Understanding the etiologies and methods to assess the need for lower limb amputation

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Abstract

Introduction: Over 150,000 lower limb amputations every year in the US cost the healthcare system billions due to rising diabetes rates. Clinical state and soft tissue viability determine amputation. Medical optimization and amputation methods are examined. Guillotine, complete, and skin flap patterns are explored for below-knee amputations. Marking an incision, separating nerves and veins, cutting bones, and stabilizing the weight are the procedures. Rehabilitation requires wound care and prosthetic fitting after surgery.

Aims and objectives: This study aims to investigate lower limb amputation causes and assessment methodologies for clinical decision-making and patient care.

Methods: This prospective observational study at a tertiary care centre, examined lower limb amputations. From medical records, demographics, comorbidities, amputation levels, complications, hospital stays, death, prosthetic use, and functional outcomes were obtained. While protecting privacy and ethics, statistical tests were used to compare patient subgroups. The study aims to improve patient care and treatment after lower limb amputations.

Results: Table 1 shows that 51.7% of lower limb amputations were attributable to PVD and 41.7% to diabetic foot. Spread cellulitis was 5% and osteomyelitis was 1.6%. Table 2 demonstrates that transfemoral (58.3%) amputations were more common than transtibial (41.7%), suggesting severe underlying diseases. Table 3 shows that PAOD patients had above-knee amputations and Diabetic Foot patients below-knee ones. The 40-60 age range had 86.70% male patients, as seen in Figure 1.

Conclusion: This research emphasizes stump quality over length in amputation recovery and the benefits of early prosthesis fitting and complete care teams for amputee outcomes.

Keywords: Guillotine, blood loss, guillotine amputation, diabetes.

Introduction

In the US, more than 150000 people have the lower limbs amputated annually. The incidence of neuropathy, tissue sepsis, & peripheral arterial occlusive disease is inversely associated with this frequency. This connection is due to the rising incidence of diabetes mellitus, which is to blame for 82% of all lower limb amputations brought out by vascular disease in the United States. People with diabetes mellitus have a staggering 30 times greater lifetime risk of suffering an amputation than people without the disease, which creates a cost burden upon healthcare systems of more than $4.3 billion yearly in the USA alone. Whether a lower extremity accident is present, there is significant soft tissue damage, widespread wound contamination, and loss, approximately 20% of patients may require an amputation. Around 2% of war victims need limb amputation, while 93% of battle-related explosive incidents result in amputation. The focus of this exercise will be distal amputations at the level within the femur; covering amputations above, through, and below the knee. It will also go through how to perform specific legs however the reader is invited to obtain further in-depth information, and amputees (Syme, Chopart, and Boyd) texts to examine these procedures. Amputations are surgical operations, albeit they can occasionally and in certain circumstances be done via computation [1].

Amputation procedures can be carried out all at once or in phases (amputation followed by reconstruction), based on how much of the tissue is still viable or necrotic. The decision between the two approaches is highly influenced by the clinical state of the patient and the state of all the soft tissues beneath the planned level of limb loss, with the main objective being to get rid of infected & non-viable tissue. In general, the suitability of an amount of amputation will depend on the nature of the soft tissue & the likelihood of acquiring bone covering. It's critical to keep in mind that flesh implants are an effective substitute for those who can build sufficient muscle mass to cover their epidermis but are unable to do so. Patients having Diabetes mellitus can cause a variety of symptoms, ranging from a non-healing foot infection due to osteomyelitis to a highly infected lesion that causes septic shock. The choice to amputate is made when non-healing wounds develop and there are no ways to regain flow due to peripheral vascular disease. These patients are typically present in one of the following two ways: either acutely with infected necrosis (which is also referred to as "wet gangrene") that results in sepsis or chronically using ischemic necrosis (also referred to as "dry gangrene"), whereby the connective tissue is necrotic but has no signs of systemic impairment [2].

