

Any Pattern Changes in Major Lower Limb Amputations? A 10-year Comparative Retrospective Study in a Private Orthopedic and Trauma Center in the South-east region of Nigeria

Thaddeus C. Agu^{1,2}, Anselm C. Ikwu³

¹Consultant Orthopedic Surgeon, Lecturer, College of Medicine, Imo State University, Owerri, Nigeria, ²Visiting Consultant Surgeon, First Choice Specialist Hospital, Nkpor-Onitsha, Anambra State, Nigeria, ³Medical officer, First Choice Specialist Hospital, Nkpor-Onitsha, Anambra State, Nigeria

Abstract

Background: Major lower limb amputations are performed for various reasons, with many studies showing constantly changing patterns. Amputations are devastating procedures, even when they are done to save lives, and this is because of poor rehabilitation of amputees in our environment. **Study Design and Setting:** The records of all the patients who had major lower limb amputations in a private orthopedic and trauma center, south-east region of Nigeria from October 2005 to September 2010 (group A) and from October 2010 to September 2015 (group B) were reviewed retrospectively. **Results:** Traumatic gangrene from traffic accidents was the most common reason for amputation (47.1% in group A and 41.7% in group B) in both groups, followed by diabetic gangrene (17.6% in group A and 27.1% in group B). Traditional bonesetters' gangrene was 13.7% in group A and 12.5% in group B. These were followed by mangled extremities and malignancies in decreasing order of frequency. Young male adults ranked high at 49.1% in group A and 58.4% in group B, while the more conservative below-knee amputation was 39.2% in group A and 47.9% in group B, compared to above-knee amputation of 52.9% in group A and 39.6% in group B. **Conclusion:** A greater majority of amputations are still being performed because of traumatic gangrene followed by diabetic gangrene, which had significantly increased comparatively. There is no overall change in the trend concerning the indications for amputation in this study despite the slight reduction in traumatic gangrene. However, the results indicate that the trend is toward being more conservative. The causes of traffic accidents are preventable, and, therefore, there is a need for continued public orientation to reduce the incidence of accidents on our roads and consequently reduce the amputation rate in our subregion.

Keywords: Amputation, gangrene, retrospective study

INTRODUCTION

Amputation is as old as medicine. Hippocrates first described the surgical technique of amputation for a vascular gangrene in an article published in *De Articularis*.^[1] The limb was severed off from the margin of the gangrenous part and left open to heal by secondary intention.^[1] The major problems with the early amputation surgeries included hemorrhage, shock, and sepsis.^[1] These resulted in increased mortality. Amputation surgery like other aspects of medicine has evolved over the centuries. It is indicated commonly in the patient whose limb is dead, or the patient whose limb is deadly and poses a life threat, or the patient whose limb is painful, functionless, and constitutes a nuisance. Major lower limb amputations are the removal of limbs from the

level of midtarsal joints or from any elected sites proximal to the aforementioned landmark. These amputations are devastating because of the sudden change in body form and the difficulties associated with rehabilitation and livelihood thereafter. Some authors have described amputation as a major but preventable health problem that is associated with profound economic, social, and psychological effects on the patients and their

Address for correspondence: Dr. Thaddeus Chika Agu, Visiting Consultant Surgeon, First Choice Specialist Hospital, Nkpor-Onitsha Nigeria: Consultant and Lecturer College of Medicine, Imo State University Owerri, Nigeria. E-mail: tcagu@yahoo.com

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family members, especially in developing countries where the prosthetic services are poor.^[2] The indications for amputations vary from country to country and from region to region in the same country. Center-to-center variation in the same region is likely to exist depending on the clientele base, catchment, and the prevailing local socioeconomic activities; this explains the heterogeneity of amputation surgeries. The indication for amputation is also dependent on whether it is a lower or upper limb disease. For instance, although trauma is non-selective, diabetic gangrene is almost exclusively a lower limb disease. There are studies that had shown changing trends concerning the indications for major limb amputations in Nigeria. A study from the south-west subregion showed that diabetic gangrene had overtaken traumatic gangrene as the most common reason for amputation.^[3] However, to describe the pervading variations inherent in this problem, a more recent study from a different center in the same subregion implicated trauma as the major indication for amputation.^[4] Studies from the south-east region, on the other hand, showed that the trend had changed from bonesetters' gangrene to primary traumatic gangrene, with some authors recently reporting diabetic gangrene as the most common indication for major extremity amputation.^[5-7] In the northern part of the country, a recent study showed that traumatic and diabetic gangrenes were ahead of the malignant limb conditions that used to be the most common reason for amputations.^[8]

The aim of this study was to determine any changing trend in major lower limb amputations between 2005 and 2015 by a comparative analysis of the first and second 5 years of amputation surgeries in a private orthopedic and trauma center in the south-east region of Nigeria.

