



# Assessment of Causes of Amputation Through Five Years

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## ABSTRACT

**Aims** Amputation refers to removing a limb's defective or useless portion. Although it is an awful solution, amputation may be the only strategy that can save lives. This study was done to identify the causes of amputation and build a database for assessing healthcare.

**Instrument & Methods** This cross-sectional descriptive study, which excluded cases of congenital amputations, included all cases admitted to Ghazi Al-Hariri Hospital for surgical specialties in the center of the medical city of Baghdad from January 2016 to January 2021.

**Findings** A total of 19744 patients were hospitalized in the orthopedics and trauma department, with 12381 male patients (63%) and 7363 female patients (37%). Also, 748 cases (4% of all cases) had their limbs amputated, of whom 499 cases (67%) were male and 249 cases (33%) were female. For both sexes, the average age was 46 years. The average hospital stay was close to five days. Lower limbs made up 677 cases (91%). However, the difference between these sides was too tiny to be taken into account. Trauma affected 269 patients (36%), complications from diabetes mellitus were found in 232 patients (31%), peripheral vascular ischemia affected 205 patients (27%), malignant tumor cases affected 32 patients (4%), infection was found in only three patients (0.4%), COVID-19 and rheumatologic affected only two patients (0.26%), and burn and chronic ulcers that did not respond to treatment affected just one patient (0.13%).

**Conclusion** Male gender and younger ages were found with lower limb disease. Both sides were affected equally. COVID-19 may present as an ischemic limb.

**Keywords** Amputation; Arterial Occlusive Diseases; COVID-19; Diabetes mellitus; Vascular occlusive diseases

## CITATION LINKS

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## Introduction

In the United States, 185,000 people have amputations annually [1]. Amputation is a surgical procedure, in which we remove all, some, or sections of a limb to remove a hazardous or useless limb [2]. Amputation can occasionally happen due to trauma or injury sustained during combat or as a result of workplace dangers [3]. However, tumors and congenital abnormalities were less common causes of amputation in the United States than the consequences of diabetes mellitus and ischemia of peripheral artery disease [4].

Tumors and sarcomas are among the more uncommon causes of amputation [5]. Soft tissue sarcoma still calls for amputation. Even so, just 1% of all adult malignancies were sarcomas [6]. The precise reasons for the emergence of these sarcomas remain unknown. Some think that it may manifest as a hereditary disease with genetic roots. Some people have noticed a link between these sarcomas and radiation exposure [7]. These sarcomas can develop at any age, in any site- especially the lower limb [8]- and in any gender.

Some of these sarcomas exhibit peculiar behavior. For example, some of these tumors develop in a pseudo capsule, but some of these tumors can protrude beyond the capsule and others extend along the face plates in the same compartment. Lymphatic and lymph node spread is uncommon. The lungs are the most common site of metastasis. Staging the tumors was essential to deciding on a course of treatment based on all these behavioral factors.

Amputation is still an option in some circumstances, despite the significant advances in medical science addressing the treatment of sarcoma, such as chemotherapy, radiation, restricted surgical excisions, or limb-sparing surgery. After local excision, the recurrence rate is reduced by radical excision of the sarcoma. However, amputation still has the lowest recurrence rate. Numerous studies have been conducted to maintain the affected limb's functionality using a combination of therapies, such as radical excision combined with radiotherapy or chemotherapy, but the recurrence rate is still high and the survival rate has not changed.

Amputation indication criteria evolve according to all documented evidence currently available. One of these requirements is that amputation is performed in circumstances when a functionless limb could result from a radical excision or when a healthy margin could not be attained under a microscope. Amputation is also recommended when the neurovascular bundle is predominantly affected. Amputation rates for primary limb sarcoma and recurrent cases in all global centers have decreased, reaching 5% [9] and 9-14%, respectively [10].

The thromboembolic effects of COVID-19 can lead to amputation [11]. The first case of COVID-19 was discovered in China as a pneumonia-complicated

respiratory illness. The pathogen that caused this outbreak was discovered, and research was conducted to comprehend it. It turned out to be an enveloped RNA b-coronavirus [12]. This virus can affect the vascular system and cause hypercoagulopathy while also having the ability to influence the lower respiratory system and cause pneumonia [13]. There is still no clear explanation for the precise pathophysiology causing this hypercoagulopathy. Thromboembolic phenomena can result from this hypercoagulopathy's impact on the veins and arteries. In comparison to venous thrombosis, hypercoagulopathy with intra-arterial thrombosis is still only occasionally reported. Thrombosis in the arteries is riskier than thrombosis in the veins [11]. Rapid system failure, ischemia of the limbs, stroke, and death can result from arterial thrombosis. Low molecular weight heparin was used as an oral anticoagulant after an injectable anticoagulant for preventative therapy. Despite all these preventative steps, arterial thrombosis still happens, leading to limb ischemia, stroke, and death. Comparing 2020 to 2019, this limb ischemia increased [14]. This is due to the dread of contracting the illness, particularly when it becomes pandemic. Limb ischemia is characterized by resting pain, delayed healing of wounds or ulcers, and/or gangrene in one or both lower limbs. Although amputation is a life-saving treatment, the mortality rate is still very high.

