



Successful results of total femoral resection and prosthetic replacement in two patients

Total femur rezeksiyonu ve prostetik replasmanın başarılı sonuçları: İki olgu sunumu

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Femurun tümünün rezeke edilmesi ve oluşan defektin endoprostetik replasmanı, önemli bir ekstremité kurtarıcı prosedürdür. Evre IIB osteosarkom tanısıyla, 20 yaşındaki iki erkek hastada total femur rezeksiyonu ve TMTS (Turkish Musculoskeletal Tumor Society) protezi ile replasman uygulandı. Ameliyat sonrası dönemde geçici siyatik sinir nöropraksisi ve hafif yara komplikasyonu dışında bir sorunla karşılaşılmadı. Dört aşamalı rehabilitasyon programı uygulanan hastalar desteksiz ve sınırlama olmadan yürüyebiliyorlardı. İzlem süreleri 22 ve 26 ay olan hastalarda kalça ve dizde tama yakın hareket genişliğine ulaşıldı ve Enneking fonksiyonel skorları mükemmel bulundu. Endoprostetik total femoral rekonstrüksiyon, dikkatli seçilmiş hastalarda, rekonstrüktif prosedürlere bağlı kalınarak uygulandığında tatminkar fonksiyonel sonuçlar sağlamaktadır.

Anahtar sözcükler: Kemik neoplazmları/cerrahi; femur/cerrahi; osteosarkom/cerrahi/rehabilitasyon; protez ve implant; protez tasarımı; protez implantasyonu; rekonstrüktif cerrahi prosedürler.

Resection of the whole femur, together with endoprosthetic replacement is a major limb-salvaging procedure. We performed total femoral resection and endoprosthetic replacement with TMTS (Turkish Musculoskeletal Tumor Society) prosthesis in two young (20 years old) male patients with stage-IIB osteosarcoma. Postoperative complications were only temporary sciatic nerve neuropraxia and minor skin necrosis around the surgical wound. After a four-staged individualized rehabilitation program, both patients were able to walk without any support or limitation. At the end of a follow-up period of 22 and 26 months, both patients achieved a nearly full range of motion of the knee and the hip, with Enneking functional scores being excellent. Endoprosthetic total femoral reconstruction results in satisfactory oncologic and functional outcome in selected patients.

Key words: Bone neoplasms/surgery; femur/surgery; osteosarcoma/surgery/rehabilitation; prostheses and implants; prosthesis design; prosthesis implantation; reconstructive surgical procedures/methods.

Extremity saving surgery applied in the treatment of muscle-skeletal system tumors has become frequently used thanks to modern chemotherapy protocols, advanced reconstruction methods, and advanced surgical techniques. With the continuance of improvements, better functional results compared to early applications were achieved, as well as mak-

ing the cases for which extremity saving surgery was previously considered impossible within indicated cases. Primary malign tumors involving the entire femur and/or primary malign tumors for which segmental femoral resection is not possible are rather infrequent. Among such patients, ones that advanced local and systemic involvements are not present are

