



COLLEGE OF HEALTH SCIENCES
DEPARTMENT OF GENERAL SURGERY

PATTERN OF MAJOR LIMB AMPUTATION AND ITS ASSOCIATED FACTORS
AMONG ORTHOPEDIC PATIENTS AT ASELLA TEACHING AND REFERRAL
HOSPITAL, SOUTHEAST ETHIOPIA

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ABBREVIATIONS/ACRONYMS

AEA - Above Elbow Amputation

AKA - Above Knee Amputation

ATRH – Asella Teaching and Referral Hospital

AOR – Adjusted Odds Ratio

BEA - Below Elbow Amputation

BKA - Below Knee Amputation

COR – Crude Odds Ratio

CVA - Cerebro-Vascular Accident

DM - Diabetes Mellitus

DFU - Diabetes Foot Ulcer

ECG - Electro Cardiograph

ETB - Ethiopian Birr

FDA – Falling Down Accident

FNAC - Fine Needle Aspiration Cytology

LLA – Lower Limb Amputation

NGO – Non-governmental Organization

PAD - Peripheral Arterial Diseases

PVD – Peripheral Vascular Disease

RTA - Road Traffic Accident

USA – United States of America

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ABSTRACT

Introduction: Amputation is a surgical procedure for the removal of a limb which is indicated when limb recovery is impossible. Major limb amputation is reported to be a major preventable public health problem that is associated with profound economic, social and psychological effects on the patient and family. Knowledge on the pattern of major limb amputation and its associated factors are scarce in Ethiopia and absent in local area. So this study strives to fill this research gap.

Objectives: To assess patterns of major limb amputation and its associated factors among orthopedic patients in Asella Teaching and Referral Hospital, Southeast Ethiopia

Methods: Institutional based cross-sectional study had been conducted to review major limb amputation performed from February, 2020 to September, 2025. Data were collected from patients chart by using kobo toolbox. Then the data were exported to SPSS version 31 for statistical analysis. Bivariable and multivariable logistic regression analyses were performed to analyze factors associated with major limb amputation by considering a statistical significance level of 5%, and 95% confidence interval (CI).

Results: A total of 118 patients with major limb amputation, dichotomized into lower limb and upper limb were included in the study. The majority were lower limb amputations (79.7%) from which above knee amputation was relatively the most frequently done. Factor associated with lower limb amputation analyzed by taking patients with upper limb amputation as target group. In the analysis age [AOR = 5.99; 95% CI: 1.101, 32.580], male sex [AOR = 23.11; 95% CI: 2.771, 192.638], diabetic foot ulcer [AOR = 5.066; 95% CI: 1.041, 26.855] and PVD [AOR= 20.883; 95% CI: 4.626, 94.265] showed a significant association with major lower limb amputation.

Conclusions and Recommendations: In the current study lower limb amputation is the most common type. Peripheral vascular disease and diabetic foot ulcer are among factors which showed significant association with lower limb amputation. Effective prevention strategies on complications associated with diabetes mellitus i.e. diabetic foot ulcer, peripheral vascular disease and robust research efforts are critical to minimize limb amputation and its complications.

Key words: Amputation, major limb amputation

1. INTRODUCTION

1.1. Background

The term Amputation is derived from the Latin word amputare (to excise or to cut out), which means the removal of part or all of a body part delimited by the skin. It is a surgical removal of a limb, performed when the limb is unsalvageable, nonfunctional, or life-threatening. It is one of the oldest surgical procedures, dating back over 2,500 years to the time of Hippocrates. The causes of amputation vary by region. In developed countries, peripheral vascular disease and diabetes-related complications are the leading indications, whereas in developing countries trauma, infections, uncontrolled diabetes, and malignancies predominate (1,2).

In diabetics, it has been shown that the incidence of lower limb amputation (LLA) increases with the duration of diabetes. Limb amputation has been defined as a complete loss in the transverse anatomical plane of any part of the limb for any reason. A distinction must be made between major and minor amputation. A minor amputation is any amputation which is below the ankle joint in lower limb and below wrist joint in the upper limb (2).

A major amputation is any amputation through or proximal to the ankle joint and wrist joint. Limb amputation is usually performed as a lifesaving procedure. Major lower limb amputation (LLA) is performed at different anatomical levels depending on the need and reason for amputation. These includes ankle disarticulation (Symes amputation), below knee amputation (BKA), knee disarticulation, above knee amputation (AKA), hip disarticulation, and Hind quarter amputation (hemipelvectomy) (2).

Upper limb amputation could include the removal of one or more fingers, wrist disarticulation, below-elbow or transradial amputation, elbow disarticulation, arm or above-elbow amputation, shoulder disarticulation, and amputation of the arm, clavicle, and scapula together which refer as for quarter amputation (3).

As far as the site of amputation is concerned, studies showed different results, but lower-limb amputations accounts for 79% of all dysvascular limb loss discharges from hospital. The pattern of limb amputation in a low-income country also showed, in descending order, trans-tibial, Trans-femoral, trans-radial, and trans-humeral (4,5).

In Ethiopia, non-diabetic vascular disease is relatively uncommon, and amputation is often the only practical treatment for late complications of trauma, gangrene from various causes, tumors, and chronic infections. Selecting the appropriate amputation level requires balancing better function with more distal amputations against lower complication rates with more proximal levels. Although the goal is to preserve the most distal level that allows primary healing and a functional stump, the final level is determined by the extent of disease and the limb's blood supply(6,7).

1.2. Statement of the problem

Major amputation is reported to be a major problem but preventable public health problem that is associated with profound economic, social and psychological effects on the patient and family especially in developing countries where the prosthetic services are poor (8).

Limb amputation is often the preferred treatment for severe lower-extremity injuries when reconstruction would be prolonged, costly, and unlikely to restore satisfactory function. This is particularly true in many parts of Africa, where limited reconstructive resources, delayed hospital presentation, and complications such as gangrene from traditional bone-setter practices reduce the chances of limb salvage. Despite its gravity, amputation can relieve pain, remove a nonviable limb, and enable rehabilitation with a prosthesis, allowing the patient to regain functional mobility(9).

A study done in India among lower limb amputees who were visiting a rehabilitation center for more than 18 years reported that almost more than half of the amputees (52%) had no job at the time of the study and 80% of them reported having a job before amputation and of this groups, 82% of them reported a loss of job as a direct consequence of amputation (10).

