

**PROFIL OF MOROCCAN PATIENTS
WITH MAJOR LOWER LIMB AMPUTATION: A REVIEW OF 296 CASES**

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Abstract

Background: Determine the epidemiological characteristics of patients with major lower limb amputations and compare the results with published data. **Methods:** A retrospective study was conducted from a chart review of patients with major lower limb amputations over a three-year period from September 2017 to September 2020. **Results:** 274 patients with 296 major lower limb amputations of which 22 (8%) patients had contralateral limb amputations. 286 (96%) of major lower limb amputations were unilateral and 148 (50%) concerned the right limb. Transtibial and transfemoral amputations were 151 (51%) and 148 (46.6%) respectively. The mean age of the amputated patients was 63 ± 15 years. The majority of patients were male with a sex ratio of 2.2. 157 (57%) patients are diabetics, 96 (35%) are hypertensive and 84 (30.7%) are active smokers. Diabetes was the main cause of amputation with 56.4%, followed by obliterative arteriopathy of the lower limbs with a percentage of 25.3%. Postoperative complications were observed in 138 (47.4%) patients, of which stump infection represented 41.2%. The average length of hospital stay was 16 days [6, 21]. The in-hospital mortality rate was 6.9% (19 patients). The cause of mortality was mainly due to complications of comorbidity or infection. **Conclusion:** the major amputation of the lower limb concerned male patients aged 63 ± 15 years who had at least one poorly treated comorbidity. Diabetes and hypertension were the most common comorbidities in our results. Transtibial amputation of the right side was the most frequent due to the complication of diabetic foot.

Keywords: Major amputation, lower limb, diabetic foot, infection, reamputation, Morocco.

Introduction

Lower limb amputation (LLA) is the removal of part or all of a lower limb segment by surgery, often considered as the last step when all treatments have failed [4]. The amputation is a procedure, which has an impact on the patient's quality of life that can be physical, psychosocial, and economic. It can be due to arterial occlusive disease of the lower limbs, infection, tumor, trauma, or congenital malformation [17]. The surgical procedure of LLA represents a pivotal moment in the trajectory of a patient's life, a decision often reached when conventional treatments have been exhausted. This intervention transcends the confines of the operating room, leaving an indelible mark on the physical, psychosocial, and economic aspects of an individual's existence. The underlying reasons for

major LLA vary, encompassing arterial occlusive diseases, infections, tumors, trauma, and congenital malformations. This multifaceted nature underscores the complexity of major LLA and the imperative to comprehensively understand its epidemiological landscape.

The indications for major LLA differ from place to place. Diabetes and vascular pathologies are the main causes of amputation in developing countries, while trauma, infections and tumors are the most common indications in low-income countries [13]. In developing countries like Morocco, the prevalence of major LLA is predominantly attributed to diabetes and vascular pathologies. These chronic conditions not only underscore the burden of non-communicable diseases but also emphasize the pressing need for targeted interventions to address the root causes. Conversely,

in low-income countries, major LLA finds its origins in traumatic incidents, infections and tumors, illuminating the necessity for region-specific healthcare approaches tailored to the prevalent epidemiological trends.

In general, amputation is an international health problem. In the United States, there are more than 1.6 million amputations, and this number may rise to 3.6 million by 2050 [10]. However, the World Health Organization (WHO) has found that annual amputation rates have not increased for several decades in developed countries, which may be due to better surgical and medical prevention strategies [18]. However, amidst this concerning rise, the WHO reports a stabilizing trend in annual amputation rates in developed countries. This stability is attributed to advancements in surgical techniques and the implementation of effective medical prevention strategies, signifying the resilience of healthcare systems in addressing the challenges posed by major LLA. Despite the global attention accorded to lower limb amputations, certain regions remain underexplored, their epidemiological profiles concealed in the absence of dedicated retrospective studies. Morocco, with its rich cultural heritage and unique healthcare landscape, stands as one such enigma. In stark contrast to the evident prevalence of major LLA cases, a retrospective study elucidating the epidemiological dimensions of this condition is conspicuously absent from the scientific discourse in Morocco. This research void prompts us to embark on a comprehensive exploration of major LLA in Morocco, seeking not only to bridge the existing gap in knowledge but also to contribute meaningful insights to the broader global dialogue on this critical health concern. The absence of a retrospective study on the epidemiological profile of major LLA in Morocco underscores the urgency for an in-depth examination, one that considers the socio-economic, cultural, and healthcare intricacies unique to this North African nation. The primary aim of this study is to meticulously unravel the epidemiological characteristics of individuals who have undergone major LLA in Morocco. By doing so, we aspire to uncover the distinctive features of major LLA cases within this geographical context and draw meaningful comparisons with existing global data. This research endeavor transcends academic curiosity; it holds the potential to catalyze transformative changes in healthcare policies, intervention strategies, and the overall trajectory of major LLA in Morocco. As we embark on this investigative journey, it is imperative to acknowledge the multifaceted nature of major LLA. By delving into the intricate interplay of medical, social, and economic factors influencing the prevalence of major LLA in Morocco, we aim not only to contribute to the advancement of scientific knowledge but also to the enhancement of healthcare practices. This study aligns with the global imperative to deepen our understanding of

