

RESEARCH ARTICLE

Short Term Complications and Functional Results of Sarcoma Limb Salvage Surgeries

Mohammad Gharehdaghi, MD; Mohammad Hassani, MD; Ali Parsa, MD; Farzad Omidikashani, MD; Lida Jarrahi, MD; Rahim Hosseini, MD

Research performed at Mashhad University of Medical Sciences, Mashhad, Iran

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Abstract

Background: Limb salvaging surgeries are current surgical treatment of extremity bone sarcomas. Resected bone replacement consists of two main methods; tumor prosthesis versus structural allograft. Biological reconstruction with an allograft is an economic cheap method in young sarcoma patients, however, the surgeons are more convinced with tumor prosthesis replacement.

Methods: We evaluated the short-term complications and functional results of 40 patients with aggressive extremity tumors in a retrospective cohort study. The mean age of cases was 25 and we followed them for 24 months. 17 patients underwent tumor prosthesis replacement after wide resection of limb sarcomas. 16 cases had structural allograft reconstruction and 7 patients treated with amputation. We matched confounders including age, sex, blood cell count and chemotherapy treatment in the study groups.

Results: We found 15 major complications (45.5%) in limb salvage surgeries composing infection, allograft nonunion, allograft fracture, prosthesis fracture, prosthesis loosening and device failure that needed another surgery to be resolved. We had 10 major complications in allograft group (62%) and 5 in tumor prosthesis group (29.4%). Although the rate of complications was higher in allograft group, it didn't statistically indicate strong correlation (Fisher's exact: 0.084). Mean Musculo-Skeletal tumor rating Scale (MSTS) score was 25.8(73.7%) and 22.3(63.7%) in allograft group and prosthesis cases respectively. MSTS score had a normal distribution in the different groups with no significant difference between them.

Conclusion: Although complications were higher in the allograft group, allograft could be offered to bone sarcoma patients, whom are predicted to have short life expectancy.

Level of evidence: III

Keywords: Allograft, Limb salvage, Sarcoma, Tumor prosthesis

Introduction

Sarcomas are mesenchymal cell malignancies which account for about 1% of all malignancies in adults with the proportion of 0.2% for bone sarcomas. The

annual incidence of bone sarcomas is about 8 cases per million (1).

Until the 1970s, amputation was the main treatment

Corresponding Author: Mohammad Hassani, Department of Orthopedic Surgery, Orthopedic Research Centre, Mashhad University of Medical Sciences (MUMS), Mashhad, Iran
Email: hasanim@mums.ac.ir



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of limb sarcomas but after publishing an article in 1980 reporting the results of limb salvaging surgeries (LSS) in 104 patients, the tendency to limb preservation after tumor resection increased gradually (2).

Increasing knowledge and skills in tumor surgery in addition to the development of chemotherapy and radiotherapy methods, as well as improved imaging techniques especially magnetic resonance imaging (MRI), altogether resulted in escalating the number and quality of LSS for limb sarcomas (3).

Due to these advances, many of definite contraindications for limb salvaging surgery including pathologic fractures and neurovascular bundle involvements are now considered as relative contraindications (4).

Although limb salvaging surgeries are more time-consuming and costly than amputations and they are also associated with more complications, in most studies the function and satisfaction of patients in the limb preserving groups are much higher compared to those in the amputation group (5).

There are various reconstructive methods that can be used after resecting the involved bone.

These methods are grouped into two main categories: reconstruction of the bone with a structural allograft; or replacement of the bone with a tumor prosthesis (6).

Each of these two methods has their own advantages and disadvantages which lead the tumor surgeons to choose one based on the patient's age, tumor location, type of limb involvement and cost consideration.

The aim of this study was to compare the short-term complications and functional results of these two main methods in the first two years after the limb salvaging surgery.

Materials and Methods

40 patients, 35 of whom had high-grade sarcomas, 3 had low-grade sarcomas, and 2 had benign aggressive tumors, all were evaluated in a retrospective cohort study. These patients were divided into three groups:

1. LSS by replacing the bone with tumor prosthesis (17 patients);
2. LSS by replacing the bone with allograft (16 patients);
3. Amputation (7 patients).