Research shows that limb amputation especially major amputation causes profound changes in body structure and function. Beyond the loss of the limb itself, patients are affected by the underlying disease, associated comorbidities, and concurrent injuries. While prosthetic fitting can partially restore function, many individuals still experience limitations in daily activities and participation in social roles. Environmental barriers such as inaccessible infrastructure and personal factors including age, sex, education level, and coping ability can further restrict social integration for people with lower extremity amputations(11).

Additionally, it indicated in different literature losing a limb in developing nations is almost like a sentence to poverty and beggary. This is due to the fact that rehabilitation facilities are still in their low stage and prosthetic walking aids are still reserved for the wealthy. Hence, there are high financial, social, and psychological impacts for the suffering patient and by extension, for their family and the society at whole (12).

In Ethiopia, amputation is often the only available treatment for the late results of trauma; mainly, for late complications of DM, gangrene of various causes, tumors and other chronic infections. The majority of these amputations are preventable by empowerment of traffic rules, health education, early preventions and appropriate management of the common infections (6).

Several studies have attempted to explain and identify the patterns and causes of limb amputation in Ethiopia. Most prior research concerning limb amputation has done focused almost exclusively on lower limb amputation and its causes, there is little quantitative information in the literature regarding the pattern of limb amputation and its associated factor. Hence, this study has planned to assess the pattern of major limb amputations and its associated factors in Asella Teaching and Referral Hospital with the view to enlighten the public and make recommendations to prevent the untoward experiences that follow amputations.

1.3. Significance of the study

Information on the patterns and factors associated with major limb amputation is critical for the improvement of quality care. However, very limited studies have tried to determine patterns of major limb amputation cases in Ethiopia in general and in study area in particular. Therefore, the aim of this study is to generate information that explains the patterns and factors associated with major limb amputation cases admitted to ATRH.

The results of the study will be used by health personnel, health service managers and policy makers as best reference for future similar field of study. The findings will also be used by researchers as baseline information to conduct large scale study using stronger study designs.

2. LITERATURE REVIEW

2.1. Patterns of major limb amputation

It is estimated that 1.2 million individuals are living with an amputation; and that 185,000 are performed each year worldwide (13).

A study done in USA, on lower extremity amputation revealed that Below knee amputation was the most common pattern accounting for 50% of cases followed by Above knee amputation (38%) and minor amputation (12%) (14). Study from India showed that the lower limb amputation accounts for 94.8% and BKA was the most common types of amputation(15). In Germany in 2015, minor amputation accounts for 67.5% of lower limb amputation followed by AKA (17.3%), BKA (11.5%) (19).

According to study results from Sweden 89% of lower limb amputees underwent unilateral limb amputations, in which below knee amputation was most common (47%) followed by above knee amputation in 26%, and minor amputation or partial foot amputation distal to ankle was done in 20%, knee disarticulation was done in 7%, and hip disarticulation, or hemipelvectomy was done in < 1% (18).

A Study done in northern Tanzania shows, that Lower limbs were involved in 86.4% of cases and upper limbs in 13.6% of cases giving a lower limb to upper limb ratio of 6.4:1. Below knee amputation was the most common procedure performed in 46.3%. Lower limbs were involved in 140 (86.4%) cases and upper limbs in 22 (13.6%) cases giving a lower limb to upper limb ratio of 6.4:1. In the lower limb, the ratio of below knee amputation to above knee amputation was 1.2:1 and in the upper limb, the ratio of below elbow to above elbow was 1.2:1 (8).

A Study done in northwestern Nigeria, showed that 98(84.8%) amputations were in the lower limb while 17(15.2%) were in the upper limb. Of the upper limb amputations, 45.5% occurred in children. Above knee amputations accounted for majority of the amputations followed by below knee amputations. A study done in Rwanda at University Teaching Hospital Butare showed that the prevalence of limb amputation was 3.08% of operation performed during period. Males accounted for 75 cases (70.09%) and 32 cases (29.91%) were females. The male to female sex ratio was 2.3 to 1. Their ages ranged between 1 and 93 years old with a median of 44 years (12,19).

In Kenya, rates of vascular amputations vary between 25% and 56%. One study done in Kenya showed that the prevalence of amputation was 3.2% of all surgical operations performed. Trauma constituted the most common cause of amputation (35.7%) with a significant proportion caused by road traffic accidents (RTA) (20).

Prospective study done to assess the outcome of road traffic accident among victims at the adult emergency department of Tikur Anbessa Specialized Hospital, Addis Ababa, Ethiopia, showed that the limb amputation accounts for 1.1% of surgical procedures performed for the victims. In a study conducted in Ayder Referral Hospital, northern Ethiopia in 2018, the commonest type of amputation was major lower limb amputation (58.6 %) which included AKA (35.6%) and BKA (23%) followed by digital amputation (17.2 %). Major upper extremity amputation surgery was done in 11.4%, among which one patient underwent bilateral arm amputation (6,21).

2.2. Factors associated with major limb amputation

A study done in the United State of America reported that males are at significantly higher risk for trauma-related amputations than females, and the risk of amputation increases with age, regardless of etiology, sex, and race (22). According to a meta-analysis study result reports on risk factors for lower extremity amputation in patients with diabetic foot ulcers, which included the studies published in 2019, risk factors like presence of foot ulcers ($P<0.00001$), osteomyelitis ($P<0.00001$), and gangrene ($P<0.00001$) were reported to be associated with an increased risk of amputation (23).

Different study results reported also observing a strong association between major amputations and prior intervention for a foot-related problem, as 52% of the sample that had a pre-existing wound or a prior minor amputation underwent re-amputation in 32% of cases (28). A study in Germany showed that Diabetes mellitus (DM) or peripheral arterial disease (PAD) were the two major diseases causing amputation, with approximately 75 to 78% of all amputations of the lower limb in Germany being attributed to DM or PAD and median age range was 64-81 years, while women accounts for 30.5% of cases (17).

Study from India showed over all trauma (70.3%) was the leading causes of amputation followed by peripheral vascular disease (27.7%). Trauma was the leading causes of amputation among patients younger than 30 years and majority were caused by RTA and burns. In age group >60 years,

PAD was the most common causes of amputation accounting for 34.9% while trauma accounts for 3.6% of the cases (16).