PATIENTS AND METHODS

Ethical approval

The work was approved by the ethical committee of First Choice Specialist Hospital, Onitsha, after having satisfied all issues about patients' confidentiality and the best practice methods concerning human research.

Study design

This was a retrospective study, using the records of patients who had limb amputations in an orthopedic and trauma center located in a highly populated, commercial city in the south-east region of Nigeria.

Study setting

The center is a 25 bedded hospital that has an average yearly admission for major limb surgeries standing at 184 patients and is located in a highly populated, commercial city of Onitsha, which was last estimated in 2015 by GeoNames geographical database to have a population of 561,066. All of the patients were managed by the same orthopedic team consisting of a resident medical officer and a visiting orthopedic surgeon as well as the support staff. The period

under review was grouped into A, the first 5 years from October 2005 to September 2010, and B, the second 5 years from October 2010 to September 2015.

Data collection

The patients' documentations, which were compiled as case files and kept routinely with the medical records department of the center, were retrieved using the search words amputation and/or gangrene, and covered the periods under review. Additional information was also obtained from the operation register master list. Data analyzed included age, sex, diagnosis, indication for amputation, type of amputation, duration of hospital stay, prosthesis fitting, complications, and mortality. Self-referred patients with complicated amputation stumps admitted for revision were excluded from the study.

Technical intervention

The patients were mainly victims of accidents from commercial motorcycles and tricycles, which are the major means of intracity transport in this bustling, commercial city, and from traditional bonesetters scattered within the vicinity. Patients were resuscitated and, following obtainment of informed consents, were planned for operations. These operations were either definitive, one-stage procedure or provisional, two-stage procedures with the elected levels of amputation determined preoperatively or intraoperatively. Aftercare was instituted till prosthesis fitting or discharge.

Statistical analysis

The data were subjected to statistical analysis using the Statistical Package for Social Sciences software by International Business Machine (SPSS IBM for Windows) version 20, Armonk, NY, USA, 2011, and the results were displayed as frequency distributions in tables and charts. Statistical significance was taken as *P* value at <0.05.

RESULTS

A total of 51 and 48 amputations were done during the two periods under review, respectively. Traumatic gangrene was $n = 24$ (47.1%) in the first group and $n = 20$ (41.7%) in the second group. Diabetic gangrene followed at $n = 9$ (17.6%) and $n = 13$ (27.1%), respectively, while traditional bonesetters' gangrene was $n = 7$ (13.7%) and $n = 6$ (12.5%), respectively. These gangrene were trailed by mangled extremities and malignant limb conditions. Significantly, young adult males in their primes, 30–49 years old, were mostly affected in both groups [Table 1]. Most of the patients in group A had above-knee (AK) amputation followed closely by below-knee (BK) amputation, but the trend was toward BK amputation in group B [Table 2]. Majority of the patients were hospitalized within the range of $4 < 8$ weeks, $n = 79$ (79.8%), as shown in Figure 1. The most common complication was wound infection and dehiscence especially among patients with late presenting traumatic and diabetic gangrenes. A total of six

Table 1: Age and sex distribution of the two comparative groups of amputation

Age (years)	Total number (%) in group A	Male	Female	Total number (%) in group B	Male	Female
10–19	5 (9.8)	3	2	3 (6.3)	3	0
20–29	3 (5.9)	3	0	3 (6.3)	3	0
30–39	14 (27.5)	12	2	15 (31.3)	11	4
40–49	11 (21.6)	8	3	13 (27.1)	12	1
50–59	6 (11.8)	4	2	5 (10.4)	3	2
60–69	7 (13.7)	4	3	7 (14.6)	6	1
70–79	3 (5.9)	2	1	1 (2.1)	1	0
80–89	2 (3.9)	2	0	1 (2.1)	0	1
Total	51 (100)	38 (74.5)	13 (25.5)	48 (100)	39 (81.3)	9 (18.7)

M:F is 3.5:1; *P* value is <0.05.

