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Pediatric lower extremity sarcoma reconstruction: A review of limb salvage procedures and outcomes☆

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Review

Summary *Background:* In recent years, dramatic advances in the multidisciplinary treatment of pediatric sarcoma have resulted in significant improvement in the long-term survival of the patient. Thus, following tumor resection, significant effort has gone into limb salvage and improving functional outcomes. Plastic surgeons, in conjunction with orthopedic surgeons, are using techniques in microvascular free-tissue transfer and rotational flap surgery to preserve limb length. This study presents a review of the current reconstructive strategies and the oncologic, surgical, and functional outcomes in this population.
Methods: Using the Pubmed and Cochrane Library databases, studies describing lower extremity plastic surgical reconstruction were identified following pediatric lower extremity sarcoma resection. This study included those studies which described reconstructive techniques, oncologic and functional outcomes, and surgical complications.
Results: A total of nine articles were identified, yielding 96 pediatric patients. The most common procedures performed were free fibular flaps (53 patients) followed by pedicled muscle flaps (31 patients). A total of 72 of 96 patients (75%) achieved independent ambulation, and an additional 19 patients (20%) ambulated with assistance. There were only three (3%) amputations. A total of 13 patients died from metastatic disease (14%).
Conclusions: Plastic surgery procedures play an increasingly important role in pediatric lower extremity sarcoma reconstruction and functional limb salvage. Published series are limited in number and case volume; to date, no systematic review has been published. The existing data

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emphasize the role of microvascular free-fibula transfer as well as local muscle flap coverage in preserving limb length and function, with minimal risk of local recurrence and need for amputation.

Introduction

Over the past 30 years, improved chemotherapy regimens have dramatically improved long-term survival of pediatric sarcoma patients. With the improved survival rates, significant effort has gone into limb salvage instead of amputation. In conjunction with orthopedic oncologists, plastic surgeons are using techniques in microvascular free-tissue transfer and rotational flaps to preserve limb length and function. Unlike adults, children have immature skeletons, and thus reconstructive efforts must address their vigorous functional demands and the potential for limb-length inequality as they continue to grow and develop.

Options for achieving local tumor control include primary amputation, rotationplasty — a type of autograft wherein a portion of a limb is removed, while the remaining limb below the involved portion is rotated and reattached — and other limb salvage techniques. There is debate over which technique provides the best oncologic outcomes. There are no prospective randomized controlled studies to date demonstrating improved oncologic safety of amputation in comparison to limb salvage.[1–6] However, retrospective studies show no difference in overall or disease-free survival between limb salvage and amputation.[7]

Although there are certain characteristics which make patients better candidates for limb salvage, such as distal tumor location and limited disease extent,[3] the final decision made between the orthopedic surgeon, reconstructive surgeon, oncologist, patient, and family to pursue limb salvage is complex. The type of tissue lost is one of the most important variables out of several choices including the availability and size of transferrable local tissue, vascular inflow, and the elected method of bony reconstruction. The aim of this study is to present a review of the current reconstructive strategies for limb salvage, as well as evaluate the oncologic, surgical, and functional outcomes in this population.

Materials and methods

Literature search

The focus of this study is to identify literature that details outcomes for plastic surgical reconstruction of pediatric lower extremity sarcoma. Published studies were identified using the Pubmed and Cochrane Library databases. Search terms used alone and in combination included the following: "pediatric," "lower extremity," "sarcoma," "reconstruction," "limb salvage," "cancer," "tibia," and "tumor." Two of the authors conducted the initial study selecting studies that described reconstructive techniques, oncologic and functional outcomes, and surgical complications in the pediatric population. To find additional articles, the references of selected articles were reviewed.

After identifying 373 articles based on these search terms, titles were reviewed to target 114 abstracts for further evaluation. Abstracts were read to isolate studies that involved only pediatric patients (19 years or younger) who underwent reconstructive plastic surgery procedures following lower extremity sarcoma resection. Although skeletal maturity for boys and girls is 16 and 14 years,[10] respectively, the age range was extended and included in this study so as to have a larger number of patients.[8,9] This yielded 16 papers for review. Papers were then excluded for the following reasons: (1) failure to delineate between outcomes of upper and lower extremity reconstruction, (2) reconstruction not involving the care of plastic and reconstructive surgeons, (3) failure to address functional status, (4) incomplete presentation of postoperative complications, and (5) inadequate follow-up. Incomplete presentation of postoperative complications meant the article only stated overall complication rates, but did not describe the actual complications. Inadequate follow-up was defined as a mean follow-up of <1 year. Of the initial 16 papers reviewed, seven were excluded, which left nine studies to be included in this review (See Figure 1).

Results

A total of nine articles were reviewed, yielding 96 total patients. Two were case reports, and the remaining seven

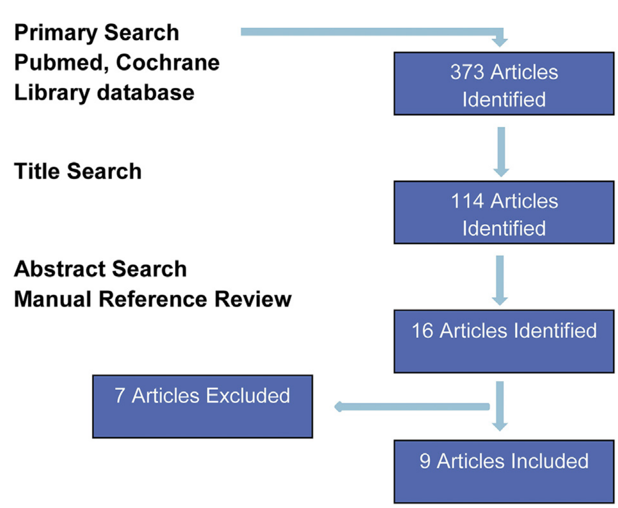

Figure 1 Study attrition diagram.