major LLA, offering a nuanced perspective that extends beyond numerical figures to encompass the lived experiences of those impacted by this life-altering procedure. Through a meticulous exploration of the epidemiological landscape, we endeavor to lay the foundation for targeted healthcare interventions, prevention strategies, and, ultimately, a more compassionate and effective healthcare system tailored to the unique needs of the Moroccan population.

Materials & Methods

We conducted a retrospective descriptive study of patients who underwent major LLA over a period of three years, extending from the 1st of September 2017 to the 1st of September 2020. The study was done at the surgical departments of the IBN SINA University Hospital, Rabat, Morocco. The data was collected from medical records, registers of vascular surgery and trauma-orthopedics departments, operating reports, and hospitalization notes of patients with LLAs. We included all patients aged 16 years old and over, who have undergone a major amputation above the ankle, either unilateral or bilateral, at the IBN SINA hospital whatever the cause of amputation during the selected period. Subsequent major amputation of the contralateral lower limb was considered a new amputation. Patients with below-ankle amputations (minor amputations) and/or patients who were not amputated during the study period or amputated in another hospital were excluded.

Data collection and definitions

For each patient, we evaluated age, gender, comorbidity and smoking habits. We evaluated the type, the cause, the level, the side and the complication of amputation. We also noted the delay before amputation and the length of hospital stay. Major amputation of the lower limb was performed above the ankle, it could be transtibial (TT), transfemoral (TF), knee disarticulation, or hip disarticulation. Minor amputation is performed below the ankle and can be a forefoot or a toe amputation [6]. The categorical variables were presented as frequency with percentage and continuous variables were expressed as mean with standard deviation if the distribution is normal, when it is skewed, a median and interquartile range will express the variable. Comparison of continuous variables were made with Student's t-tests. The confidence interval was 95% and the two-sided significance level was 0.05. The results were analyzed by SPSS version 23 and recorded in Excel and Word.

Results

During the study, 300 files were selected (**Figure 1**), 26 files were excluded of which 15 were not found

and 11 files with missing data. 274 patients were selected of which 22 patients had an amputation of the contralateral limb, with a total of 296 amputations.

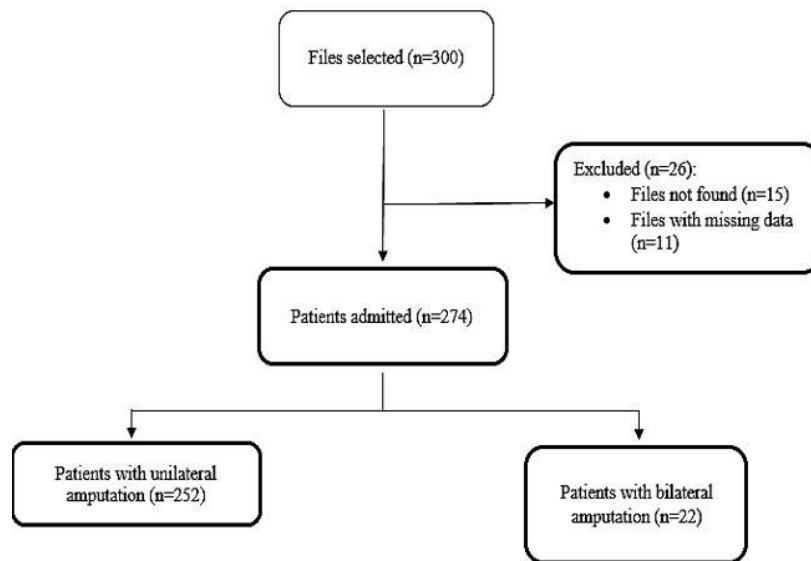


Figure 1: Flow-Chart of the selection of the files studied

The remaining 274 patients had a mean age of 63 years old ± 15, with a male dominance (sex ratio= 2.2). Demographic and clinical characteristics of patients are shown in **Table 1**. 157 (57.3%) patients

had diabetes and 96 (35%) were hypertensive. More than 1/3 of lower limb amputees were heavy smokers (more than 30 packs per year).

Table 1: Characteristics of patients with major LLAs (n=274)

Variables	Patients (n)	Percentage (%)
Age		
40 years	25	9.1
41 - 60 years	80	29.2
61 - 80 years	141	51.5
>81	28	10.2
Sex		
Male	188	68.6
Female	86	34.4
Comorbidities		
Diabetes	157	57,3
Hypertension	96	35
Heart disease	47	17,2
Chronic renal insufficiency	15	5,5
Dyslipidemia	22	8
Other diseases*	38	13,9
Smoking habits	84	30,7

* Hypothyroidism, Dermatitis, Anemia, chronic obstructive pulmonary disease.