A Study done in northern Tanzania shows, that the most common indication for major limb amputation was diabetic foot complications (41.9%), followed by trauma (38.4%) and vascular diseases (8.6%). The majority of patients 90.1% were aged above 10 years of age. 66.7% were males and females were 33.3%). Males outnumbered females by a ratio of 2:1. Trauma (mainly road traffic accidents and falls) and malignancies were most common indications for amputations in young adults (2nd to 3rd decades) whereas complications of diabetes and peripheral vascular diseases were the main indications in the 4th to 5th decades of age. Post-burn contractures, iatrogenic and congenital limb deformity were the most common indications in children aged 10 years and below. The major indications for upper limb amputations were trauma (42.3%) and malignancies (24.6%) while diabetic gangrene (45.5%) and trauma (32.2%) were the most common causes of amputation in lower limbs (8).

A Study done northwestern Nigeria, however, indicated the leading cause to be trauma (27%) followed by diabetic foot gangrene, infection, and neoplasm. Seventy-seven cases (68.1%) were males while thirty-five cases (31.9%) were females. The male-female ratio was 2.1:1. The age range was from 3-89 years (mean=32.4). Out of 90 amputations performed in adults, 26 (30.5%) were due to trauma, 25 (26.3%) were due to diabetic foot gangrene, 19 (22.1%) were due to neoplasm, 13(13.7%) were due to peripheral vascular disease and 7 (7.4%) due to post-infective gangrene. 27(24.1%) amputations were due to trauma, followed by diabetic foot gangrene which is 26(23.2%) (12).

In a study done in Rwanda at University teaching Hospital Butare in 2013, the commonest indication for amputation was gangrene (43.95%), especially dry gangrene (22.43%) most often secondary to peripheral vascular disease (19). In a study done in Kenya Kikuyu Hospital, out of a total of 4,324 operations, 140 cases (3.2%) were amputations. Trauma constituted the most common cause of amputation (35.7%), followed by congenital defects (20%), dysvascular causes (17.1%), infection (14.3%) and tumors (12.8%). The overall male to female ratio was 2:1. Dysvascular amputations were made on patients with an age range of 40–80 years with a mean age of 60 years. Of the trauma cases, RTA constituted 29%, burns 24% and falls 22%. Diabetic vasculopathy accounted for 11.4% of the amputations and 69.6% of the dysvascular cases (20).

A study conducted in Ayder Referral Hospital, northern Ethiopia, showed that trauma (37.7%), tumors (24.1%) and PAD (20.7%) were the common causes for amputations. In patients under the age of 15, trauma specifically falling down accident was the commonest cause of amputation while, in the age group between 15 to 45 malignancy and electrical burn were the commonest causes. After the age of 45, malignancy and PAD were the commonest causes. Of total of 87 patients who had amputation, 78.2% were males and the age range was from 3 to 95 years, and the mean age was 40.6 in years (6).

2.3. Conceptual framework of the study

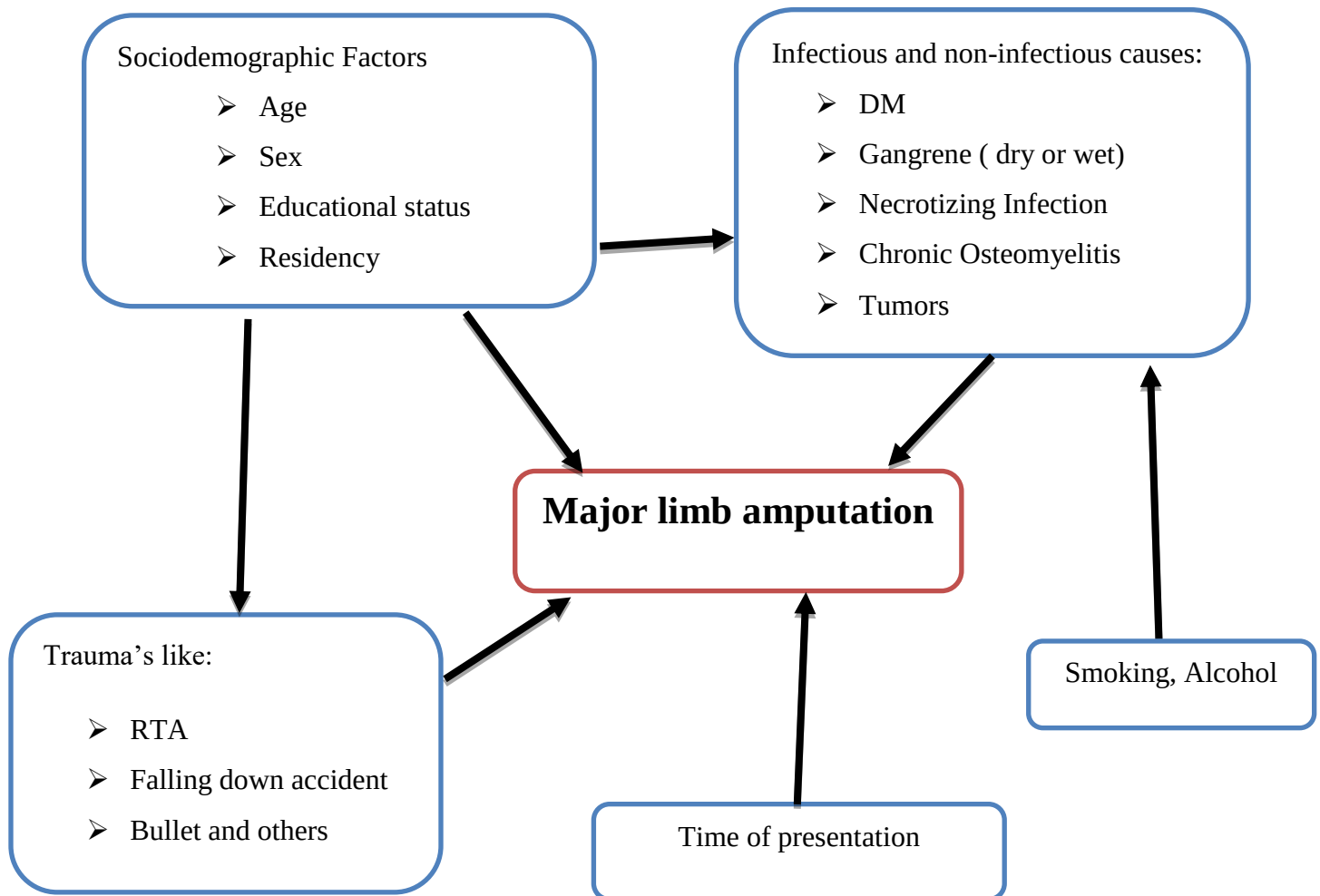


Figure 1: Conceptual framework of study on Patterns of Major Limb Amputation and its associated factors among Orthopedic Patients in Asella Teaching and Referral Hospital, South East Ethiopia (12,20,21).