Table 2: Cross-tabulation of the diagnosis with the treatment performed

	Above knee	Below knee	Ray	Midtarsal	Total (%)
Group A					
Traumatic gangrene	13	11	0	0	24 (47.1)
Diabetic gangrene	1	4	3	1	9 (17.6)
Bonesetters' gangrene	5	2	0	0	7 (13.7)
Mangled extremity	5	3	0	0	8 (15.7)
Malignancy	3	0	0	0	3 (5.9)
Total (%)	27 (52.9)	20 (39.2)	3 (5.9)	1 (2.0)	51 (100)
Group B					
Traumatic gangrene	8	11	1	0	20 (41.7)
Diabetic gangrene	2	6	5	0	13 (27.1)
Bonesetters' gangrene	4	2	0	0	6 (12.5)
Mangled extremity	3	4	0	0	7 (14.6)
Malignancy	2	0	0	0	2 (4.2)
Total	19 (39.6)	23 (47.9)	6 (12.5)	0	48 (100)

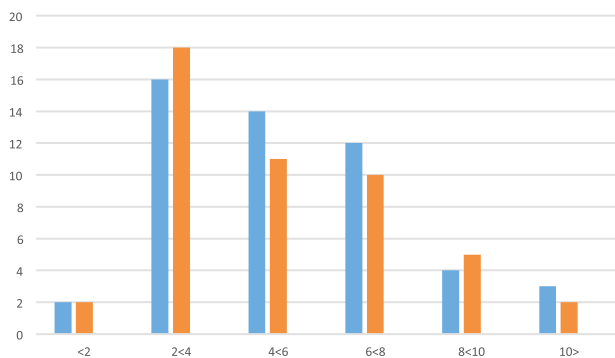


Figure 1: Bar chart showing duration of hospital stays for the two groups – blue for group A and brown for group B

patients died following their amputations giving a rate of 6.1%.

There was a slight decrease in the number of patients with traumatic gangrene and a slight increase in the number of patients with diabetic gangrene between group A and group B as shown in Table 2.

There was still a higher percentage of patients with trauma-related gangrene necessitating amputation compared to

patients with diabetic gangrene, even though the latter was on the increase in group B as shown in Table 3, and this had statistically significant *P* value at <0.05.

Slightly more of patients with diabetic gangrenes were treated by the two-stage procedures, while more of patients with traumatic gangrenes were treated by the one-stage procedure as shown in Table 4. However, the general trend was toward the two-stage procedures.

Figure 1 is a histogram showing that majority of the patients in both groups were hospitalized for between 2 and 8 weeks.

The number of complications and mortality decreased markedly from group A to group B as shown in Table 5.

DISCUSSION

Amputation is a fairly common procedure that is performed in orthopedic practice. It is estimated to constitute 0.38% of all orthopedic procedures in Nigeria.^[9] In addition, some authors estimated that the prevalence rate of amputation in Nigeria was 1.6 per 100,000 operations.^[5] The indications for amputations vary from region to region and from country

Table 3: The distribution of trauma- and diabetic-related amputations and other indications for amputation

	Group A (number)	Group B (number)
Traumatic gangrene	24	20
Bonesetters' gangrene	7	6
Mangled extremity	8	7
++Subtotal (%)	++39 (76.5%)	++33 (68.8%)
Diabetic gangrene (%)	9 (17.6)	13 (27.1)
Malignancy	3	2
Grand total	51 (100)	48(100)

Trauma-related limb conditions far more outranked diabetic gangrene as reasons for amputation with *P* value <0.05.

Table 4: The distribution of amputation technique performed

	Group A (number)	One stage	Two stage	Group B (number)	One stage	Two stage
Traumatic gangrene	24	20	4	20	12	8
Diabetic gangrene	9	4	5	13	5	8
Bonesetters' gangrene	7	4	3	6	0	6
Mangled extremity	8	7	1	7	5	2
Malignancy	3	3	0	2	2	0
Total	51	38	13	48	24	24