Complicated rheumatoid arthritis may require amputation as a treatment [15]. Some rheumatological cases may be presented to the orthopedic department as situations requiring amputations. All these rheumatological conditions are defined by their chronic nature, extensive involvement of bone and soft tissues, and auto-immunological antibodies. The cause of these disorders is unknown and unexplained. The mechanism, by which amputation is suggested varies across rheumatological disorders; for instance, some of the indications for amputation may be due to functional issues and difficulties walking, particularly in rheumatoid arthritis of the foot. This challenge could be attributed to both metatarsalgia and deformity at the same time. Examples of these deformities include hallux valgus deformity or inflammation of the metatarsophalangeal joint with the erosion of the bones and inflammation of the soft tissue around the joint resulting in this deformity with the heads of the metatarsal bones pointing downward resulting in planter callosity and pain while the phalanges took the claw position resulting in corn at the proximal phalangeal joint. All of these malformations may cause discomfort and make it difficult to find shoes that fit. Some surgeons recommend restricted treatments, such as the removal of only the metatarsal heads, while some surgeons invented amputation through the metatarsal bone as a more

effective method of maintaining the foot's functionality [16]. Different mechanisms expose the patients to amputation in other rheumatological illnesses.

Amputation in systemic sclerosis patients may be brought on by microvascular occlusion. This microvascular blockage may result in digital ulcers, soft tissue infection, bone infection, and ultimately gangrened digits that necessitate amputation. Amputation may be a viable option due to other factors in the same group, such as skin sclerosis and joint contracture [17].

Vasculitis was another factor in amputations related to rheumatological disorders. There is a substantial link between systemic vasculitis, particularly in the small and medium-sized arteries, peripheral artery occlusive disorders, and diabetes mellitus [18].

Although it is uncommon, burns can result in amputation [20]. Despite the limited number of cases, 2% of all known occurrences of various causes needed an amputation following a burn. Amputation is nonetheless still advised as a life-saving option to avoid complications from severe burns, which might result in uncontrolled infection, septicemia, and death. Despite this important fact, rehabilitation is still required, adding to the social and financial consequences. Burns that require amputation can generally be divided into three categories. Ancient studies suggest that the majority of cases requiring amputation were due to thermal burns, while more recent studies disagree and find that electrical burns account for 68% of these cases [19-21]. The chemical burn was the third reported group. Chemical burns are a job hazard that can happen in workplaces and have a three-fold higher amputation rate than thermal burns [22].

This study was done to create a database to track changes in community health and develop a strategy to investigate reasons, regulate these causes, and stop the progression toward amputation.

### Instrument and Methods

This descriptive cross-sectional study was carried out at Ghazi Al Hariri Hospital for surgical specialties in Baghdad Medical City Center in June 2021. The cases were accepted between January 1, 2016, and January 1, 2021. Except for congenitally amputated cases, all hospitalized patients (both civil and military cases) who underwent amputation were included in this study. All lower and upper limb amputations were part of this study. Authorization was obtained from the Health Directory at Baghdad Medical City as well as the scientific committee in the College of Medicine at the University of Fallujah. In this study, "trauma" refers to all civilian and military cases that required amputation and were regarded as work-related accidents. As there is no accurate database of the patients' jobs, their occupations were excluded from this study.

Although this center was supposed to be a tertiary center, this study was limited by the fact that only one hospital provided the data; this would have prevented the results from accurately reflecting the true state of this treatment and its causes.

These data were gathered after receiving permission from the health directory and collected from the patient's files.

These surgeries (amputations) were carried out using the usual techniques outlined in any orthopedics and trauma textbook with some modifications based on the soft tissue's health or the degree of intact vascularity. All orthopedic surgeons at the hospital contributed to the data collection related to their patients. Traditional techniques for dismembering any site include the following derogatory points:

After examining the patient in the emergency room, and following an orthopedic surgeon's consultation, the decision was made regarding amputation. Consultation with a vascular surgeon to determine the level of amputation was the second step. The final step in the medical and legal phases of these treatments was setting the appointment and obtaining the patient's and his family's consent for the procedure. After consulting with three surgeons in three different departments, the treatment was carried out. General surgery, vascular, orthopedics, and trauma departments are some of these divisions. Following the permission process, the patient was prepared for surgery given his/her current condition. The patient was then allowed to enter the theater and sedated there. Then, it was time to wash, shave, mark the amputation surface using a marker (avoiding a tourniquet), and then paint with povidone-iodine. After that, the towels were spread over the desired area. Skin and soft tissues were cut following the chosen level. Ligation of a big or medium-sized artery was then done. The next phase was to cut the bone. Gauze back was used for hemostasis to avoid cauterization as much as possible. Depending on the surgeon's discretion, the wounds were then closed or left open for secondary suture.