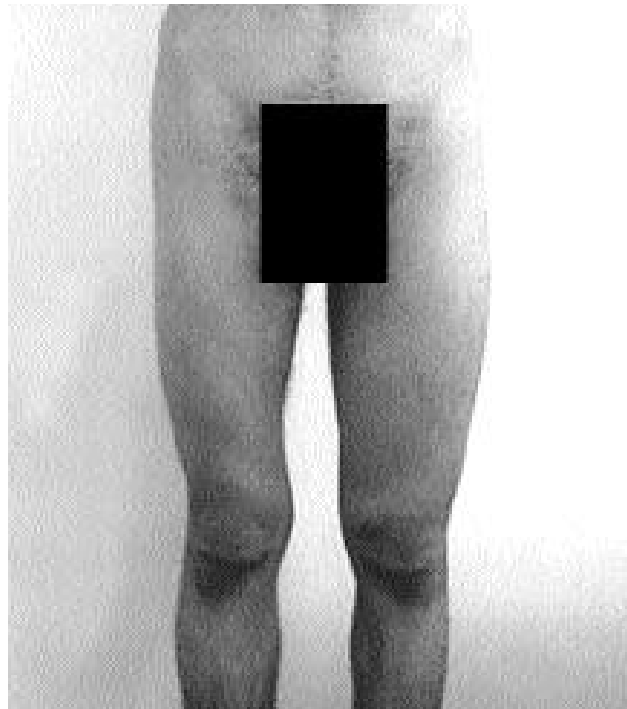
cases that are candidates for total femoral resection as an extremity saving operation. For the rest of the patients, hip disarticulation is the only surgical option. Total femoral resection is used in high-grade extra-compartmental bone malign conditions. In addition, following the meticulous dissection of connections, intra-articular knee and hip resections were applied. Total femoral resection was completed taking care to preserve the quadriceps mechanism and patellar tendon in the distal, and the abductor group and short lateral rotators in the proximal. Length of the prosthesis and diameters of the head and tibial stem were re-measured intraoperatively. After proximal tibial cut was performed, trial prosthesis was installed and implanted. Length, extremity axis, and width-stability of the hip-knee movement planned through the trial prosthesis were assessed, and the actual prosthesis was implanted with the suitable cementing technique. In the reconstruction of soft tissue, care was taken to construct the functional peri-prosthetic muscle connections (in particular, abductor mechanism was sutured to the apparatus on the prosthesis, and tensor fascia lata), to capsulography, and covering the prosthesis primarily on the incision line (Figures 4a, b).

In the postoperative period, skin traction for two weeks was applied with mild flexion and abduction of the hip. Patients were accepted to a rehabilitation program consisting of four stages in nine weeks. This program consisted of resting and protecting (2 weeks), passive movements and mobilization (2nd-4th weeks), active movements and strengthening (4th-6th weeks), and full activity and bestowing resistance (6th-9th weeks) stages, respectively. Adjuvant chemotherapy was carried on during this period with three cures of chemotherapy.

Patients were followed closely during the adjuvant chemotherapy (3rd, 6th, and 9th weeks); then follow up continued with intervals of three months and with radiological and clinical examinations

(Figure 4c). While the radiological examinations focused on local recurrence and systemic involvement, clinical examinations focused on mobility levels, joint movements, and satisfaction of the patient. It was confirmed that the surgical margins were negative with histopathological examinations; and necrosis rates were reported as 90% for the first case, and 100% for the second.

Follow-up periods were 26 and 22 months, respectively. Superficial skin necrosis on an area of approximately 8 cm developed in the second case postoperatively, and it was treated with debridement. Sciatic nerve paralysis developed presenting with loss in dorsal flexion in the patient who had a fracture (case 1), and axonal degeneration was seen in electromyographic examination. Patient used a short walking device during the rehabilitation program, and returned to normal clinically in the sixth month postoperatively, and in the eighth month electromyographically. Rehabilitation period was a longer in this patient because of the neurological



Şekil 1. Ameliyat öncesi klinik görünüm. Tüm femurda diffüz çevre artışı izleniyor (olgu 2).

problem. Range of movement of the joints was complete in the hip, and complete extension and an average flexion of 110° in the knee could be achieved (Figure 5a,b). Patients were able to walk at the end of the sixth month without support and without restriction. Results for both of the patients were found to be excellent according to Enneking scoring performed in the last follow-up visit. No other surgical intervention was applied for any complication. However, metastasis in lungs were found in case 1 in the 18th month postoperatively, and treated with metastectomy and additional chemotherapy. Muscle strengths were an average of 4 clinically; the least positive result was obtained for the hip abduction.

Discussion

Total femoral resection and endo-prosthetic replacement (TFR-ER) was first defined by Buchman in 1952[4]. Half a century later, from a

few articles regarding the subject consisting of case reports mostly with limited number of cases, it can be seen that the procedure has been used in a wide range of age (2-91) [1,3,5,8].