In all three groups, tumors were removed by two sarcoma surgeons from Mashhad University of Medical Sciences and we used wide-margin resection method. Patients were evaluated for post-operative complications requiring surgical intervention and also their function in the first two years after the first surgery.

Patients were monitored for WBC, Lymphocyte and Platelet counts. Hemoglobin and Alkaline phosphatase levels were also evaluated. Fresh frozen Gamma-ray-sterile allograft was used in allograft group. In this retrospective cohort study, all three groups were matched in terms of patient's sex, age, familial history, serum evaluations and risk factors like smoking. To evaluate the relationship between the rate of complications and the type of surgical procedure Fisher's exact test was used.

The surgical functional results of the patients in this study was assessed by MSTs 87 (Musculo-Skeletal tumor rating Scale) Questionnaire. It is a health-provider

assessment method for evaluating outcomes of limb sarcoma surgeries. MSTs evaluates the following 7 components: Pain; Range of motion; Strength; Stability; General functional ability; Emotional acceptance; and Deformity.

Results

The age of patients was between 7 and 62 years with an average of 25. 4 patients had a familial history of malignancies and 4 patients had a history of smoking. Distal femur was the most common site of tumor involvement (50% of cases) and accordingly knee pain was the most common symptom (55%). The final diagnosis of 31 patients was Osteosarcoma (77.5%); 3 patients had Ewing sarcoma; And 2 patients were diagnosed with Chondrosarcoma. In 2 patients, final pathologic evaluation of the tumor (after the surgical removal) did not match the preoperative biopsy report. 30 patients received neo-adjuvant chemotherapy with a mean of 4 courses prior to their surgery, and 21 patients received adjuvant chemotherapy with a mean of 3 courses postoperatively.

In the first 24 months after the surgery, out of the whole 40 cases, 17 had severe complications (42%) requiring secondary surgical intervention to control the complications.

These complications comprised infection, allograft non-union, allograft fracture, prosthesis fracture, prosthesis loosening, and device failure [Figure 1-3].

Ten patients suffered minor complications such as



Figure 1. Distal femur allograft non-union.

shortness of the limb, reduced joint range of motion, pain, and neutropenia [Tables 1; 2].

In allograft group, 10 patients had major complications (62%) while the rate of major complications in prosthesis and amputation groups was 5 patients (29.4%) and 2 patients (28.5%) respectively. The total incidence of major complications in limb salvaging group was 45.5%. Despite the higher incidence of complications in allograft group, by using Fisher's statistical analysis, we found no significant correlation

between using allograft and complications (Fisher's exact: 0.084) [Table 3].

From the viewpoint of MSTs score, the mean score of allograft group was 25.8 (73.7%) and the mean of prosthesis group was 22.3 (63.7%).

Although the MSTs score in two limb salvaging groups followed a normal distribution pattern, there was no statistically meaningful correlation between the mean MSTs score and the selected reconstruction method [Figure 4; 5].



Figure 2. Tumor prosthesis Loosening.



Figure 3. Allograft fixation-device failure.

Table 1. Short-term complications in the allograft group

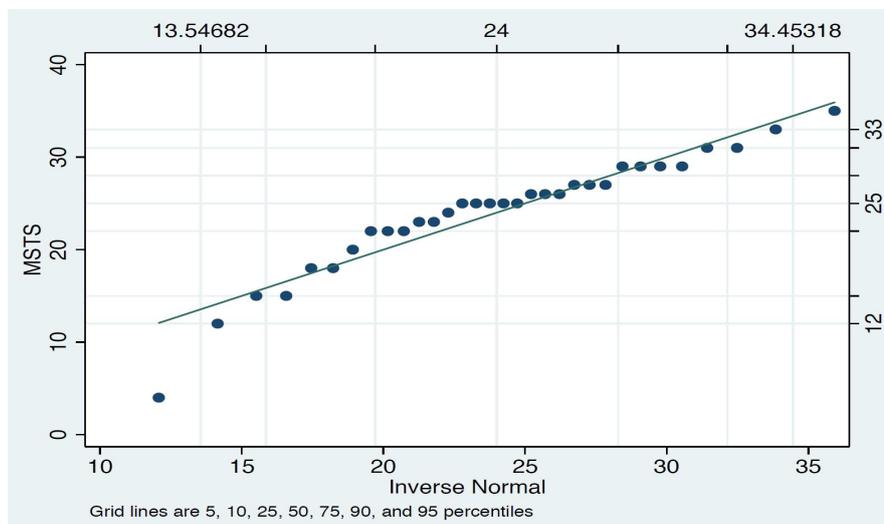
Case Number	Pathology	Complication
1	Osteoblastic Osteosarcoma	NO (mild pain)
2	Spindle Cell Sarcoma	LLD
3	Osteosarcoma	Local Recurrence
4	Osteosarcoma	Allograft Fx + non-union
5	Low Grade Osteosarcoma	Device failure
6	Ewing Sarcoma	LLD 1.5cm
7	Ewing Sarcoma	Non-union
8	Brown Tumor	Non-union
9	Osteosarcoma	Infection
10	Osteosarcoma	Allograft Fx
11	Osteosarcoma	LLD 5cm + device failure