3. OBJECTIVES

3.1. General objective

- To assess the Patterns of Major Limb Amputation and its associated factors in orthopedic patients who undergone limb amputation at ATRH from February, 2020 to September, 2025.

3.2. Specific objectives

- To determine the patterns of major limb amputation in orthopedic patients who undergone limb amputation at ATRH from February, 2020 to September, 2025.
- To identify factors associated with major limb amputation in orthopedic patients who undergone limb amputation at ATRH from February, 2020 to September, 2025.

4. METHODOLOGY

4.1. Study Design and period

Institutional based cross-sectional study had been conducted to review records from February, 2020 to September, 2025.

4.2. Study area

The study had been conducted in Asella Teaching and Referral Hospital, southeast Ethiopia. Currently Asella Teaching and Referral Hospital has 5 functional Operation Room (OR) tables and giving emergency operation 24 hours/day all time and elective general surgery operation 3 days/week and elective orthopedics surgery 2 days/week in general serves more than 3.3 million in catchment area.

4.3. Source and Study Population

4.3.1. Source population

The source population comprised of medical records of all patients who underwent limb amputation from February, 2020 to September, 2025

4.3.2. Study population

The study population comprised of all eligible medical records of those patients who underwent amputation and met inclusion criteria from February, 2020 to September, 2025.

Inclusion criteria

- ✓ All major amputation cases with complete and accessible medical records
- ✓ Pediatric patients who undergone major limb amputation within study period

Exclusion Criteria

- ✓ Re-amputation cases or revision surgeries
- ✓ Incomplete medical records

4.4. Sample size determination and sampling technique

4.4.1. Sample size determination

Due to the rarity of overall major limb amputation, no sample size calculation used in this study.

4.4.2. Sampling Techniques

As census method was used in this study, all eligible medical records had been reviewed and no sampling techniques was used.

4.5. Variables of the study

4.5.1. Dependent Variable

- Major limb amputation

4.5.2. Independent variable

- Socio-demographic variables: age, sex, residence,
- DM, Chronic osteomyelitis, trauma, tumors
- Smoking, time of presentation, PVD

4.6. Operational definitions

Amputation: described as the removal of a body extremity by surgery or trauma

Pattern of amputation: Anatomical level of amputation, site of amputation, laterality, gender and age based distribution of amputation.

Major limb amputation: Any amputation performed at or above the level of the ankle for a lower limb and at or above the wrist for upper limb.

Minor amputation: Refers to excision of any part of one or more of the toes for lower limb or finger for upper limb.

Disarticulation: Amputation through the center of a joint

Incomplete information: patient's medical charts with incomplete data greater than 20% of the variables of study.

4.7. Data collection instrument and procedure

The data was collected using kobo Toolbox data collecting system. The tools included information on socio-demographic characteristics of the study participants and variables that were used to assess pattern of limb amputation and its associated factors. First year surgical residents and interns who was assisted by medical record unit workers, has extracted data from patient cards and one third year surgical residents has supervised data collectors.

4.8. Data Quality Assurance

Training was given to data collectors and supervisors by principal investigator to approach the study, confidentiality and privacy of data and how to use the tools. Investigator and supervisor has made a thorough check before receiving the filled questionnaire from each data collector and they has randomly selected questionnaire to cross check its completeness and errors on spot.

4.9. Data processing and Analysis

After data collection and questionnaire checked for completeness, data was encoded to Epi-data info latest version and was analyzed using SPSS latest version. After cleaning data for missing values, outliers and extreme values, data was recoded and categorized accordingly. Descriptive statistics was applied to determine means, frequency and ranges. Results are presented using tables, graphs and pie charts. Bivariable and multivariable binary logistic regression tests was used to analyze factors associated with major limb amputation by considering a statistical significance level of 5%, and 95% confidence interval (CI).

4.10. Ethical consideration

Ethical approval for the study was obtained from the College of Health Sciences, Arsi University, and Ethical Review Committee (ERC). Permission has taken from department of surgery and then ATRH medical records room. Individual informed consent and name of the patient has not been undertaken as the study used patients' medical records.

4.11. Dissemination of the study result

The findings of the study will be communicated to academic advisors and Arsi University through oral and written communication. The findings will be communicated to Asella Teaching and Referral Hospital with their health facilities through seminars and further efforts will be made to publish the findings on national or international peer reviewed journal

5. RESULTS

5.1. Socio-Demographic Characteristics

During the study period, a total of 169 patients underwent major limb amputation. All medical records identified were taken, from which 118 (70%) charts were complete and fit for analysis. From those, 89 (75.4%) patients were males and 29 patients (24.6%) were females which makes the male-to-female ratio about 3:1.

Of the 118 patients, more than half of patients were aged over 46 years with the mean age of 44.3 ± 11.2 years. Overall, the risk of having amputation increases as patient age increase. The majority of patients were from rural areas, accounting for 69 patients (58.5%), while 49 patients (41.5%) resided in urban areas (Table 1).

Table 1: Socio-demographic profiles of patients who underwent major limb amputation at ATRH from February, 2020 to September, 2025

Characteristics		Frequency	Percentage
Age category	Under 14	14	11.8%
	15-45	37	31.4%
	46 and older	67	56.8%
	Total	118	100%
Gender	Male	89	75.4%
	Female	29	24.6%
	Total	118	100%
Residency	Urban	49	41.5%
	Rural	69	58.5%
	Total	118	100%

5.2. Behavioral characteristic of the participants

Regarding smoking status of study participants, majority were non-smokers, with 79 patients (66.9%) reporting no history of smoking. Smokers accounted for 39 patients (33.1%). This shows that approximately one-third of the study population had a history of smoking.