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Optimizing the patient from a medical perspective is crucial before choosing to amputate. All efforts should be made to achieve sufficient glycemic control and start antibiotic therapy as soon as possible in diabetic patients to lessen the risk of infection at the surgical site or increase the duration of non-infected cells, respectively. If the soft tissue quality permits it, it is feasible to consider these particular options for a single procedure. The clinical condition of the patient will determine whether a fully phased reconstruction with open (guillotine) amputation or a single procedure should be done in the case of a patient who presents with septic shock. The priority of the goal should be to acquire sufficient source control, leaving reconstruction for a later time. Intravenous antibiotics may be used as the first line of therapy for patients who come with severe cellulitis and symptoms of a broad inflammatory reaction. A less severe case of cellulitis can make it possible to amputate at a more distant level than first planned and complete the procedure in one step. High-energy trauma at the scene of the accident might lead to amputation. Patients may occasionally arrive at the hospital with an extremity which cannot be fixed due to a broken bone. To decide if sophisticated reconstruction choices should be explored, many rating methods might be used [3]. However, Since individuals can present with several, potentially fatal injuries, the major focus should be on using the Advanced Trauma Life Care procedure. This includes determining whether the wound is bleeding, achieving hemostasis, and providing effective resuscitation. The extent of the amputation required will depend on how successfully the soft tissues were used to obtain bone coverage. It is crucial to keep in mind that individuals who previously qualified for limb salvage due to severe catastrophic lower body injuries may now need to have their limbs amputated because of infection, an inability for bone and hardware coverage, unrelenting pain levels, or a lack of motivation to undergo drawn-out reconstructive procedures for subpar functional outcomes [4].

Advanced peripheral arterial disease patients frequently have diabetes, are old, have several concomitant conditions, and have little physiologic reserve. Therefore, medically optimizing these individuals before a significant procedure is ideal. The hazards of operation anaesthesia must be laid out for the patient and/or chosen advocates since an emergency limb amputation could turn out to be necessary to allow for clinical improvement. With inadequate cardiopulmonary reserve, some patients receive vasoactive infusions and severe sedation in the critical care unit. Although amputation would be necessary, their urgent illness prevents it. It is appropriate to postpone an amputation until after clinical optimization. Computation, which refers to the idea of freezing an

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ischemia limb that cannot be saved in severely sick patients, is an alternative to this. Several methods are mentioned, including the use in the use of dry ice, ice containers, ice water entanglement, motorized refrigeration, and refrigeration. With the proper nursing staff education and the formation of institutional standards, it may be utilized efficiently while being time-consuming. Once the metabolic disturbances have healed and the dangers of the operation have been outweighed by the benefits, an official amputation procedure can be performed [5].

There are several techniques for doing a BKA, with guillotine vs full amputation being one of the most notable variations. Additionally, some skin flap patterns have been developed to conceal the amputation stump. It has been common practice to utilize a lengthy posterior skin flap as well as uneven (skewed) both frontal muscle & skin (myocutaneous) flaps. Ernest M. Burgess is principally responsible for the introduction of the latter approach. Lutz Brückner later improved the Burgess method to take into account the unique restrictions of occlusive vascular disease.

When performing a near-total amputation at the bedside for a fractured limb, or to limit infection or blood loss, guillotine amputation is used. When tissue layers must be distinguished over several hours or days, requiring multiple debridements before the closure is completed, this method may be helpful. Where the circumstances and tissue permit, however, a full amputation incorporates all of the stages listed below and leaves a decreased, sutured stump that is prepared for the use of a stump shrinker as well as a prosthetic design. The following lists a few fundamental procedures often utilized to carry out a straightforward BKA [6].

The tibial tubercle then joint line are identified once the patient has been prepared and draped, and the BKA incision is marked distally, usually between ten and fifteen centimetres away from the tibial tuber. The anterior third of the lower leg is covered by an anterior skin flap, and the outer To give enough soft tissue to cover the closure, the flap must be pulled 150% longer than the previous flap. It has an inflated tourniquet. Around the perimeter, an incision into the skin is created that extends to the fascia. After carefully separating the muscles into each leg, the fascia is cut.

The deep & superficial peroneal nerves, as well as the tibial nerve, are recognized within the corresponding neurovascular bundles. Each nerve is sharply separated with a new scalpel blade after receiving an optional 1% lidocaine injection, moderate traction, and the injection. This enables nerve retraction and prevents the growth of a bothersome neuroma distally on the BKA stump. Identification and silk tie ligation for every major artery, particularly both sides of the tibial, is performed [7].

