

En bloc resection of osteosarcoma of the proximal fibula. An analysis of 8 cases

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Osteosarcoma of the proximal fibula is a rare entity that poses a surgical challenge. Limb salvage is the goal of treatment, and this entails sacrifice of the common peroneal nerve as well as the anterior tibial artery. Also the loss of the lateral collateral ligament and biceps attachment leads to unavoidable knee instability which requires special reconstructive procedures. From 2002 to 2008, eight patients with osteosarcoma of the fibular head were treated in our institution with Malawer type II resection. Seven of these patients are still alive without evidence of disease. Our results indicate that the sacrifice of the common peroneal nerve ensures a wide margin of resection which in turn correlates with long-term survival. Furthermore, our technique of reconstruction of lateral knee structures has produced good functional outcome without significant postoperative knee instability.

Keywords: osteosarcoma ; fibula ; resection ; lateral collateral ligament, common peroneal nerve.

of all osteosarcomas (9). The surgical treatment of this tumour is challenging as the common peroneal nerve and anterior tibial artery need to be sacrificed in order to achieve wide and tumour free margins of resection, thereby resulting in an iatrogenic foot drop. The resultant loss of function necessitates the postoperative use of a functional ankle foot orthosis. In addition, stability of the knee joint is also at stake as the insertions of the lateral collateral ligament (LCL) and biceps femoris from the fibular head are also resected (2). There are reports in the literature which study the intentional marginal resection of the osteosarcoma of the proximal fibula in order to preserve the limb function (7,8,15). On the contrary, we aim to achieve tumour free resection limits by Malawer type II resection (10) for the proximal fibula in order to minimize the chances of recurrence and thereby to achieve a better survival rate, even at the cost of a resultant dropfoot. We

INTRODUCTION

Osteosarcoma is the most common primary malignancy of bone if we exclude the marrow based malignancies such as myeloma, lymphoma and leukemia. The site of predilection is the metaphyseal area of long bones, with the distal femur, proximal tibia and proximal humerus being the commonest sites in decreasing order of distribution. The proximal fibula is a rare site representing about 2%

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report our experience with Malawer type II resection in the 8 patients with proximal fibular osteosarcoma, with special attention to reconstruction of the LCL attachment and postoperative knee stability.

PATIENTS AND METHODS

Between 2002 and 2008, 8 patients presented to our institution with a diagnosis of non metastatic osteosarcoma of the proximal fibula. Five of them were between 15 and 25 years of age while three were above 55 years. They all presented within 2 to 3 months of onset of symptoms. Pain was the initial symptom in all the patients ; it was later on accompanied by swelling over the posterolateral aspect of the proximal tibia. Only one patient had symptoms pertaining to common peroneal nerve involvement. Initial work up included conventional radiographs. Radiographic findings varied from an eccentric osteolytic lesion with irregular margins with moth eaten appearance (fig 1) to osteolytic expansion of the proximal fibula with irregular margins and to osteosclerotic expansion of the proximal fibula. The radiological findings were further substantiated with the help of MRI by assessing the local extent of the tumour, soft tissue involvement, skip lesions and adjacent neurovascular status. Open biopsy was used for histological diagnosis. All patients received neoadjuvant combination chemotherapy involving standard doses of methotrexate, adriamycin and cisplatin. The effect of preoperative chemotherapy was evaluated by the percentage of tumour necrosis in the surgical specimens, as good (> 95%), moderate (90-95%) and poor (< 90%). CECT chest, abdomen and bone scan were used to rule out distant metastasis. CT Angiography defined the relationship of the popliteal trifurcation with the adjacent tumour (fig 2).

A Malawer type II resection (10) was done in all the cases, which included an extraarticular resection of the proximal fibula with approximately 5 cm of normal diaphysis (as assessed on the MRI), the anterior and lateral muscle compartments, the anterior tibial artery and the common peroneal nerve. The LCL and the lateral head of biceps femoris were reattached to the lateral wall of the tibia and surrounding knee capsule with the knee in 20° of flexion. Non absorbable sutures (ETHIBOND No.5) were used to reattach the stumps of LCL and biceps femoris through drill holes made in the lateral wall of the proximal tibia. The LCL and biceps were further reinforced by suturing them to the overlying iliotibial band. In order to diminish the severity of the iatrogenic foot

