Modular Tumor Resection Prosthesis in Osteosarcoma Treatment

Osteosarkom Tedavisinde Modüler Tümör Rezeksiyon Protezi

Osteosarcoma and Prosthesis

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Özet

Amaç: Osteosarkom nedeniyle tümör rezeksiyon protezi uygulanan olguların değerlendirilmesi amaçlandı. Gereç ve Yöntem: Kliniğimizde 2000 ile 2012 yılları arasında Osteosarkom nedeniyle tümör rezeksiyon protezi uygulanan ve yeterli takipleri olan 14 olgu değerlendirildi. Olgular cinsiyet, yaş, yön, tümör yerleşimi, takip süresi, tedavi başarısı, komplikasyon, nüks ve sağkalım açısından incelendi. Elde edilen veriler SPSS 15.0 programına aktarılarak analiz edildi. Verilerin normal dağılıma uygunluğu Shapiro-Wilk testi ile değerlendirildi. Bulgular: 14 olgunun 8'i erkek, 6'sı kadın ve ortalama yaş 21.9±7.02 idi. Osteosarkom 9 (%64.3) hastada femur distalinde, 5 (%35.7) hastada tibia proksimalinde, 5 hastada sağ ve 9 hastada sol alt ekstremitede idi. Ortalama takip süresi 33 (dağılım, 3-144) ay idi. Ortalama MSTS skoru 81.9 (dağılım, 53-96) hesaplandı, 11 hastada (%78.6) mükemmel, 3 hastada (%21.4) yetersiz sonuç elde edildi. Komplikasyon olarak 3 olguda aseptik gevşeme, 2 olguda peroneal sinir felci, 2 olguda cilt nekrozu, 2 olguda periprostatik kırık, 1 olguda protez enfeksiyonu ve 1 olguda lokal nüks gözlendi. Peroneal sinir felci olan 2 olgu dısında komplikasyonlar sorunsuz iyileşti. Lokal nüks gelişen hasta akciğer metastazı nedeniyle kaybedildi. Tartışma: Osteosarkomun tümör rezeksiyon protezi ile tedavisi, uzun dönemde protezin sağkalımını etkileyecek olan olası komplikasyonlar nedeniyle kullanımında soru işareti yaratmaktadır. Ancak stabilite, erken yük verme ve osteosentez kaygısından uzak olması nedeniyle avantajlı ve amputasyona kıyasla psikolojik olarak yüz güldürücüdür.

Anahtar Kelimeler

Osteosarkom; Cerrahi Tedavi; Tümör Rezeksiyon Protezi; Sonuç

Abstract

Aim: The aim of the study is to evaluate the cases who underwent tumor resection prosthesis due to osteosarcoma. Material and Method: 14 cases who underwent tumor resection prosthesis due to osteosarcoma in our clinic between 2000 and 2012 and who had sufficient follow-ups were evaluated. The cases were examined in terms of gender, age, direction, tumor location, follow-up time, success of the treatment, complication, recurrence, and survival. The data obtained were transferred to the SPSS 15.0 program and analyzed. Normality distributions of the data were analyzed with the Shapiro-Wilk test. Results: 8 of the 14 cases were male, 6 were female, and the average age of the cases was 21.9±7.02. Osteosarcoma was in the distal femur in 9 (64.3%) of the patients, in the proximal tibia in 5 (35.7%) of the patients, in the right lower extremity in 5 of the patients, and in the left lower extremity in 9 of the patients. Average follow-up time was 33 months (3-144 months range). Average MSTS score was found as 81.9 (53-96 range), perfect results were taken in 11 (78.6%) patients while insufficient results were taken in 3 (21.4%) patients. As for complications, aseptic softening was observed in 3 cases, peroneal nerve paralysis was observed in 2 cases, skin necrosis was observed in 2 cases, periprostatic fracture was observed in 2 cases, prosthesis infection was observed in 1 case, and local recurrence was observed in 1 case. Except for the two cases with peroneal nerve paralysis, cases with complications recovered without any problems. The patient who developed local recurrence was lost due to lung metastasis. Discussion: Treatment of osteosarcoma through tumor resection prosthesis raises question marks due to possible complications that can affect the survival of the prosthesis in the long term. However, this treatment method is favorable in terms of stability, early load efficiency, and causing less anxiety than osteosynthesis; it is also psychologically more pleasing than amputation.

