



# Long-Term Psychosocial and Functional Outcomes of Limb Salvage Surgery Versus Amputation: A Review Article



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## Abstract

Osteosarcoma is the most common form of malignant bone cancer. Patients with lower extremity musculoskeletal tumors are candidates for either amputation or limb-salvage surgery. Traditionally, limb salvage surgery with neoadjuvant chemotherapy has been the preferred surgical method for localized carcinoma. Amputation is frequently reserved for cases with possible metastasis or increased tumor size. Our study aims to review the functional and psychosocial outcomes between amputation and limb-salvage surgery to achieve a better patient-centered result.

**Keywords:** Psychosocial outcomes, Malignant neoplasm, Conventional osteosarcomas, Secondary sarcomas, Li-Fraumeni syndrome, proximal humerus, Surgery, Limb-salvage surgery, Amputation

## Introduction & Background

Osteosarcoma, also known as osteogenic sarcoma, is a form of malignant neoplasm. It is the most common type of bone cancer, with an incidence rate of 1.7 per million per year [1,2]. There are three groups of conventional osteosarcomas: osteoblastic osteosarcoma, fibroblastic osteosarcoma, and chondroblast osteosarcoma. Other variants include small cell, telangiectatic, multifocal, and malignant fibrous histiocytoma, just to name a few. Osteosarcoma follows a bimodal distribution model, with the first peak in the second decade of life and the second peak in the seventh or eighth decade of life [3,4]. Typically, osteosarcoma is a primary neoplasm in adolescence and a secondary neoplasm in older adults from Paget's disease, secondary sarcomas, bone infarcts, or bone lesions [3]. Although there are identified predisposing risk factors, usually, cases of osteosarcoma are sporadic [1,5]. Some of these risk factors include, but are not limited to, prior irradiation/chemotherapy, other bone lesions, inherited retinoblastoma, Li-Fraumeni syndrome, Rothmund-Thomson syndrome, and most importantly in a discussion of adolescence, bone growth issues [1]. There is no definite translocation for osteosarcoma, unlike other bone tumors. Osteosarcoma presents with an insidious onset over a few months with localized pain that waxes and wanes [5]. While the distal femur is usually the most affected site, other bones can also be involved such as the proximal tibia, proximal humerus, middle and proximal femur, and pelvis [3,4]. Once clinical suspicion arises for osteosarcoma in patients, a thorough staging workup must be completed with imaging, biopsy,

and histological classification. In patients with non-metastatic osteosarcoma, chemotherapy with resection, via amputation or limb-salvage surgery is usually the standard treatment of choice among surgeons [1]. Chemotherapy can be used as a neoadjuvant or adjuvant to surgical intervention. Survival rates are statistically similar between the two options [6]. With chemotherapy's success, survival rates have increased, and more patients have been determined to be suitable candidates for the adjuvant surgical intervention, whether that be amputation or limb salvage [6]. Limb salvage surgery is the favored surgical option, especially when wide local excision is attainable [3]. Surgeons commonly use the Enneking surgical system to determine how much bone should be removed [3,4]. However, limb salvage surgery does come with limitations, such as patient-centered goals or metastasis. Lower limb amputations typically take the approach of above-knee amputation or below-knee amputation, which each can be further subdivided. This review paper is an update of previous literature on this topic and will discuss surgical techniques such as limb-salvage and amputation. Subsequently, they will be compared to the functional and psychosocial outcomes of patients.

## Methods

The scientific literature was reviewed to give an overview on the functional and psychosocial effects between amputation and limb-salvage surgery. Articles published in the English language, without geographic limitations, between 2010 and 2021 were

retrieved from databases including Journal of Bone Oncology, Prosthetics and Orthotics International, Pediatric Bone Cancer, Science Direct, and PubMed. The search excluded predatory publishers and predatory journals. Studies that were included in the review were those on limb salvage surgery and lower limb amputation. The search methodology was as follows: First, the word “amputation” “limb salvage surgery” was searched for, and then articles were narrowed down by going into the advanced search and typing AND “psychosocial outcomes,” “functional outcomes.” Second, articles were sorted out by relevance; the reference list of identified articles was analyzed to create a list of 18 articles used for the review.

Inclusion criteria were the following:

- i) Must be a scholarly or peer-reviewed source,
- ii) ii) a relevant article published after 2010,
- iii) iii) articles published in the English language only,
- iv) v) related to functional and psychosocial outcomes of amputation and/ or limb salvage surgery,
- v) studies on participants regardless the age, ethnicity, and gender. Exclusion criteria were the following:
  - vi) Publications potentially used for marketing purposes,
  - vii) Articles in foreign languages,
  - viii) Articles dated prior to 2010.

## Results

### Limb-salvage Technique

In a study comprising of 360 patients with osteosarcomas conducted by Reddy et al. patients who underwent limb-salvage surgery, where reported to have the best survival rate: 46.2% (71 patients) for five years and 41.3% (51 patients) for ten years. In the same study, 52 patients (14.4%) that had limb-salvage surgery were noted to have developed recurrent osteosarcoma. A study performed by Henderson et al. involved 527 patients who presented with femoral primary bone tumors and metastases, noted that 20 patients had postoperative instability after 35 days [7]. Thus, the majority of patients have normal function with proper physiotherapy. Although this paper will not detail the following, other methods can also be used; such as autograft bone reconstruction and Soft tissue reconstruction [8]. By carefully maintaining soft tissue quality, quantity, and neurovascular supplies, patients may have a better lifestyle. Limb sparing is essential, especially in children and adolescents who still have a functioning growth plate and have not achieved their final height. It is possible to attain limb-salvage surgery by preserving the bone's growing center using the Van Ness rotationplasty [9]. Usual complications include infection and failure of the mechanical prosthesis and local tumor recurrence.