Table 1. Continued

12	Osteosarcoma	NO
13	Osteosarcoma of Distal Tibia	Non-union
14	Chondrosarcoma	NO
15	Osteosarcoma (telangiectatic)	Non-union
16	Ewing Sarcoma	NO

Table 2. Short-term complications in the tumor prosthesis group

Case number	Pathology	Complication
1	Osteosarcoma	neutropenia
2	Small round cell tumor	No
3	Osteosarcoma	Loosening
4	Low Grade osteosarcoma	LLD+ loosening+ Ext lag
5	Paraosteal osteosarcoma	Decrease ROM +infection
6	Osteosarcoma	Decrease ROM
7	Osteosarcoma	Prosthesis locker Fx
8	Osteosarcoma	Mild pain
9	Osteosarcoma	No
10	Osteosarcoma	No
11	Osteosarcoma	Prosthesis locker Fx
12	Osteosarcoma	Decrease ROM
13	Osteosarcoma	No
14	Osteosarcoma	Decrease ROM
15	Osteosarcoma	Decrease ROM
16	Osteosarcoma </td <td>No</td>	No
17	Chondrosarcoma	No

**Figure 4. Normal distribution of MSTS score in the salvaging groups.**

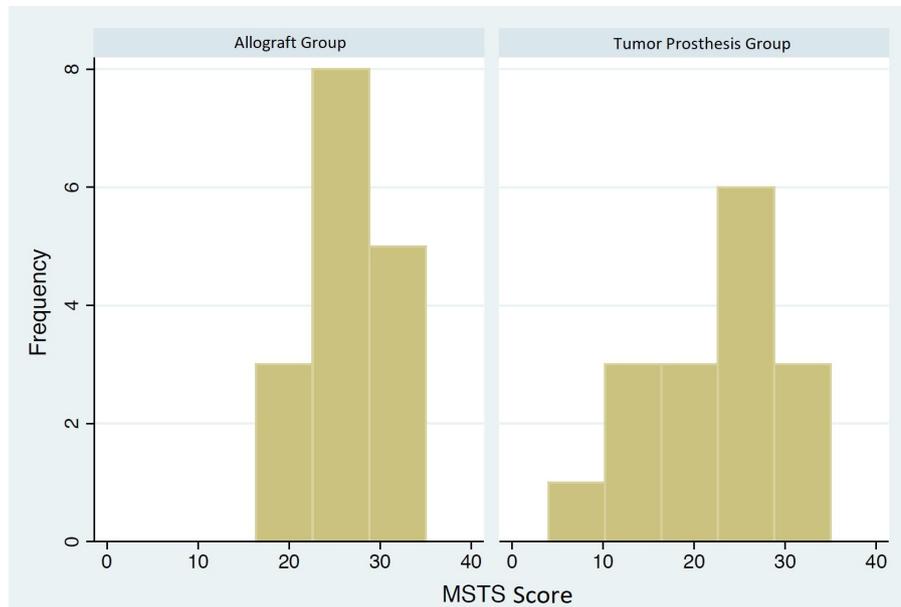


Figure 5. MSTS-score distribution in allograft (1) and prosthesis (2) groups.