This descriptive statistical analysis was carried out using SPSS version 20. The mean was used as the central tendency analytic variable in this study, and the percentile was used as the distribution analytic variable. The right-to-left and upper-to-lower ratios were also computed. Maximum and minimum values were determined to serve as the dispersion scale. The p-value was generated to demonstrate the relevance of the factors and the amputation.

### Findings

During the considered period, there were a total of 19,744 cases (100%) admitted to the hospital for surgical specialties, with 12,381 cases (63%) being male and 7,363 cases (37%) being female. Only 748 (4%) of these patients needed amputation when they

were admitted. These amputated cases also included 499 cases (67%) involving males and 249 cases (33%) involving females. There was a significant association between gender and amputation ( $p < 0.002$ ). The average age of all amputated cases was 46 years, with men and women having mean ages of roughly 43 and 50, respectively. There was a substantial correlation between age and amputation ( $p < 0.002$ ). The minimum age was determined to be three years old, and the maximum age was 19. For both sexes, the average length of stay in the hospital was around five days.

The estimated  $p$ -value for residency in a hospital for amputation equals  $p = 0.290$ , which revealed no significant correlation between hospital stay and amputation.

Also, 677 cases (91%) had affected lower limbs and 71 cases (9%) had affected upper limbs. There was no correlation between the affected limbs (upper or lower) ( $p = 0.765$ ). In all these cases, the right side of the body was affected in more than 393 cases (53%) compared to 355 cases (47%) on average. However, the area that was exposed to amputation changed every year. There was no association between the side and amputation ( $p < 0.179$ ).

The causes of amputations varied, with the highest rate for trauma (269, 36%), diabetes mellitus complications (232, 31%), peripheral vascular ischemia (205, 27%), malignant tumors (32, 4%), infections 3, 0.5%), rheumatologic disease and COVID-19 (2, 0.26%), and burns 1, 0.13%).

The causes of amputation were as follows:

A) Trauma: trauma was the leading cause of amputations: The lower limb to upper limb ratio in males was 5:1, which indicates that the lower limb was five times more traumatized than the upper limb. A ratio of 1:1 indicates equal impact on the right and left sides.

The lower limb was more severely injured in females, with a lower limb to upper limb ratio of 10:1. The right to left side ratio was 1:2.

With a male-to-female ratio of 1:1, the average length of stay in the hospital was four days. The average age of males and females was 32 years.

B) Diabetes mellitus was the second contributing factor.

With a lower limb to upper limb ratio of 38:1, the lower limb was more affected in males. With a right-to-left lower limb ratio of 2:1, the right side was more affected.

The lower limb was more affected by the lower limb to upper limb ratio of 11:1 in females. The ratio of 1:1 showed an identical impact on the right and left sides. Men and women were equally affected (1:1), with a ratio of lower/upper extremity involvement of 18:1 indicating affecting both sides equally.

On average, both sexes spent an equal amount of time in the hospital—about five days. Males were 56 years old on average, compared to 47 for females.

C) Vascular ischemia: Both sexes experienced the same ratio of vascular ischemia-related amputations (1:1), with equally affected sides.

In males, the lower limb was more affected than the upper limb (15:1), with both sides affected equally (1:1). The lower limb was more seriously injured in females with a ratio of (15:1) and both sides equally affected.

Both genders experienced an average of three days of hospitalization. Men and women aged 62 and 58 years old on average, respectively.

D) Oncological causes: Among the causes of amputation in this study, malignant tumors ranked fourth. However, both sexes rated the lower limb (4:1) as having the highest risk of amputation, affecting both sides equally. In males, both sides of the body were equally affected, with the lower limbs to upper limbs ratio of 9:1.

Women were more affected than men (2:1), with the lower limbs being more afflicted and the left side was more affected.

For both sexes, the typical length of stay in the hospital is four days, with male and female average ages of 32 and 19 years, respectively.

E) COVID-19: Sever cases of COVID-19 might manifest as a thrombo-embolic illness that affects the limbs. Only two cases of thrombo-embolic illness affecting both lower limbs in males were reported, with an average hospital stay of nine days with the current age of 57 years.

F) Chronic infections: Only three females have chronic infections, and only their lower limbs are affected (2:1) more on the right than on the left.

G) Rheumatoid arthritis: It affected the left lower limb of two women. With an average age of 33 years after presentation, the patients spent six days in the hospital.