Table 5: Distribution of complications in the groups

	Group A	Group B
Wound infection	6 (11.8)	2 (4.2)
Chronic osteomyelitis (ring sequestrum)	4 (7.8)	2 (4.2)
Revision amputation due to ascending infection	3 (5.9)	1 (2.1)
Subtotal	13 (24.5)	5 (10.4)
Mortality	4 (7.8)	2 (4.2)

to country. In the United States of America, vascular insufficiency in the limbs from peripheral vascular diseases or diabetes mellitus related vasculopathy was the reason for 80–90% of all the amputations.^[10] In Nigeria, some older studies from the southern parts showed trauma as the most common indication for amputation.^[11,12] Malignancy was quoted as the most common reason in the northern region,^[8] while post-traumatic gangrene and traditional bonesetters' gangrene were the reasons for amputations in the south-east region.^[5] These studies, however, might not be true representations of the entire regions, because these data were obtained from only the selected, single-center studies. However, recent publications indicated that the trend is changing, and diabetic foot complication was reported from the south-west and the south-south regions as the most common reason for amputation.^[13,14] In our study, the general trend remained the same. Trauma-related gangrene was still the leading reason for amputation despite the slight reduction from *n* = 39 (76.5%) in group A to *n* = 33 (68.8%) in group B. There was a slight increase in the number of amputations for diabetic foot complications in group B when compared to group A; however, generally, it was still trailing behind trauma. In the south-east subregion of Nigeria, some recent

studies still maintained trauma as the most common reason especially in the young patients,^[15] just as it was many years ago; however, some authors had reported complications of diabetes as the most common indication having overtaken trauma.^[7] The overtake by diabetic gangrene related amputation had been explained by these studies to be the result of the preventive and proactive measures taken to regulate road use and the limitations in the use of motorcycles as modes of transportation. These studies though conflicting were not surprising because of the different pattern of presentations in different centers even within the same subregion, and multicenter studies are needed in the subregions to determine the overall patterns of amputation surgeries. On the other hand, our study supported primary traumatic gangrene as the most common indication for amputation, and it showed that the overall trend had not changed in our locality when compared to studies from the early 2000s, when commercial motorcycles were adopted in most cities of Nigeria as the mode of intracity transport. Unfortunately, in our setting, there was still an enabling environment for a lot of road mishaps, as commercial motorcycles as well as the recently introduced tricycles were still the main intracity transport system. Many internally displaced

persons from Boko Haram flight, who hitherto were not commercial motorcyclists, jump at the opportunity to eke out a living in this ever-busy, commercial city, even when it is probable that they cannot ride these vehicles very well, and thereby resulting in increased rate of accidents.

Following trauma and amputation, the sudden change in body form is devastating to the patient and family members. There are severe emotional and physical burden following loss of a limb.^[16] Majority of the patients initially did not accept the option of amputation even when it was the only life-saving procedure. Obtainment of an informed consent should involve the family members, who must be aware of the options and have realistic expectations of surgical outcome to make the informed as well as timely decision regarding amputation.^[10] This is important because some limbs may not be outrightly dead but just severely damaged, and managing them may amount to waste of man-hour and funds, as these may eventually result in painful, stiff, and functionless limbs. Therefore, early decision to amputate by the surgeon and early acceptance of the same by the patients and family members are essential for the effective and timely management of these conditions.

There was an overall male predominance in this study with an increasing male-to-female ratio in group B. This male dominance was similar to the findings in other studies.^[6,7,16] The simple explanation for this male dominance is that in this bustling city, commercial motorcycles and tricycles, which are understandably male business, are also patronized more commonly by males. The frequent traffic gridlocks in the city make transport by commercial motorcycles easier, and especially through areas that are not motorable. The road menace of these commercial cyclists is common knowledge; yet, this mode of transportation is still a booming business. Severe trauma from traffic accident leading to gangrene was the leading indication for amputation in our study and in our setting, where more men were more actively engaged to provide for their families; it was not unusual for males to dominate. The age range mostly affected was 30–49 years, which was similar to the findings by other authors.^[4-6] This is the age when people are always on the go to earn their living and so are prone to accidents. The older age group in our study corresponded to amputation in diabetic patients with foot complications similar to studies from the south-west subregion of Nigeria.^[10,13,14]