About 84.8% of the respondents had no history of alcohol drinking and while 15.2% of them reported having history of alcohol drinking (Table 2).

Table 2: Behavioral characteristics of patients who underwent major limb amputation at ATRH from February, 2020 to September, 2025

Behavioral Characteristics of the participants		Frequency	Percentage
Smoking status	Yes	39	33.1%
	No	79	66.9%
	Total	118	100%
Alcohol drinking behavior	Yes	18	15.2%
	No	100	84.8%
	Total	118	100%

5.3. Reason for hospitalization and types of operation

In this study, among all 118 patients, gangrene was the most common reason for hospitalization, accounting for 46 patients (39.0%). Bone fractures from different trauma were the second most frequent reason, reported in 37 patients (31.4%) followed by diabetic foot ulcer (DFU) in 23 patients (19.5%) and Malignancy accounted for 10 patients (8.5%), while chronic infection were less common and it accounted for 2 (1.7%) patients.

Most of procedures were performed as emergency operations. Emergency amputations accounted for 91 cases (77.1%), while elective amputations were performed in 27 cases (22.9%) (Table 3).

Table 3: The reason for hospitalization and types of operation among patients who underwent major limb amputation at ATRH from February, 2020 to September, 2025

Characteristics		Frequency	Percentage
Reason for hospitalization	Gangrene	46	39%
	Traumatic bone fracture	37	31.4%
	Diabetic foot ulcer	23	19.5%
	Malignancy	10	8.5%
	Chronic infection	2	1.7%
	Total	118	100%
Types of operation	Emergency	91	77.1%
	Elective	27	22.9%
	Total	118	100%

5.4. Indications and patterns of major limb amputation.

5.4.1. Indication for major limb amputation

Among the 118 patients who had undergone amputation, Peripheral vascular disease (PVD) was the leading indication for amputation, accounting for 49 patients (41.5%). Trauma was the second most common indication, reported in 40 patients (33.9%) followed by diabetic foot ulcer (DFU) in 23 patients (19.5%). Chronic infection and malignancy were less frequent indications, each accounting for 3 patients (2.5%) (Table 4).

Table 4: Indications of amputation among the patients who underwent major limb amputation

Characteristics		Frequency	Percentage
Indication for amputation	Peripheral arterial disease	49	41.5%
	Diabetic foot ulcer	23	19.5%
	Trauma	40	33.9%
	Malignancy	3	2.5%
	Chronic infection	3	2.5%
	Total	118	100%

Table 5: Types of trauma among the patients underwent major limb amputation

Characteristics		Frequency	Percentage
Causes of trauma	Road traffic accident (RTA)	10	25%
	Crush injury	8	20%
	Falling down accident	15	37.5%
	Burn injury	2	5%
	Gun-shot	5	12.5%
	Total	40	100%

5.4.2. Pattern of major limb amputation

5.4.2.1. Site and level of major limb amputation

In this study, the majority of amputations involved the lower limb. Unilateral lower limb amputations accounted for 92 patients (78.0%), while unilateral upper limb amputations were performed in 24 patients (20.3%). Bilateral lower limb amputations occurred in 2 patients (1.7%). Overall, lower limb amputations predominated in this study population.

Concerning the level of amputation, from patients who had undergone lower limb amputation, above-knee amputation was the commonest level, performed in 37 patients (31.4%), followed closely by below-knee amputation in 36 patients (30.5%). Ankle disarticulation accounted for 9 patients (7.6%), while knee disarticulation and hip disarticulation were relatively uncommon, reported in 2 (1.7%) and 3 (2.5%) patients, respectively. From upper limb amputation, below-elbow amputation done for 13 patients (11.0%), elbow disarticulation for 11 patients (9.3%), arm amputation in 6 patients (5.1%), and shoulder disarticulation in 1 patient (0.8%) (Figure 2).

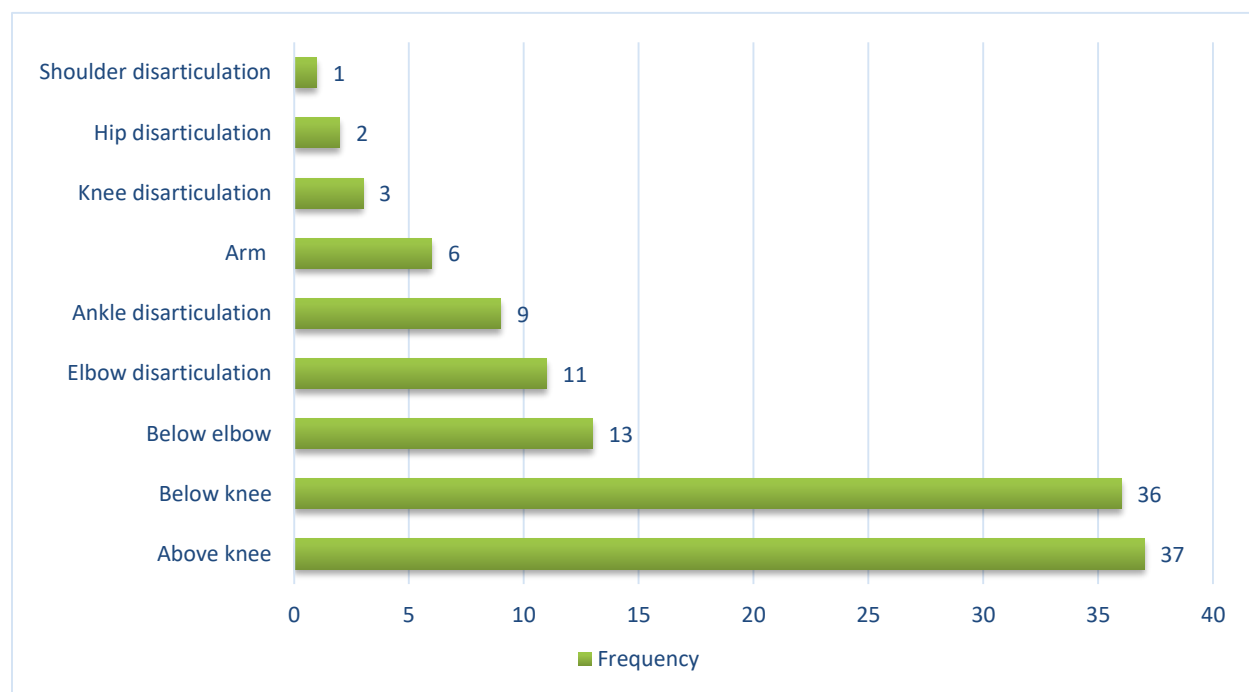


Figure 2: Site and level of major limb amputation among patients who underwent amputation

5.4.2.2. Distribution of the amputation by its indications among sex and age groups

In this study majority of limb amputees were males 89 (75.4%) and 29 patients (24.6%) were females. The leading indications were peripheral vascular disease (PVD) (49 cases), trauma (40 cases), and diabetic foot ulcer (DFU) (23 cases). Trauma related amputations were much more common in males (29 cases) than females (11 cases). Peripheral vascular diseases (PVD) was the most common indication in both sexes but was markedly higher in males (38 cases) compared to females (11 cases).