Keywords

Osteosarcoma; Surgical Treatment; Tumor Resection Prosthesis; Result

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Introduction

Osteosarcoma (OS) is the most common primary malign bone tumor in children (20-22%) [1]. Considering all bone malignancies, it is the third most common malignancy after bone metastasis and multiple myeloma [2]. OS is more common in males and peaks around the age of 15 [3]. In terms of localization, the most common involvement area is the knee area [4].

Traditional methods of OS are resection if extremity-protective surgery can be performed and the surgical removal of the tumor including amputation, if necessary [5]. In the treatment of OS, which is considered radiotherapy-resistant, surgery and chemotherapy (neoadjuvant and adjuvant) applied together is the most accepted approach. In cases who received only surgery before chemotherapy, the five-year survival rate was 10-20% [6]. With the inclusion of chemotherapy in treatment and the development of new treatment protocols, the rate of recovery began to increase. Thus, limb-salvage surgery replaced amputation, which had been the dramatic and only treatment choice before the 1970s, when existing micrometastases were first reported as treatable through chemotherapy [7].

Since extremity-protective surgery did not influence survival negatively and only increased the local recurrence rate, and also due to the modular manufacture of tumor resection prostheses, extremity-protective surgery began to form the basis of treatment. As a result, in cases with no metastasis whose lesions were completely removed surgically, the five-year survival rates increased to 60-70% [8, 9].

The purpose of this study is to evaluate the cases who underwent tumor resection prosthesis due to OS in our hospital, a tumor center in the region, in terms of treatment and the results.

Material and Method

Fourteen cases who underwent tumor resection prosthesis due to OS in our clinic between 2000 and 2012 and who had sufficient follow-ups were evaluated after the necessary permissions from the ethical board were received. The cases were examined in terms of gender, age, direction, tumor location, follow-up time, success of the treatment, complication, recurrence, and survival.

Planning

The patients who came to our clinic with a pre diagnosis of OS were evaluated in the musculoskeletal system tumors council (consisting of orthopedic oncology, medical oncology, pediatric oncology, radiation oncology, pathology, and nuclear medicine specialists) of our hospital, which has the position of tumor center for the area. The council determined the diagnosis and planned suitable treatment.

While the treatments were being planned, all the patients were questioned about personal and family history, detailed examinations were made, and the required radiologic and laboratory examinations and biopsies were completed. Before the surgery, neoadjuvant treatment was started on patients who the council decided were suitable candidates. Care was taken to consider the disappearance of bone marrow pressure in the timing of the surgery.

Surgical Treatment

A 1 gr cefazolin sodium iv. was given to all the patients at 10:00 pm the night before the operation and at 7:00 am on the morning of the operation. Sufficient erythrocyte suspension was prepared before the operation based on the blood values. The patients who were thought to have problems related to vascular or soft tissue reconstruction were consulted to the cardiovascular surgery and plastic and reconstructive surgery departments. Each prosthesis set was controlled to confirm that all of the medical consumables were complete. The extremity to be operated on was signed during the last visit, one day before surgery. In the operating room, the direction of the extremity was confirmed again and the patient was taken to supine position. A urinary catheter and, if required, a central venous catheter were placed. The operation area of the patient was cleaned in the operation room immediately prior to surgery. The surgical area was washed and dyed with antiseptic solution. A tourniquet was applied and the patient was covered with sterile cloths, leaving the surgical area open. Ioban drape was applied in such a way that joints moved and vision would not be limited. Operations were performed by a team experienced in oncological orthopedic surgery.

Postoperative Care and Follow-up

Following surgery, all patients were taken to the postoperative surgical intensive care unit. The patients who became stable in their follow-ups were taken to the service and antithrombotic treatment was started following the postoperative 12th hour. In patients who did not have any problems with soft tissue reconstruction and recovery, isometric exercises were started from the first day. In patients who were being followed for daily hemovac drain, at the end of the postoperative 48th hour, the drains of those patients who had drained less than 50 cc. were removed. After the postoperative second day, the patients were mobilized, first with walkers and then with crutches, to the extent they could tolerate pain. As the wounds of patients allowed, those who were to receive adjuvant treatment were referred to medical oncology and radiation oncology clinics. The patients were called for control one month after their sutures were removed. After this control, they were again called for control once every three months in the first two years, once every four months in the second two years, once every six months in the next two years, and once a year in the following years.