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The cutting is done with an oscillating saw tibial as fibular shafts, and a rongeur or saw is used to bevel the corners. The gastrocnemius muscles are bound using a nonabsorbable suture after a tiny hole is drilled in the distal femoral shaft. In the "Ertl" approach, to ensure the continuity of the medullary canals, the bone portions in the fibula and tibia ought to be revealed subperiosteally, and then the canal should be cracked open. The distal bone ends should be enclosed by the periosteal sleeve, which should be constructed to do so and filled with the bone graft. A stable weight-bearing surface is generated By joining your distal tibia & fibula together in synostosis, improving prosthesis function. A certain amount of weight bearing is provided by the tibiofibular bone bridge.

The tourniquet is removed, and major bleeding vessels are cauterized or tied off to achieve appropriate hemostasis. The fascia is first approximated, the subcutaneous tissue, and lastly, the skin is done after inserting a drain into the incision. Depending on the surgeon's inclination, this could get sutured or stapled [8].

A sterile dressing is applied to the stump before it is put inside a knee immobilizer and splint that is well-padded. This will protect the regenerating soft tissue and prohibit the knee from developing an early flexion deformity, which would otherwise limit postoperative mobility with a prosthesis. Every between 24 and 48 hours in the initial postoperative period, the limb stump ought to receive a serial examination for symptoms of infection, bleeding, and necrosis at the skin margins. Once there's sufficiently little leakage, any drains ought to be removed based on the surgeon's decision. A stump shrinker, which provides circumferential compression over the stump & distal extremity, may be inserted once the wound is healing satisfactorily. With a proper patient evaluation in hand, a prosthetics firm should be contacted and the temporary prosthesis should be selected. There are many different types of lower limb prostheses, and which one is ideal for the long term will depend on the patient's preferences, medical situation, and insurance, amongst other things [9].

Method

Research Design

The purpose of this prospective observational research was to perform a thorough examination of patients who had undergone lower limb amputations at a tertiary care centre. Data on demographics, co-morbidities, amputation levels, complications, hospital stay, mortality, prosthesis use, and functional outcomes were obtained from medical records for all instances of

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lower limb amputation throughout the research period. The significance of differences across patient subgroups was evaluated using statistical methods such as the Student t-test, the chi-squared test, and Fisher's exact test. All necessary precautions were taken to protect participants' privacy and adhere to ethical standards. The study's ultimate goal was to provide helpful information that would aid in better treating and managing patients at tertiary care centre who had undergone lower limb amputations.

Inclusion and exclusion criteria

Inclusion

- Peripheral vascular disease
- Diabetes Mellitus
- Spreading cellulitis
- Osteomyelitis

Exclusion

- Traumatic amputations
- Age < 18 years
- Amputations for Orthopedic neoplasia
- Patients unfit for surgery.
- Patients who were reluctant to oblige for the study.

Statistical analysis

The statistical analysis examined lower limb amputation patients' medical records for demographics, comorbidities, level of amputation, complications, length of hospital stay, mortality rates, prosthesis utilization, and functional outcomes. The Student's t-test for continuous variables, the chi-squared test (2 test) for categorical data, and Fisher's exact test for small sample sizes or categorical variables were used to compare patient subgroups. These tests revealed statistically significant differences in patient characteristics and outcomes.

Result

Table 1 shows the patient cohort's lower limb amputation causes. Peripheral Vascular Disease caused 51.7% of amputations, demonstrating a high prevalence of lower limb circulation

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difficulties. Diabetic Foot was the second most prevalent cause, accounting for 41.7% of amputations, highlighting the burden of diabetes on this patient population. Spreading cellulitis caused 5% and osteomyelitis 1.6%. These figures show that vascular diseases and diabetes are this group's leading causes of lower limb amputations, emphasizing the need to treat these health concerns to lessen them.