The cause for majority of amputation among age groups above 46 years was due to PVD (41 cases) and DFU (20 cases), while trauma was infrequent (2 cases). Malignancy appeared only in this older age group (3 cases). In young patients between 15 – 45 years of age, trauma remained the leading indication (26 cases), with smaller contributions from PVD (7 cases) and DFU (3 cases). This suggests injury-related causes are still dominant in the productive age group. In pediatric age groups (less than 15 years of age), amputations were predominantly due to trauma (12 cases) and non-traumatic causes were uncommon.

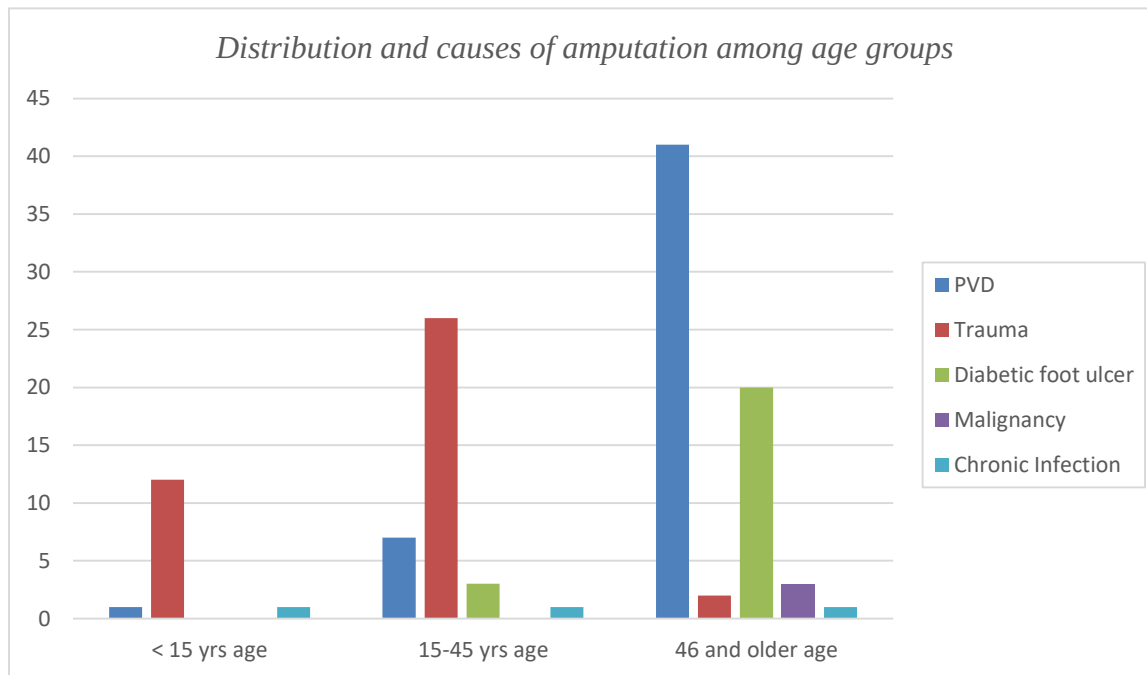


Figure 3: Distribution of causes of amputation by age groups among patients who undergone amputation.

5.5. Factors associated with major limb amputation

In this study, independent variables such as age, sex, smoking history, alcohol drinking, presence of trauma, DM, diabetes foot ulcer, malignancy, infection and peripheral vascular disease were analyzed first by bivariable analysis.

Depending on this analysis, eight variables with p-value < 0.25 i.e. age, sex, smoking history, history of trauma, diabetes mellitus, diabetic foot ulcer, malignancy and PVD were identified as candidate variables for the multivariable analysis for major lower limb amputation.

The result of the multivariable analysis indicated that age, sex, diabetic foot ulcer and PVD are independent variables that showed significant association with major lower limb amputation.

Those patients older than 45 years of age has 5.99 times higher odds of having major lower limb amputation when compared with patients who are under 15 years of age [AOR = 5.99; 95% CI: 1.101, 32.580] and male patients had significantly higher odds of lower limb amputation than females (AOR = 23.11, 95% CI: 2.77–192.64). Also, when compared with trauma-related amputations, diabetic foot ulcer (AOR = 5.07, 95% CI: 1.04 – 26.86) and peripheral vascular disease (AOR = 20.88, 95% CI: 4.62 – 94.27) were strong predictors of major lower limb amputation. (Table 6).

Table 6: Bivariate and Multivariate logistic regression analysis of factor associated with major lower limb amputation.

Variables		Major limb amputation		Bivariate analysis (COR)	P-value	Multivariate analysis (AOR)	P-value
		LL(target)	UL(ref.)				
Age	< 15 yrs.	4	10	1		1	
	15-45	30	7	2.15(0.52 – 14.123)	0.89	--	--
	> 45 yrs.	53	14	91.00(8.86, 934.41)	<0.001	5.99(1.101, 32.58)	.003
Sex	Females	18	11	1		1	
	Males	78	12	4.24(1.377, 13.051)	0.012	23.11(2.77, 192.64)	.004
Smoking	No	70	9	1		1	
	Yes	35	4	2.12(1.02, 11.262)	0.15	1.06(0.25-9.73)	.27
DM	No	63	3	1		1	
	Yes	47	5	3.57(0.955-4.515)	0.065	1.66(0.598-4.591)	.332
Malignancy	No	85	23	1		1	
	Yes	9	1	2.99(1.18 - 6.413)	0.23	1.57(0.87 - 3.249)	.071
Causes of amputation	Trauma	28	12	1		1	
	DFU	22	1	15.00(3.179, 70.78)	0.11	5.066(1.04, 26.86)	.047
	PVD	43	6	14.0(1.766, 111.01)	0.043	20.88(4.62, 94.26)	<.001

6. DISCUSSION

This study was a hospital-based Census study, conducted in Asella Teaching and Referral Hospital involving viewing records of one hundred eighteen (118) medical records of patients who underwent major limb amputation from February, 2020 to September, 2025. During the study period, 118 complete medical records were analyzed. The findings provide important insight into the patterns and factors associated with major limb amputation and are discussed in comparison with existing regional and international literatures.