H) Chronic ulcerations: Only one case of left lower extremity involvement was found that did not respond to treatment. He spent two days in the hospital and was roughly ten years old.

I) Burns: Only one female patient with burns required an amputation of her left upper limb; she was 11 years old and spent an average of two days in the hospital.

## Discussion

In this analysis, only 748 cases (4%) requiring amputation were reported. According to other studies, there is little data on the precise number of persons who require amputations [1]. According to our data, males (67%) accounted for the majority of amputations due to various reasons.

According to other research, there were almost twice as many male patients with amputations as female patients [2]. Both sexes were on average 46 years old, with men being on average 43 years old and women being on average 50 years old. Studies conducted in different medical centers showed that there is no age

preference and the risk of amputation increases with age [23].

According to this study, both sexes must spend five days in the hospital after having an amputation before they are ready to be discharged. Since hospital stays vary and are based on the patient's overall health, there are no studies that indicate how long patients must stay there. These results correspond with previous reports, and the lower limbs were more severely injured in this study, accounting for 677 cases (91%) [25]. Although the difference between the right and left sides was statistically insignificant, more than 393 people (53%) were found with the right side of the body involvement during these five years.

Different factors contributed to amputations, with trauma accounting for the highest percentage of cases (269, 36%). However, other investigations revealed that diabetes mellitus was the most common factor [25, 26], followed by peripheral vascular ischemia, trauma [25, 27], malignancy [25, 28], and other minor causes of amputation. The fact that trauma accounted for the largest percentage of cases in the current study is inconsistent with other national studies in which the situation differs due to distinct lifestyle factors.

In contrast to the present study, other research found that only 16% of admissions for amputation involved trauma, and 45% of all admissions involved amputation [29]. Males in the current study had a mean age of 32, while females had a mean age of 23 years. According to another research, people under the age of 45 are more susceptible to trauma as a cause of amputation [29]. The reason for this result is that most trauma as an occupational hazard occurs during a person's early productive years.

Unlike other studies on diabetes, male gender is considered a risk factor for amputation, while age, although the mean age of 60 years has been reported in other studies, is still not considered a risk factor [30]. This is because males may be more susceptible to injury in addition to a smoking habit, hyperglycemia, and its complications, which all make diabetics more susceptible to amputation, and diabetic patients have a 20-30 times higher risk of amputation than non-diabetic patients [31].

Regarding other research, the amputation rate as a result of vascular ischemia is still high at 25% and will rise to 35-67% in the following four years [32]. Other research, however, claimed that the amputation rate/hospital stay is modest and may only reach 13% in patients who are 70 years of age or older [33]. According to another research, a quarter of patients with limb ischemia require limb amputation [34].

According to studies, sarcoma accounts for only 1% of all admitted adult carcinoma cases, making it a rare cause of amputation. Sarcoma can cause amputation at any age, mostly in adults, at any place, but more frequently in the lower limbs [8]. Amputation rates in

oncological hospitals range from 5% for initial tumors to 9% to 14% for recurrent masses [10].

Although there was only one case of COVID-19 reported in the current investigation, other studies have shown that the amputation rate was 18% of all hospitalized patients, with a mean age of more than 65 years, a male predominance of 76%, and lower limb involvement of 71% [15]. When a patient has acute lower limb ischemia with COVID-19, his/her risk of morbidity and mortality rises to 50%, compared to 5-9% in non-COVID-19 patients [35].

According to our results, infectious causes of amputation were too few to be quantified. Several studies [36] explain why amputations occur in cases of infection, acute or chronic osteomyelitis of the foot, ulceration, or infection after surgery.

The prevalence of rheumatoid arthritis in the United States ranges from 0.5% to 0.8%, with a peak age between 65 and 69 [37]. Systemic vacuities, with an incidence ranging from 7% to 29%, are the most frequent reason for amputation in rheumatoid arthritis [38].

Several studies have described persistent wounds with various pathologies that require amputation as a form of treatment, such as malignant tumors with diverse anatomical locations including skin, other soft tissues, or bone cancer [39]. Diabetes mellitus, ischemic ulcers, and neuropathic ulcers develop infections.

In contrast to previous studies, only 32% of burn cases in the Philippines had electrical burns, indicating that thermal burns were more common [40]. Males with electrical burns and upper limb involvement are more likely to need an amputation [41].

Since only one medical center was involved, relatively few patients requiring amputation were recorded, which is one of the limitations of our study.

## Conclusion

Amputations were most frequently caused by trauma. While the other reasons still occur in the same order as in the previous research. The discovery in the study's COVID-19 patients— ischaemic limbs requiring amputation—is breaking news. The risk of amputation can be decreased by improving healthcare through patient education, group therapy for patients, and an increased understanding of the origins and etiologies of diseases.

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