### Amputation Technique

According to Reddy et al. in their study, it was found that patients who underwent amputation had a lower five- and ten-year survival rate (36.3% and 31.8%, respectively). The study concluded limb salvage surgery with marginal margins had better overall survival; alternatively, amputation had no overall recurrences [10].

### Psychological factors

Psychosocial and functional outcomes following a diagnosis and treatment for cancer can be a significant adjustment for the patient and caregivers. Although research in this area is scarce, it is evident that the limb's functionality, regardless of limb salvage surgery or amputation, plays a prominent role in individuals' psychological well-being [11]. As more patients are becoming long-term survivors, especially pediatric patients, it is becoming even more critical to assess the quality of life between each surgical procedure. Amputations are the gold standard of surgical intervention for patients with limb-salvage contra-indications or risk of local recurrence. Surgical procedures, such as amputations, significantly impact an individual's quality of life and mental health. Yonemoto et al. concluded there was an increase in post-traumatic stress symptoms, ironically it was reported more in the parents of patients with osteosarcoma than in the patients themselves [12]. Limb loss plays a vital role in socio-economic and psychological effects on patients and their relatives, especially in developing countries, due to the shortage or unavailability of proper prostheses. Solooki et al. revealed that patients who underwent limb-salvage surgery or amputation for osteosarcomas had similar functional and socioeconomic outcomes [13]. These outcomes are further explained by Silva et al. who discussed that although there is an advancement in cancer therapy, many patients have difficulty returning to their respective careers and social life. These new obstacles were cited in the study as financial and emotional points of view. Many of these financial difficulties were due to the patient being the sole primary source of income [14]. A study conducted by Srivastava et al. discussed that patients who underwent amputations had decreased self-esteem, distorted body image, and increased dependency [15]. Furthermore, the study refers to another study by Parker et al. suggesting that in the first year following surgical amputation, 25 percent of amputees suffer from depression, insecurity, and self-consciousness. Patients also reported an un-relentless fear of the disease returning, which also played on the psyche of the patient's future and goals [16].

### Functional Outcomes

To assess functional outcomes between the two groups, two different subjective questionnaires were evaluated in our research, Toronto Extremity Salvage Score (TESS) and Musculoskeletal Tumor Society (MSTS). Using our methods

mentioned above, we have noted a few differences in assessing functional outcomes between the two. We have focused on lower limb surgical procedures as it relates to the practical outcomes. There has been much debate on whether amputation or limb salvage surgery would have a better functional result. In [17], quality of life was also assessed via the amount of lower limb function each patient had post-operation. The more functional the limb was post-surgery, ultimately resulting in a positive body image, leading to the correlation of functional and emotional well-being outcome [17,18]. Differences in initiating ambulation were noted in [19]. As amputation patients were not allowed full weight-bearing abilities until the wound was fully healed, whereas, in limb salvage, patients' weight-bearing activities could have commenced immediately depending on how much bone was resected [19, 20] followed patients in a cohort study for a 20-year follow-up and found patients adjusted relatively well to their surgical procedures and remained productive. In all studies, TESS and MSTs results were found to be equivalent.

## Discussion

The goal of limb-salvaging techniques is to preserve the affected limb's function by keeping adequate limb length and soft tissue quantity and quality. Thus, avoiding any psychosocial problems and ultimately preserving the patient's autonomy. Compared to amputations, limb-salvage techniques are known to have narrower surgical margins. Still, they have an increased local failure and local recurrence [10,21]. Limb salvage consists of en bloc resection using margins of bone that are 3 cm. Neurovascular tissues are separated and protected, and the surrounding tissue is inspected for tumor invasion. If an invasion of neighboring tissue is noted, the tissue is excised [8]. Residual joints and limbs, after that, undergo reconstruction surgery. Limb reconstruction is essential in all individuals undergoing limb salvaging procedures to preserve cosmetic appearance. For patients affected by proximal femoral tumors, tumor endoprosthesis is the most common limb reconstruction technique in adolescents and adults. It consists of inserting a custom prosthesis in the residual joints and maintaining proper limb length, function and preventing any abnormal cosmetic appearances. In recent years, amputation is the final choice of therapy in people with osteosarcomas. Tumor size, neurovascular invasion or involvement of neighboring structures, and increased malignancy are common denominators that result in complete amputation. Many surgical methods are used to aid in patient post-surgical care and rehabilitation by an external prosthesis. The risk for local recurrences is less than 5 percent [21]. Although studies show that neither limb-sparing techniques nor amputation has a difference in increasing survival rate or patient prognosis, limb-sparing techniques are most commonly used due to the psychosocial benefits. However, it is essential to consider a higher risk of recurrence in limb-salvaging procedures than amputation [10].

## Conclusion

Throughout the study, we discussed the surgical treatment options for individuals with osteosarcomas. We assessed the benefits of limb-salvage surgery versus amputation in terms of patient-centered outcomes like psychosocial and function benefits due to their essential correlation with the surgical treatments. Patients who undergo surgical procedures for osteosarcoma preferred having limb-sparing operations due to their more favorable cosmetic appearances. However, no actual significant difference was found between the psychosocial benefits or the patients' functional outcomes. Advancements in utilizing a variety of materials for reconstruction, remodeling, and recovery in surgical patients with osteosarcoma, leads patients to undergo limb-reconstruction surgery. We believe that limb-salvage surgeries may be applied in various surgical areas so that patients can benefit from it and maintain a favorable psychosocial and functional outcome and autonomy. Further research and cohort studies should be conducted to evaluate the impact on psychosocial and functional outcomes with other surgical procedures, along with a larger sample size.

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