In this study, males constituted 75.4% of all major limb amputations, yielding a male-to-female ratio of approximately 3:1. This finding is consistent with multiple studies from Ethiopia and other African countries, including reports from Ayder Referral Hospital in which cases most of patients who undergo limb amputation are male patients (78.2%) and also in northwestern Tanzania from patients who undergo limb amputation 66.7% are male patients (6,8). Overall, most studies which are done on limb amputation has documented male predominance. This may be explained by greater exposure of men to high-risk occupations like sport activities, road traffic accidents, agricultural injuries, and outdoor activities.

More than half of the amputees (56.8%) were aged 46 years with the mean age of 44.3 ± 11.2 years, indicating that the risk of major limb amputation increases with advancing age. This pattern aligns with findings from different countries including Ayder Referral Hospital, in which the age range was from 3 to 95 years, and the mean age was 40.6 in years (6). A study conducted in Germany also shows that, the median age of patients who undergone limb amputation ranges from 64-81 years (17). The predominance of older patients reflects the cumulative effect of chronic comorbidities such as peripheral vascular disease and diabetes mellitus, which are strongly associated with limb ischemia and gangrene. Regarding residence, 58.5% of patients were from rural areas, a finding comparable with studies from rural Kenya in which more than half of patients who had limb amputation are from rural areas (20). Rural predominance may reflect limited access to early medical care, delayed presentation, reliance on traditional healers, and poor awareness of chronic disease management, all of which increase the likelihood of late-stage disease necessitating amputation.

In this study lower limb amputations constituted 79.7% of all amputations, with a lower-to-upper

limb ratio of approximately 4:1. This finding is consistent with studies from Ayder Referral Hospital in which lower limb amputation accounted around 58.6 % and also study in northwestern Nigeria showed that 84.8% of amputations were in the lower limb while 15.2% were in the upper limb (6,12).

Among lower limb amputations, AKA (31.4%) and BKA (30.5%) were almost equally frequent in this study. This differs slightly from studies in the USA where, BKA was the most common pattern accounting for 50% of cases followed by AKA (38%) and study from India showed BKA as the most common types of amputation which may be due to early presentation and availability of vascular reconstruction (16,22). The relatively high rate of AKA in this study likely reflects late presentation, advanced ischemia, and limited revascularization services necessitating more proximal amputations to ensure wound healing. Upper limb amputations accounted for 20.3%, with below-elbow amputation being the most common level. This distribution is comparable with reports from Tanzania and Ayder Referral Hospital, where trauma and malignancy were the predominant causes of upper limb loss (6,8).

The present study demonstrated a clear age-related pattern of major lower limb amputation etiology. In patients aged 46 years and above, peripheral vascular disease (PVD) and diabetic foot ulcer (DFU) were the predominant causes, while trauma was the leading indication among patients aged 15–45 years and pediatric age group. This pattern mirrors findings from India where trauma was the leading causes of amputation among patients younger than 30 years and PVD was the most common causes of amputation accounting for 34.9% in age group > 60 years (16). Study done in Tanzania and Ethiopia also showed trauma as most common cause of limb amputation in younger age groups and vascular causes increase with age (6,8).

In contrary to the other studies in our country which reported that the leading cause of limb amputation was trauma (6,21,25), the most common cause of limb amputation in current study was peripheral vascular disease (41.5%), followed by trauma (33.9%) and diabetic foot ulcer (19.5%), but it correlates to some studies done in other place, in Africa and other parts of the world. Study done in a tertiary hospital in northwestern Tanzania reported that complication of diabetes mellitus was the main indication for the major limb amputations in 68 (41.9%) patients followed by trauma in 62 (38.4%) patients (8). A study done in Germany showed that Diabetes mellitus (DM) complication and peripheral arterial disease (PAD) were the two major diseases

causing amputation, with approximately 75 to 78% of all amputations of the lower limb being attributed to DM or PAD (17). The current study also in line with study done in Rwanda at University teaching Hospital Butare, the commonest indication for amputation was gangrene (43.95%), especially dry gangrene (22.43%) most often secondary to peripheral vascular disease (PVD) (19). The possible reason for this might be due to the high prevalence of diabetes with inadequate awareness and increasing risk factors such as the change in the lifestyle of the population over recent decades, sedentary lifestyle in an urban area, overweight and obesity which increased risk of vascular related complications.

In addition, according to some literatures reports, in developing countries, foot ulcers and amputations are very common as a result of poverty, lack of sanitation and hygiene, and barefoot walking that interacts to compound the impact of diabetic foot damage (26).

In current study the result from multivariable logistic regression analysis indicated age, male sex, diabetic foot ulcer, and peripheral vascular disease were variables that shows significant association with major lower limb amputation. These findings are in line with study done in USA where males are at significantly higher risk for amputations than females, and the risk of limb amputation increases with age, regardless of etiology, sex, and race (22). It is also similar to a meta-analysis study result reports on risk factors for lower extremity amputation in patients with diabetic foot ulcers in which variables like, a history of foot ulcers ($P<0.00001$), chronic infections like osteomyelitis and gangrene ($P<0.00001$) were associated with an increased risk of amputation (23).

7. STRENGTH AND LIMITATIONS OF THE STUDY

7.1. Strengths

Results are clearly and systematically presented, encompassing socio-demographic, clinical, and operative characteristics. The use of bivariate and multivariable logistic regression enhanced analytical rigor by identifying independent predictors of major lower limb amputation. The discussion appropriately contextualizes the findings within regional and international literature, highlighting both global consistency and important local differences, particularly the predominance of peripheral vascular disease. Overall, the study offers clinically and public health relevant evidence to inform prevention strategies and future research.