Functional Evaluation

In the evaluation of functional results, the MSTS (Musculoskeletal Tumor Society) scoring system was used [10]. With this scoring system, a total of 6 parameters, including pain, functional capacity, emotional acceptance, support use, walking distance, and way of walking, were evaluated. Each parameter was scored from 0 to 5 according to specific criteria. The results, in percentages, were calculated by dividing the total by 30, which is the highest possible score. MSTS scores obtained were classified as perfect 75-100%, good 70-74%, moderate 60-69%, insufficient 50-59%, and bad 50%.

Statistical Analysis

The data obtained were analyzed with the SPSS 15.0 (SPSS Inc., Chicago, IL, USA) program. The Shapiro-Wilk test was used to determine whether the data were normally distributed. The data that were normally distributed were expressed as average±standard deviation and the data that were not normally distributed were expressed as mean (min-max).

Results

8 of the 14 cases were male, 6 were female, and the average age of the cases was 21.9±7.02. OS was in the distal femur in 9 (64.3%) of the patients, in the proximal tibia in 5 (35.7%) of the patients, in the right lower extremity in 5 of the patients, and in the left lower extremity in 9 of the patients (Figure 1). Average follow-up time was 33 (3-144 months range) months. The average MSTS score was 81.9 (53-96 range). Eleven (78.6%) patients had perfect results and 3 (21.4%) patients had insufficient results. In terms of tumor location, in those patients with distal femur-located OS, 8 (88.9%) had perfect results and 1 (11.1%) patient had insufficient results. In patients with proximal tibia-located OS, 3 (60%) patients had perfect results and 2 (40%) had insufficient results (Figure 2).

In terms of complications, aseptic softening was observed in 3 cases, peroneal nerve paralysis was observed in 2 cases, skin necrosis was observed in 2 cases, periprostatic fracture was observed in 2 cases, prosthesis infection was observed in 1 case, and local recurrence was observed in 1 case (Table 1). No improvement was found in the follow-up of the two cases with peroneal nerve paralysis; one case received a tendon transfer and the other case was followed with AFO orthesis because he did not accept surgical intervention. The patients are alive and their MSTS scores in the last follow-ups were 90% and 84%, respectively.

Figure 1. 13 years of age, images of left femur distal located osteosarcoma case.

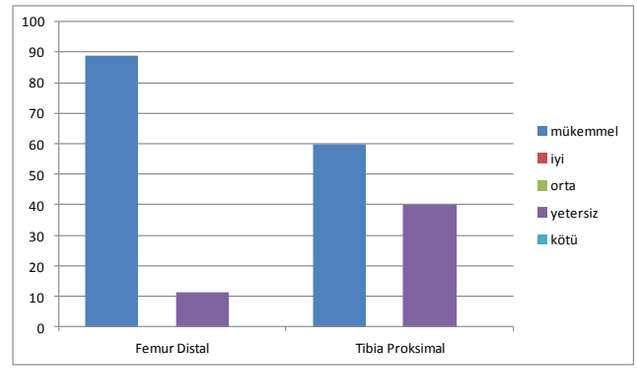

Figure 2. The comparison of functional results in patients with osteosarcoma in terms of the location of the tumor.

Table 1. Summary of cases who developed complications.

Tumor Location	Complication	Time of development	Treatment
Proximal tibia	Peroneal nerve paralysis	Intraoperative	AFO (Sequellea)
Distal femur	Peroneal nerve paralysis	Intraoperative	Transfer of posterior tibial (improved without sequellea)
Distal femur	Skin necrosis	Postoperative 3rd day	Free anterolateral thigh flap
Distal femur	Skin necrosis	Postoperative 5th day	Pedicle anterolateral thigh flap
Proximal tibia	Prosthesis infection	Postoperative 1st month	Antibiotheraphy after debridement and washing
Proximal tibia	Aseptic softening	Postoperative 84th month	Revision
Proximal tibia	Aseptic softening	Postoperative 120th month	Revision
Distal femur	Aseptic softening	Postoperative 2nd month	Revision (flexion constraint after revision, Judet procedure)
Distal femur	Periprostatic fracture (femoral stem+femur neck part following trauma)	Postoperative 72nd month	Revision (total femur resection prosthesis)
Distal femur	Periprostatic fracture (following trauma)	Postoperative 36th month	Follow-up with long leg plaster

Except for the two cases with peroneal nerve paralysis, cases with complications recovered without problems. The patient with distal femur location developed local recurrence in the 12th month, and was lost due to prevalent lung metastasis in the 14th month.