The most frequent cause of major LLAs in our population was diabetes complications, followed by obliterating arterial disease (often arteritis), then traumatic and tumor causes with rates of 7.8% and 6.8% respectively. The most frequent level of

amputation was the TT site followed by the TF site. The mean delay of hospital stay before major LLA was 9 days [1; 12] with extremes between 0 and 10 days (0: amputation at admission in the emergency department). More data are shown in **Table 2**.

Table 2: Clinical parameters related to major LLA (n=296)

	Frequency (n)	Percentage (%)
Type of amputation		
Programmed	151	51
Urgent	145	49
Level of amputation		
TT	151	51
TF	138	46,6
Hip disarticulation	4	1,4
Knee disarticulation	3	1
Side of amputation		
Right	148	50
Left	137	46,3
Bilateral	11	3,7
Cause of amputation		
Diabetic foot	167	56,4
Vascular	75	25,3
Traumatic	23	7,8
Tumor	20	6,8
Infection	11	3,7

Postoperative complications were observed in 138 patients (47%); surgical site infection was the most common complication. The remaining complications were wet gangrene, stump necrosis, and tumor recurrence. 71% of the patients were amputated only once against 29% who underwent a re-amputation, of which 59% operated at the TF

level, 34% at the TT level and 7% disarticulated at the hip level. The average length of hospital stay was 15.9 days [6, 21]. The postoperative mortality rate during the hospital stay was 6.9% (19 cases). The main cause of death is related to complications of the diabetic foot due to infection (sepsis) and complications of their comorbidities (**Table 3**).

Table 3: Complications related to major LLA (n=274)

Variables	Frequency (n)	Percentage (%)	Median&IIQ
Delay of hospital stay			15.9 [6, 21]
Delay of hospital stay before amputation			9 [1, 12]
Complications	138	47	
Infection	113	41	
Necrosis	22	16	
Tumor recurrence	3	2	
Re-amputation	86	29	
TT	29	34	
TF	51	59	
Hip disarticulation	6	7	
Mortality	19	6.9	
Septic shock	12	4.4	
Cardiogenic shock	7	2.5	

Discussion

To the best of our knowledge, this is the first study describing the characteristics of major LLA in Morocco. Our study showed that major amputation of the lower limb concerned male patients aged 63 ± 15 years who had at least one poorly treated comorbidity. Diabetes and hypertension were the most common comorbidities in our results. TT amputation of the right side was the most frequent due to the complication of diabetic foot.

The mean age of our study is 63 ± 15 years. Pande et al. found in their series an average age similar to our results (62.7 years) [14]. On the one hand, the authors found that major amputation of the lower limb was common in patients aged 70 years and over [3, 8]. On the other hand, other authors found a mean age of less than 50 years [5, 12, 16]. The category most affected by major LLA is between 61 and 80 years followed by 41 to 60 years (**Table 1**). In our study, a major LLA was characterized by a male preponderance (70%) with a sex ratio of 2.2. This result is similar to that found in the literature with a prevalence that varies between 68% and 86% [1, 9–13, 16]. However, other studies have found that the prevalence for men was less than 65% [2, 8, 14]. The majority of patients with major LLAs have one or more comorbidities. Diabetes was the most observed comorbidity in our study, this comorbidity remains largely high compared to that reported by Pande et al. in Singapore [14]. Icks et al. found a 7.4 higher risk of amputation in the diabetic population than in the non-diabetic patients, with a high individual and attributable risk of amputations due to diabetes [9]. Hypertension was the second most common comorbidity, followed by cardiovascular disease (17%) and renal failure (5%). These results are lower than those reported by Pande and Ambler [3, 14]. These might be explained by unknown previous history as well as by the diagnosis of comorbidities at admission. A significant proportion of amputees use tobacco (31%) which is lower than the result found by Pande et al [14].

In our study, diabetic foot complications were the dominant cause of major LLA (56.4%). Similar results have been reported in other studies [6, 10, 12]. The cause of major LLA is variable from place to place. In Western countries, major LLA is often due to diabetic or vascular disease, but in low-income countries, trauma is the leading cause of amputation [12]. This prevalence of diabetic foot complications may be related to poor compliance, inadequate management and lack of patients' information- education and communication.

The majority of studies on major LLA showed a predominance of the TT level as described in our study [1, 8, 10, 12, 13]. The TT level was the most affected site in our population because the most frequent cause found was diabetic foot in which TT

amputation was the most performed [7, 14]. Knee and hip disarticulations presented a small percentage of 1% and 1.4% respectively, which was similar to the result of Ajibade et al. [1].