7.2. Limitations

Although the current study has provided insight into patterns of the major limb amputation and its associated factors in Asella Teaching and Referral Hospital, these findings were based on only data from this hospital and are the reflective of this catchment population. As this study is limited by its single-center with small sample size and retrospective design, which may reduce generalizability and subjected to incomplete documentation, generalization of these findings to a general population is beyond the scope of this study which requires larger, multi-center studies that includes a large sample size.

Additionally, due to the poor recording of patient's information and data management system, some other potential confounding variables such as; socioeconomic status, nutritional status, BMI, and time of Presentation that may affect limb amputation were not included under the study.

8. CONCLUSION

This study is aimed to assess the pattern of major limb amputation and its associated factors. The findings of this study showed that lower limb amputations was the most common type of limb amputation constituting around 79.7% from which above knee amputation was relatively the most frequently done type. Male patients accounted for around 75.4% of cases and more than half of the amputees (56.8%) were aged 46 years and above, indicating that the risk of major limb amputation increases with advancing age. The common causes of amputation was diabetic foot ulcer and peripheral vascular diseases which are common among adult and older age groups.

In the current study multivariate analysis revealed that an increase in age, male sex, diabetic foot ulcer and peripheral vascular diseases were independent factors that showed significant association with the major limb amputation.

9. RECOMMENDATIONS

Based on gathered data and the results demonstrated by this study, the following suggestions are forwarded for the following stake holders and concerned bodies.

Public health planners, and health service providers:

- ✓ Health education on prevention of diabetes foot ulcer and vascular related complications shall be planned
- ✓ Age specific prevention activities should be planned against risk factors associated with limb amputation
- ✓ Allocate adequate budget for preventive activities.

Governmental, non-governmental organization and private sectors involved in providing prosthetic limb and walking aid devices:

- ✓ Allocate adequate budget for preventive activities and hospital care.

Researchers should consider:

- ✓ Conducting population-based prospective studies that involve a large sample size to generate more representative data concerning limb amputation.

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11. ANNEXES

ARSI UNIVERSITY

COLLEGE OF HEALTH SCIENCES

DEPARTMENT OF GENERAL SURGERY

Questionnaire to determine the Patterns of Major Limb Amputation and its associated factors among Orthopedic Patients in Asella Teaching and Referral Hospital, South East Ethiopia.

S No	Coding Categories	Questions and filter	Skip	Code
Section I. Socio-demographic characteristics				
1.1	Age of the patient age?	Age (in years): _____		
1.2	Sex of the patient.	1. Male 2. Female		
1.3	Residency	1. Rural 2. Urban		
Section II. Risk factor assessment				
2.1	Did the patient has history of trauma?	1. YES		
		2. NO	If no skip to Q.* 2.3	

2.2	What type of trauma is it?	1. RTA 2. Fall down accident 3. Gun-shot 4. Burn 5. Emaciating injury 6. Other		
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2.3	Previous history of amputation?	1. YES	If YES go to Q* 2.4	
		2. NO		
2.4	What type of amputation?	1. Major amputation 2. Minor amputation		
2.5	Does the patient ever diagnosed with DM?	1. Yes	If no skip to Q.2.8	
		2. No		
2.6	Did the patient have a diabetic foot ulcer?	1. Yes		
		2. No		
2.7	Does the patient smoke?	1. Yes		
		2. No		
2.8	Does the patient drink alcohol?	1. Yes		
		2. No		
2.9	Does the patient have any of the following infections?	1. Gas gangrene	Circle the diagnoses the patient has.	
		2. Chronic osteomyelitis		
		3. Wet gangrene		
		4. Leprosy		
		5. Necrotizing fasciitis		

2.10	Does the patient have any limb malignancy or tumor?	1. YES 2. NO		
2.11	Does the patient have any PVD?	1. YES 2. NO	If NO skip to sec -3	
2.12	Which type of PVD?	1. Diabetic 2. Non-diabetic		
Section III. reason for hospitalization and questions related to amputation				
3.1	What was the Reason for hospitalization?	1. Bone fracture 2. Chronic infection 3. Malignancy 4. Tissue injury 5. Dislocation 6. Bullet Injury 7. Diabetic foot ulcer 8. Others (specify)	Circle one or more answer(s)	
3.2	Major limb amputated?	1. Lower limb 2. Upper limb	Circle one	
3.3	If amputation was done, what type of operation was it?	1. Elective 2. Emergency		

3.4	What was the indication for amputation?	1. Trauma 2. Chronic infections 3. PVD 4. Malignancy 5. Others (specify)-----		
3.5	Which limb was amputated?	1. Unilateral upper limb 2. Bilateral upper limb 3. Unilateral Lower limb 4. Bilateral Lower limb 5. Combination		

3.6	What is the amputation level for any of the chosen limbs?	1. Fingers 2. Hand 3. Below elbow 4. Elbow disarticulation 5. Arm 6. Shoulder 7. Toes 8. Foot 9. Ankle disarticulation 10. Below knee 11. Knee disarticulation 12. Above knee 13. Hip 14. Others (Specify)		
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12. DECLARATION

Declaration of Investigator

I, the undersigned student of specialty in general surgery, declare that this thesis result is my original work, submitted in partial fulfillment of requirement for the specialty degree of general surgery, to the best of my knowledge.

Name of investigator: _____

Signature: _____

Date_____

Declaration of Advisors

We, the undersigned, hereby declare that we have carefully reviewed this thesis and we confirm that this thesis fulfills requirements with our approval as the university advisor(s). To the best of our knowledge, the work presented meets the academic standards and is ready in partial fulfillment of requirement for the specialty degree in general surgery.

1. Name of Primary Advisor : _____

Signature: _____

Date: _____

2. Name of Secondary Advisor : _____

Signature: _____

Date: _____

3. Name of Dep't Head: _____

Signature: _____

Date: _____

Examiners' Declaration

We, the undersigned examiners, hereby declare that we have thoroughly examined the thesis presented for partial fulfillment of requirement for the specialty degree of general surgery. After careful review and defense of the thesis, we confirm that it meets the academic standards and requirements of the university. We therefore approve the thesis and recommend that the candidate can be awarded the Specialty Degree in General Surgery.

Name of Examiner 1: _____

Signature: _____

Date: _____

Name of Examiner 2: _____

Signature: _____

Date: _____