Discussion

Although it is rare, OS is the most common primary malignant tumor of the bone in children and adolescents; it has a high grade and it originates from mesenchymal tissue [1]. In terms of histological examination, it is characterized by the malignant osteoid production of sarcomatoid cells [9]. While the average age of its onset is 15, it is most common in the second decade when growth is fastest [3]. It is more common in men than in women [1]. In terms of localization, it is most frequently seen

in the distal femur, proximal tibia, proximal humerus, and shin bones and its most common involvement area is the knee joint [4]. In our study, male cases were greater in number, the average age of the cases was 21.9±7.02, and in all of the cases, the tumor was in the knee area. From this point of view, our results align with the literature.

Until the beginning of the 1970s, OS was controlled with amputative surgical interventions and, at times, postoperative radiotherapies. . In the treatment of OS, which is acknowledged as radiotherapy-resistant today, neoadjuvant (preoperative), adjuvant (postoperative), and palliative chemotherapy is applied in addition to surgical treatment. Today, the contribution of chemotherapy to disease-free survival is indisputable. As a result of more experience with the application of prostheses, developments in the prosthesis industry, and the inclusion of chemotherapy in treatment, reconstruction of the wide segmenter defects (which include the joint surfaces and which develop as a result of tumor resection applied due to extremity-located bone tumor) became an accepted method by many orthopedic surgeons after the 1970s. Thus, the success rate in treatment increased from 20% to 70% [11-13]. Today, patients who in the past would have been treated with amputation are treated with extremity-protective surgery which has similar local recurrence and survival rates to that of amputation. This is now the preferred treatment option because of patient stability in the early postoperative period and fast rehabilitation [14-17].

Today, there is no standard chemotherapy treatment protocol. Studies of new preoperative and postoperative treatment protocols to improve survival rates have become more frequent. Cooperation and the present protocol of reconstructive surgery and oncology are promising for the future. When the functional results of patients who receive tumor resection prostheses due to OS are reviewed in the literature, Guo et al. [18] reported average MSTS score as 80% in their series, with perfect results in 62% of the patients, good results in 27% of the patients, sufficient results in 7% of the patients, and bad results in 4% of the patients, while İlbeyli et al. [19] reported perfect results in 38% of the patients, good results in 46% of the patients, and moderate results in 15%. In our series, the average MSTS scores of the OS patients was 81.9%; perfect results were found in 78.6% of the patients and insufficient results were found in 21.4%. Our results align with the literature.

Tumor resection prostheses may require revision due to the young ages of OS patients, the fact that the patients continue to grow, and because the long-term use of prosthesis may cause some complications [20]. Complications were seen in cases with knee-area location as in our series [21]. These are infections, nerve paralysis, skin problems, and problems caused by the prosthesis and its periphery [22]. Of the 20 cases they treated for OS, Kavanagh et al. [23] reported late infection in one case and collapse in the tibial component of the prosthesis in another case. The infection rate was reported as between 2.6% and 13.4% in different studies in the literature [14, 15, 24, 25]. In our study, aseptic softening was observed in 3 cases, peroneal nerve paralysis was observed in 2 cases, skin necrosis was observed in 2 cases, periprostatic fracture was observed in 2 cases, and prosthesis infection was observed in 1 case. No improvements were observed in the follow-up of 2 cases who developed peroneal nerve paralysis; tendon transfer was applied in one of these cases and the other case was followed with AFO orthesis because he did not accept surgical intervention. Except for these two cases with peroneal nerve paralysis, patients with complications recovered without problems.

OS frequently causes metastasis in those patients only treated surgically, that is, in 80% of the cases who do not receive chemotherapy [26]. Distant organ metastasis is most frequently found in lungs and bones [27]. Kavanagh et al. [23] reported local recurrence in 4 (20%) cases and systemic expansion in 1 (5%) case. Bacci et al. [28] reported a local recurrence rate of less than 10%. In our study, high femoral amputation was performed on 1 (7%) of the cases with distal femur location due to local recurrence in the 12th month and in the 14th month. The case was lost due to prevalent lung metastasis.

In conclusion, the treatment of OS with tumor resection prosthesis raises questions due to possible complications that affect the long-term survival of the prosthesis. However, it is favorable in terms of stability, early load efficiency, and causing less anxiety than osteosynthesis and it is psychologically more pleasing than amputation.

Competing interests

The authors declare that they have no competing interests.

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