The level of amputation in this study was slightly more in AK amputation, $n = 27$ (52.9%), than BK amputation, $n = 20$ (39.2%), for group A; however, the trend skewed in favor of BK amputation in group B. The need to be more conservative and to enhance prosthetic fitting was responsible for this slight increase in the number of BK amputation. Thus, the authors performed more two-stage operative procedures in group B especially for infected gangrenes. Other authors have also reported more BK than AK amputations in their recent studies.^[7,14] The patients who had AK amputation were usually those with traditional bonesetters' gangrene, sepsis,

high level of gangrene, and late presenters. However, when possible, retaining the knee joint is very essential to ensure easier and faster rehabilitation, reduce the energy expenditure, and improve efficiency during gait.^[17] An ultrashort BK stump is still more effective than an AK amputation, and this is made possible by the improvement in prosthetic technology,^[17] which unfortunately is not readily available in developing countries. The elected level of amputation is dependent on the surgeon's need to conserve a longer stump, to ensure that the margin of the wound and surrounding soft tissues are viable so that healing would be possible and timely, and also the need to have bulky, painless soft tissue cover on the stump either as end bearing or for prosthetic fitting. The viability of the tissue left behind is dependent on the blood flow, and this can be assessed grossly by palpating the pulse or by Doppler assessment.

Infection was not a primary reason for amputation in our study. Postoperatively, we recorded more infection-related complication in group A when compared to group B. Wound breakdown, ring sequestrum, and ascending infections that necessitated proximal revisions worsen the patients' postoperative conditions and prolonged the hospital stay. Ascending infections on the stumps were major postoperative complications reported by some authors with a rate as high as 21%.^[18] Delays in presentations, initial care from the traditional bonesetters, gangrene in addition to the compromised immune status in patients with uncontrolled diabetes mellitus, and inadequate resuscitation are the risk factors for developing wound infection postamputation.^[19] A good number of the patients had two-stage amputations (open amputation) because of infection. Provisional amputations were necessarily done for all the patients with traditional bonesetters' gangrene and for more patients with diabetic gangrene because of sepsis, and this was our approach especially for the group B patients. If the surgeon decided to be more conservative and amputated the limbs through levels that were viable but were not cleared of sepsis, it becomes surgically imperative not to close the wounds primarily but to leave the stumps open for dressing and drainage and to institute the appropriate antibiotic therapy. In addition, provisional amputation could be performed within a shorter operation time than a definitive amputation, and this was necessary for patients who were usually not fully stabilized to undergo prolonged surgery and anesthesia, but at the same time needed the amputation to remove the source of toxemia and reduce systemic inflammatory response and possibly reverse any organ dysfunction. Conversely, the wound infections and breakdowns were mainly on the stump of infected traumatic and diabetic gangrenes that were treated by the one-stage definitive amputation. Many authors reported sepsis as the underlying cause of death in their series.^[20,21] There was a reducing trend in the number of complications observed in our study, and the deaths in our study were also related to sepsis. They were some of the patients with diabetic gangrene or patients who were initially mismanaged for trauma-related gangrene, and these patients were also late presenters and, therefore, had sepsis and organ failure. The provision of affordable, durable, and light

prosthesis is a *sine qua non* to efficient rehabilitation and reintegration of amputees into the society, and this has continued to be a problem.^[2] Only 31 (33%) amputees out of the 93 surviving amputees were able to get their prosthetic fittings. This was made possible through an arrangement the center has with a local prosthetic and orthotic company to provide these artificial limbs speedily and at affordable costs.

CONCLUSION

There is no overall change in the trend concerning the indications for amputation in this study despite the slight reduction in the number of patients with traumatic gangrenes. The causes of traffic accidents are preventable, and there is a need for continued public orientation to reduce the incidence of accidents on our roads and to educate the traditional bonesetters as a further means of limiting this scourge. Our pattern of amputation tends toward being more conservative, which is important for easier prosthetic fittings, but unfortunately prostheses are still not easily affordable.

Recommendations

Putting preventive measures in place to reduce the rate of traffic accidents will go a long way to reduce limb injuries and invariably reduce the rate of amputations. Enforceable legislation on the proper use of motorcycles and the recently introduced tricycles as modes of intracity transportation is necessary. The economic impact of amputations on the patients and their family members and on the society is profound, and, whenever the support system is lacking, many of these amputees are often seen on the streets of major cities begging for alms. It would be nice if the National Health Insurance Scheme were expanded to cater for this aspect of amputation aftercare. Some non-governmental organizations have helped in the past, but help can only be complete when these amputees are fully rehabilitated, and the first step is the provision of user-friendly prostheses.

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Conflicts of interest

There are no conflicts of interest.

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