Enneking et al.[2] reported the indication for total femoral resection in musculoskeletal tumor surgery as high stage extra-compartmental sarcomas (stage IIB). However, all the patients with stage IIB sarcoma, involving the whole femur are not candidates for total femoral resection, since involvement of important neuro-vascular structures will make the hip disarticulation as the only surgical option. Indications for TFR-ER other than malign bone sarcomas have been reported in the literature. Among them are primary joint arthroplasty – revisions of primary tumor prostheses, benign or malign bone tumors, and metabolic bone disorders[1,6,7].

TFR-ER is an important application of extremity

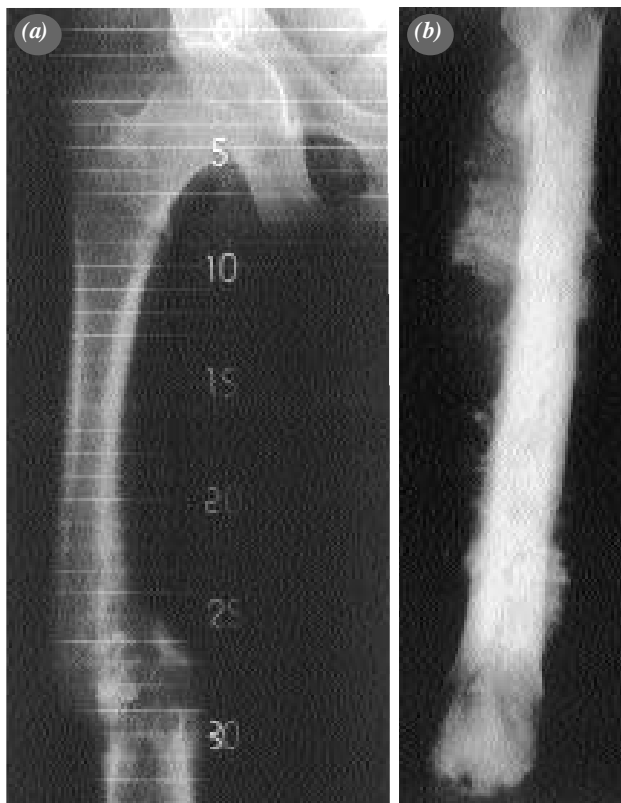


Figure 2. Preoperative AP x-rays. (a) Line of fracture (case 1), and (b) Bony formations in specular form throughout femur (case 2) can be seen.



Figure 3. (a) Case 1, (b) Case 2. Sagittal T1-weighted magnetic resonance images. Tumor involving almost entire femur invading both medulla and soft tissue can be seen. Wide involvement made total femoral resection mandatory.

saving surgery, with the resection covering both knee and hip joints, and with massive bone (marrow) and delay in soft tissue defect repair. Therefore, complication rate for total endoprosthetic replacement is greater than sole proximal or distal femoral prosthetic replacement. The major complications encountered are deep infection, flap necrosis, dislocation and total recurrence[1,3,5]. Ensuring of long-term stability of the prosthesis, and dislocation are important problems. Stability problems are encountered especially because of the difficulty of performing the multiple muscle-bone connections on the prosthesis after the resection. Consequently, hip dislocation ranging between 11-15, rotational dislocation, and sub-luxation are reported[1,9]. Reducing these complications can be possible with better performing of the muscle-prosthesis connections.

Bickels et al. [9] suggested performing hemiarthroplasty in the prosthesis without acetabular component, capsulo-raphy and per-prosthetic muscle connections with repair of the abductor mechanism in the first place, and using prosthesis types with extra-cortical fixation. Percentages of good to excellent results were found to be 81% with this method[9].