Table 1: Etiology

Etiology	Number of patients	Percentage
Peripheral Vascular Disease	31	51.7
Diabetic Foot	25	41.7
Spreading Cellulitis	3	5
Osteomyelitis	1	1.6

This study's lower limb amputations by level are shown in Table 2. Amputations were transfemoral primarily (58.3%) and transtibial (41.7%). Transfemoral amputations were more common, suggesting that more individuals suffered amputations above the knee joint. Transtibial amputations, which occur below the knee, were significantly less common but still significant. The preponderance of transfemoral amputations in patients may indicate the severity or type of the underlying diseases.

Table 2: Level of amputation

Level of Amputation	Number of patients	Percentage
Transtibial	25	41.7%
Transfemoral	35	58.3%

Table 3 shows how the kind of lower limb amputation done at this medical institution affects its etiology. Most of the 35 amputations occurred above the knee, with 11 due to PAOD and 12 due to diabetic foot problems. In contrast, 25 below-knee amputations occurred, 13 from Diabetic Foot and 10 from PAOD. These statistics show that the etiology of lower limb amputations is strongly correlated with the type of amputation, with above-knee amputations being more common in PAOD patients and below-knee amputations in Diabetic Foot patients.

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Table 3: Etiology vs Type of amputation

Etiology	Type of amputation	
	Below knee	Above knee
PAOD	10	11
Diabetic foot	13	12
Spreading cellulitis	1	2
Osteomyelitis	1	0
Total	25	35

Figure 1 shows the sex and age distribution of tertiary care centre lower limb amputation patients. Most patients were male (86.70%), whereas 13.30% were female. The patient population was mostly 40-50 years old (43.30%), followed by 50-60 at 41.70%. The lowest age group was 30-40 at 15%. In this research, male patients predominated and middle-aged patients, notably those aged 40-60, were more likely to have lower limb amputations at this medical center.

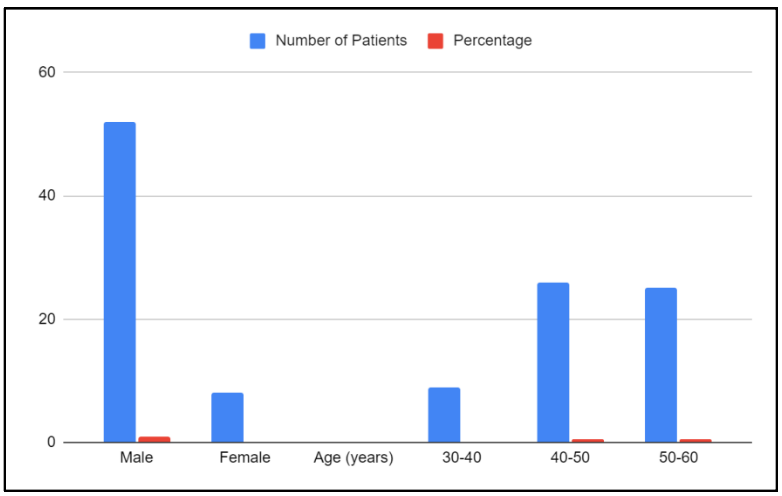

Figure 1: Age and Sex Distribution

Discussion

The character and incidence of surgical disorders in sub-Saharan Africa have undergone remarkable changes due to the region's rapid urbanization and westernization. Today, lifestyle diseases are widespread. We want to examine the experience with our surgical service in South

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Africa with lower-limb amputations. All patients with lower limb amputations were subjected to a prospectively acquired database that underwent a single-centre retrospective review. Both descriptive and inferential statistics were used. The patient's demographics, purpose, amputation type, and care were examined. The 30-day in-patient death rate was the main result. Diabetes mellitus & atherosclerosis are the most typical causes of LLA in South Africa. This represents the nation's evolving illness pattern. In South Africa, access to healthcare is severely limited in rural regions, and there are considerable delays in sending patients to tertiary facilities for expert examination. Additionally absent is basic health care foot prevention and treatment. The healthcare system must be improved globally to lower LLA instances in South Africa [10].