Discussion

Patients with bone sarcomas are mostly young people with a mean age of 25.8 years in our study. These patients are in the most active period of their lives in terms of social and personal function. Therefore, treatment in these patients focuses on a goal beside tumor removal: Using a method with minimal cost and surgical complications in addition to helping these patients to achieve the maximum function.

In recent studies in order to review the treatment outcomes, factors such as disease recurrence, the limb's function, the patient's function and his quality of life were evaluated (7,8). In current study we evaluated the incidence of short term postoperative major complications requiring secondary surgical interventions and the patients' functional results.

It has been shown that there is not necessarily a relationship between the operation method and the patient's quality of life, but there is a significant relation between the patient's function and his quality of life (9).

There are several questionnaires like MSTS and TESS that are available for evaluating the surgical outcomes after sarcoma treatment. Additionally, there are common measures like SF-36 and EQ-5D for assessing the quality of life of patients (10). We assessed our patients' outcome with MSTS-87 which is a health-provider measure. We found no significant difference in a 24-month evaluation of the patient's function who undergone limb salvaging surgeries with either tumor prosthesis or allograft replacement method. This finding suggested that the short-term results of the allograft replacement are comparable with the prosthesis replacement.

Another considerable issue in our study was the incidence of major complications in 24 months after

the surgery with the total incidence of 45.5% in limb salvaging group which was higher than the amputation group (28.5%).

Although Mavrogenis et. all reported the same rate of complications in the both amputation and limb salvaging groups, patient's satisfaction and general function in most studies outweigh in the limb salvaging group (11, 12).

Another subject in our study was the greater rate of major complications in the allograft group (62%) in comparison to the prosthesis group (29.4%). However, this was not a significant difference by using the Fisher's test which can be due to the small number of participants in our study.

Recently, there is an increasing tendency among tumor surgeons for using tumor prosthesis in most specialized centers for treatment of sarcomas, however, allograft usage in the form of structural osteochondral graft or composite form (APC) is still the preferred treatment method of some surgeons especially in younger patients and in those with specific anatomical locations (13-15).

Another advantage of allograft replacement is the lower cost of this method compared to tumor prosthesis (16) that leads this method to be selective in some public health systems like Iran's (17).

A topic that should be highlighted in this study was the use of gamma ray for sterilizing the allografts which increases the risk of non-union. In our study, 4 of the 20 patients (25%) in the allograft group presented with complication of non-union in a 2-year follow-up that could probably be decreased with a change in the sterilization method.

One limitation of our study was the low number of

total patients which could be due to the low incidence of bone sarcomas in the community. A solution is to design multi-centered studies that can improve the accuracy of the results and the validity of the study. Another limitation was our tool for outcome measure. MSTs is not a PRO (Patient Reported Outcome) measure and does not necessarily reflect the quality of patients' lives which could introduce a bias. Adding a patient-reported outcome measure (PRO) for estimating the patients' quality of life (QOL) to these kinds of studies, is something we are going to consider in future which can be a great help in evaluating the effects of the treatment method on quality of patient's lives.

Short-term complications of limb salvaging surgeries in patients with limb sarcomas are high (45% of our patients needed a secondary procedure to control the complications). There was no significant difference in complication rate between the two methods of limb salvaging surgery using allograft or tumor prosthesis in short-term follow-up.

Furthermore, MSTs evaluation of the functional outcome of the patients who undergone these two methods of surgery did not show a significant difference.

Therefore, considering the lower cost of using allograft, allograft could be offered to bone sarcoma patients, whom are predicted to have short life expectancy.

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Mohammad Gharehdaghi MD

Ali Parsa MD

Farzad Omidikashani MD

Orthopedic Research Center, Mashhad University of Medical Sciences (MUMS), Mashhad, Iran

Mohammad Hassani MD

Department of Orthopedic Surgery, Orthopedic Research Centre, Mashhad University of Medical Sciences (MUMS), Mashhad, Iran

Lida Jarrahi MD

Mashhad University of Medical Sciences (MUMS), Mashhad, Iran

Rahim Hosseini MD

Department of Orthopedic Surgery, Imamreza Hospital, Mashhad University of Medical Sciences, Mashhad, Iran

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