According to the articles of the early periods, ambulation of the patients was provided with orthoses like braces with supports or crutches[5,6]. Today, using of only the abduction brace for about six weeks if needed[1]. We also believe in the benefits of short immobilization / early ambulation. Rehabilitation programs should be specialized according to the muscle groups on which resection was performed, and should be modified according to the response. We believe that the rehabilitation pro-

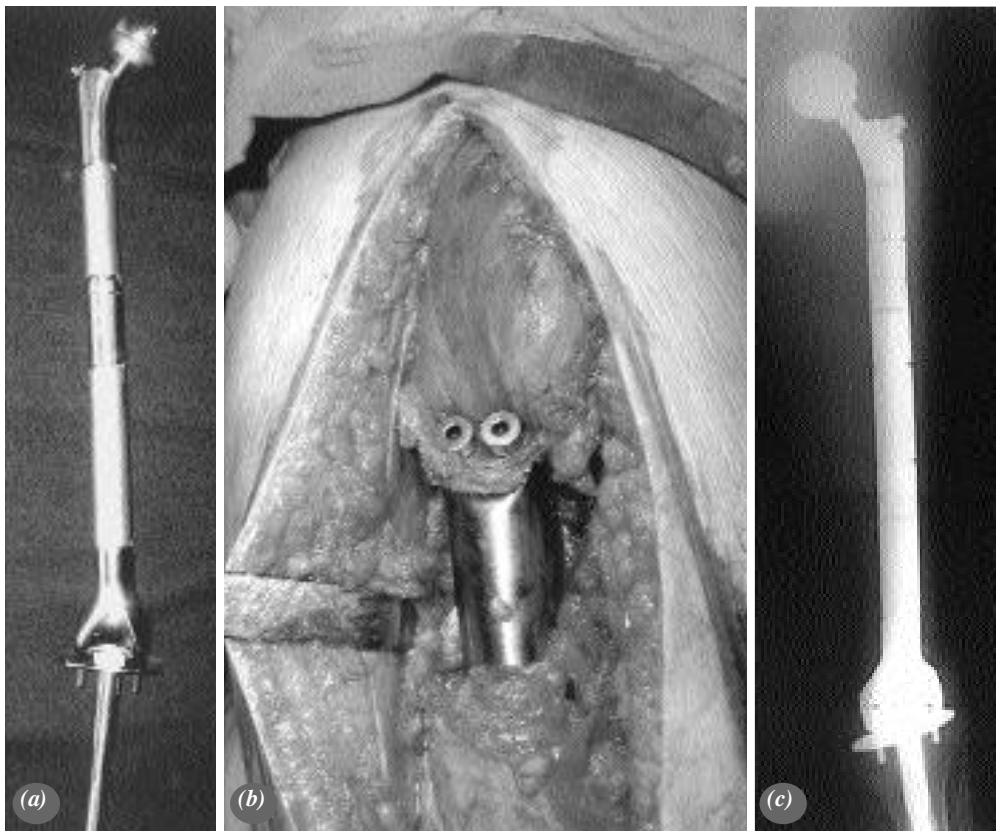


Figure 4. (a) Trial prosthesis must be installed and used for the intraoperative measurements. (b) Intraoperative view: abductor muscle group has been connected to the apparatus on the prosthesis. Care must be given to performing of the peri-prosthetic muscle connections. (c) Total femoral prosthesis. Postoperative x-ray (4th month).

gram in four stages will improve the functional results and thus reduce the complication rates.

When the patients undergone TFR-ER are compared to patients undergone hip disarticulation, it is seen that patients undergone TFR-ER will have a better quality of life being spared from serious psychological problems; in addition, their oxygen consumption ratio is rather small compared to disarticulated patients[6,7,10]. Younger patients can tolerate surgical treatment better, and also response better to rehabilitation program, consequently, their joint movements and functional scores will be better, and they may not need external support[1,8].

Neuropraxy in sciatic nerve, which was the only complication we encountered, was attributed to tension during normalizing after TFR-ER of the shortened extremity because of being in cast for about three months preoperatively. Thus, it can be said that implanting the prosthesis with a length about 2cm shorter will prevent tension in neuro-vascular structures and related complications. We believe that prostheses with modular structure are more suitable compared to custom-made ones, because of the

advantages like being open to modifications in length, head diameter and sparing the need for waiting for manufacturing of the prosthesis[3,10,11].