To ascertain the epidemiology and ailments typically encountered in significant lower extremity amputation. ICD-10 criteria were used to identify major lower limb amputations. Retrospective data collection was done. The type of amputation, the reason it was necessary, the patient's gender, age, and death were documented. Males experienced significant lower limb amputations more frequently than females in the study group, with the frequency peaking during the seventh and ninth centuries. More than 50% of amputations were caused directly or indirectly by diabetes mellitus, and septicemia was the primary factor in fatalities [11].

To provide a foundation for subsequent health care initiatives and programmes to improve the surgical results for significant amputations of the lower limbs (MLEA) in Jordan, we set out to investigate these outcomes and the variables that affect them at a substantial referral academic centre in northern Jordan. Budgetary restrictions and a higher prevalence of diabetes-related foot issues are MLEA's negative factors; effects are more pronounced in underdeveloped nations. Cardiovascular surgeon-led MLEA was very effective for treating vascular insufficiency linked to lower revision rates, LOS, and perhaps even better results. To enhance patient outcomes in these nations, Creating a national healthcare policy is essential [12].

The study was conducted in two major medical centres in the North West Region of Cameroon and sought to describe the typical reasons for and problems associated with lower limb amputations among amputated patients. The most prevalent operation is a Despite surgery site infection being the most common complication, below-the-knee amputations are still common. In our case, lower limb amputation is primarily due to diabetic shoe gangrene [13].

Amputation of the lower limbs is still among the most frequent surgical operations. Uncontrolled diabetes is expected; it worsens with neuropathy, vasculopathy, and diabetic foot gangrene. It is

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rising in Nigeria, with motorbike accidents and uncontrolled diabetes being the primary contributors. In a private tertiary context, determine the frequency and outcomes of lower limb amputations. Young adult males had to have their lower limbs amputated the most often, and motorbike accidents typically caused the damage. Most of the stumps were healed with the original purpose. Amputations caused by diabetes carried the most significant mortality rate [14].

About 50% of patients with peripheral artery occlusive disease who have lower limb amputations also have diabetes. Lower limb amputations significantly affect quality of life, but little has been discovered about what factors affect it or how to enhance it. This systematic study aimed to identify the factors that influence the quality of life after lower limb amputation due to peripheral artery occlusive disease [15].

For those who have lost a lower limb to peripheral artery occlusive disease, Using a prosthesis to walk is essential for raising quality of life. Future longitudinal studies with a standardized measurement of outcomes are required to better understand and enhance this population's standard of life. Clinical applicability for individuals concerned with the treatment is essential for those with lower limb amputations. Successful prosthetic usage is linked to an improved quality of life; thus, efforts should be focused in this direction [16].

We performed a multistakeholder focus-group session with experienced lower-limb amputees, physicians, researchers, and prosthetic device makers to evaluate the requirements of lower-limb amputees and learn the differences between traumatic amputees and diabetic dysvascular amputees [17]. The early workshop sessions were run as regular focus groups with uniform participant groupings creating lists of concerns pertinent to each group. Following workshops created diverse participant groups to implement a two-phase approach: Codesign and Discovery. Specific demands were elicited during the discovery phase through observation and conversation. The co-design phase examined various solutions and centred on emerging issues. The participants indicated problems with the residual limb's orientation and the ankle and foot components and wanted enhancements to the socket system. A need that better education and communication might be met was a thorough grasp of the road to recovery after an amputation. Systems for remote monitoring that may raise the standard of care were also required. Participants in this session did not exhibit a disparity in demands between diabetic dysvascular disabled people and traumatic amputees. Numerous recommendations for enhancing the quality of life for amputees were

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generated during the spirited, open-ended talks and are presented here to aid in future study and development [18].

Conclusion

In conclusion, this research presents important lower limb amputation and rehabilitation data. It implies that below-knee amputees have a higher quality of life than above-knee amputees The research also stresses the relevance of stump quality over stump length in amputee prosthesis recovery, highlighting the need for optimal stump length. According to the study, amputee awareness programs, including pre-prosthetic gait training and early prosthetic fitting, improve prosthesis usage, health, and employment. This highlights the need for a multidisciplinary healthcare team, including physiotherapists, occupational therapists, nurses, psychologists, and social workers, in reintegrating patients into pre-amputation everyday life. In conclusion, prosthetic interface and stump pain management advances greatly enhance amputee quality of life.

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