Major LLA was predominantly unilateral and involved the right lower limb more than the left [1, 12]. This result is explained by the fact that the right foot is the site most affected by diabetic arteriopathy and neuropathy. It is also the area most prone to trauma, diabetic foot complications, and stump infections that can escalate to gangrene.

The median time to amputation was 9 days [1, 12], which is high and could be explained by the instability of the patient's comorbidities before amputation. Infection of the amputation stump was the most common post-operative complication in our study and was a poor prognostic factor. This result was comparable to that reported by Ajibade et al. in Nigeria [1], but Sabzi found a lower percentage in Iran [15]. The re-amputation rate in our patients was higher than that reported by Chalya et al [6]. This difference could be explained by the fact that the majority of patients with major amputations suffer from one or more medical comorbidities, of which diabetes is the most common. Poor management of comorbidities, late presentation to the hospital, and smoking abuse may increase the risk of re-amputation.

The median length of stay is a remarkable indicator of critical patient comorbidity. The median length of stay in our study was lower than that observed by Chalya et al., Fournet et al., and Pande et al. who found a median length of 22.5, 22.6, and 44 respectively [6, 8, 14]. However, a similar result to our observation was reported in the study of Ouchemi et al [13].

The mortality rate in our study (6.9%) is higher than that found by Ajibade et al. [1] (2.3%) and lower than that observed by Chalya et al. and Ouchemi et al. [6, 13] with percentages of 16.7% and 15.6% respectively. The in-hospital mortality of amputated patients was due to the complications of medical comorbidities or septic shock following infection of the amputation stump.

Conclusion

In conclusion, major lower limb amputation (LLA) stands as a pressing international health problem with far-reaching implications for both the functional and vital prognosis of affected individuals. The indications for major LLA exhibit a diverse spectrum, influenced by geographic variations and underlying health conditions. Notably, diabetes emerges as a formidable risk factor, emphasizing the critical need for targeted interventions and preventive measures to address this chronic condition and mitigate its impact on major LLA. Recognizing the complexity of major LLA, a multidisciplinary approach is paramount,

particularly for patients with comorbidities. Adopting a holistic strategy that involves various medical specialties can significantly enhance patient survival and contribute to improved functional outcomes. The intricate interplay of medical, surgical, and rehabilitative efforts becomes crucial in addressing the multifaceted nature of major LLA. Beyond the immediate medical concerns, major LLA profoundly disrupts the quality of life for affected individuals across all dimensions—physical, emotional, social, and economic. The challenges posed by this procedure extend beyond the physical realm, delving into the intricate tapestry of emotions, societal interactions, and financial well-being. As such, there is a compelling need for a dedicated study on the quality of life in this specific patient population. Understanding the nuanced impact of major LLA on the quality of life necessitates a comprehensive exploration of the challenges faced by individuals post-amputation. Physical limitations, emotional distress, social isolation, and economic hardships collectively contribute to a diminished quality of life. Therefore, a focused investigation into the experiences and perceptions of individuals who have undergone major LLA becomes imperative to inform tailored interventions that address these multifaceted challenges. Such a study should delve into the intricacies of how major LLA affects the physical capabilities of individuals, exploring the adaptability and resilience of patients in coping with these changes. Emotional well-being is equally crucial, considering the psychological impact of major LLA and the potential for anxiety, depression, and adjustments to a new self-image. Social aspects, including the impact on relationships, societal integration, and participation in community activities, should also be examined to understand the broader implications on patients' lives. Moreover, the economic burden stemming from major LLA demands attention. Financial challenges associated with rehabilitation, prosthetics, and ongoing healthcare requirements can pose significant barriers to the overall well-being of individuals post-amputation. A comprehensive study on the economic repercussions of major LLA can guide policymakers and healthcare professionals in developing support mechanisms and resource allocation strategies to alleviate these burdens. In essence, major LLA extends far beyond the operating room, shaping the trajectories of individuals in profound ways. A multidimensional understanding of its impact, coupled with a commitment to a multidisciplinary approach and a dedicated study on the quality of life, is essential. By addressing the complexities of major LLA comprehensively, we can pave the way for more empathetic, effective, and patient-centered healthcare strategies, ultimately enhancing the lives of those affected by this life-altering procedure.

Ethics approval and consent to participate:

The approval was obtained from the ethics committee for biomedical research of the faculty of medicine and pharmacy of the Mohammed V University of Rabat, Morocco (approval number: 7/20). The ethics committee is registered with the Office for Human Research Protections of the U.S. Department of Health and Human Services under the number IORG0006594 (<http://ohrp.cit.nih.gov/search/search.aspx>).

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Significance statement: This study is the first to describe the characteristics of patients with major lower limb amputation in Morocco.

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