The long-term results of total femoral resection and endoprosthetic replacement are successful for both the patient and the orthopedist. In patients that the joint stability could be reconstructed properly, the functional scores were found to be high, and complication rates low; and satisfactory results ranging from 63-84% in long-term follow-ups[1,6,7,9,11]. Schindler et al reported the MSTS score (Musculoskeletal Tumor Society Rating Score) in six children they treated with extendable total femoral prosthesis as 77.3%[8]. The close follow-up of the patients during the rehabilitation period has an important role in achieving the desired movement ranges, and achieving independent motion. Our results in both cases are consistent with the literature; we believe that this success can be attributed to the young ages of the patients, to a good soft tissue reconstruction, and to the rehabilitation period, during which the compliance of the patient was ensured.

Results obtained are promising; however, longer

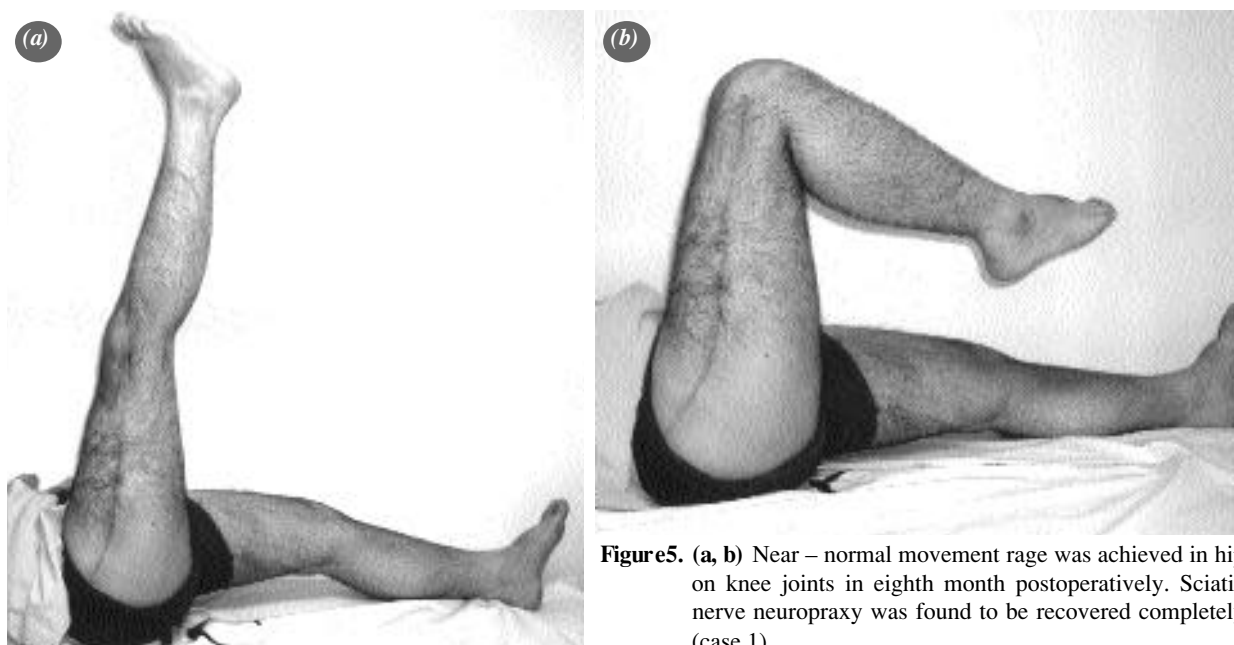


Figure 5. (a, b) Near – normal movement range was achieved in hip on knee joints in eighth month postoperatively. Sciatic nerve neuropraxy was found to be recovered completely (case 1).

follow-up periods are required for the determination of survival period and complications. Total femoral resection and endoprosthetic replacement is indicated in stage IIB primary malign bone tumors; however, it should be performed in centers having enough knowledge and experience in arthroplasty and musculoskeletal tumors. Although it is an important surgical application and has a rather high risk, TFR-ER is a procedure that the functions of the extremity can be preserved in a satisfactory level in patients selected well.

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