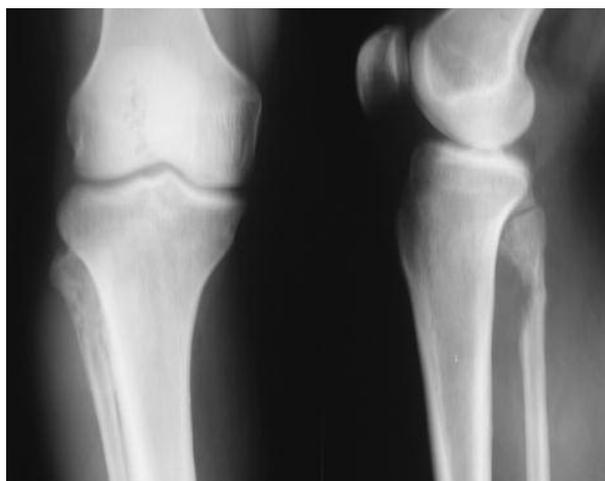


Fig. 1. — Pre-operative AP and lateral radiographs of the knee joint demonstrating the osteolytic lesion of the anterior aspect of the proximal fibula with irregular margins and moth eaten appearance of the rest of the head of the fibula, signifying the malignant nature of the pathology.



Fig. 2. — CT Angiography of the leg demonstrating the close proximity of the anterior tibial artery with the tumour of the proximal fibula.

drop, the peronei and the extensor tendons were pulled proximally, advancing the foot to a neutral position and tenodesed to the tibial shaft. Postoperatively the limb was immobilized in a cast for 3 weeks in 20° of flexion. After cast removal, all the patients underwent a physiotherapy regimen of active ROM exercises in a hinged

knee brace. Patients were allowed full weight bearing in a knee brace 6 weeks after the surgery and the brace was discarded 12 weeks post operatively. An ankle foot orthosis was needed in 6 of the patients. All the patients received a standard course of post operative chemotherapy.

The patients were assessed for any clinico-radiological evidence of recurrence or metastasis, and for knee instability at follow-up visits. Lateral knee laxity was assessed by measuring the degree of lateral joint space opening using a varus stress with the knee in 30° flexion and in neutral tibial rotation. Laxity was scored as Grade 1 to 3; Grade 1 was defined as a lateral joint space opening of 1 to 5 mm, Grade 2 as an opening of 6 to 10 mm, and Grade 3 as an opening of more than 10 mm (i.e. complete LCL dysfunction), and it was determined by comparing the result with the normal contralateral knee on the stress X-ray views (13). Subjective evaluation of knee function was based on a history of instability and ability to reach a satisfactory activity level.

RESULTS

Negative margins were achieved in all the 8 patients and consequently none required secondary resection or amputation. The maximum dimension of the tumours on the imaging studies ranged between 55 and 95 mm with a mean of 68 mm. There was no evidence of distant metastasis on CECT chest, abdomen and bone scan. On microscopy, specimens showed conventional high-grade osteosarcoma in all the patients. No unusual histological features were noted. There was a high incidence of direct muscle infiltration. None of the specimens showed evidence of tumour penetration into the fibular articular cartilage. Tumour response to pre-operative chemotherapy was good in one, moderate in five and poor in two patients. All patients completed a full course of post operative chemotherapy.

The mean follow-up of these patients was 48 months, with a range from 13 to 82 months. One of our patients died from pulmonary metastasis 13 months after the surgery. Overall, the oncological outcome has been encouraging, as the other seven patients are disease free without any evidence of local recurrence or metastasis. Complications related to the surgical procedure included iatrogenic common peroneal nerve palsy in all the patients,

synovial fistula in one patient, marginal suture site skin necrosis in one patient and superficial infection in one patient. There were no instances of deep infection, flap necrosis, arterial insufficiency or thromboembolic complications. An ankle foot orthosis was needed in 6 of our patients despite intraoperative tenodesis of dorsiflexors with the foot in neutral position. The synovial fistula seen in one patient required alternate day dressings and took about 3 weeks to completely heal. The skin necrosis seen in one patient was marginal and healed secondarily. Superficial infection that developed in another patient settled with a course of 3 weeks of antibiotics without the need for a formal debridement.

According to follow-up varus stress radiographs, two patients had stable knees, five had grade 1 laxity (fig 3) and one had grade 2 laxity. The one patient with grade 2 laxity had complaints of occasional pain and he was advised to wear a knee brace for walking. All these patients had full ROM of the knee and had no problems in carrying out their activities of daily living. None of the surviving patients had any evidence of local recurrence at the last follow-up visit.



Fig. 3. — Follow-up varus stress radiographs of the knee joint demonstrating Grade 1 instability.

DISCUSSION

The results of Malawer type II resection were encouraging in the patients with non metastatic osteosarcoma of the proximal fibula. A few authors have reported good results by preserving the common peroneal through intentional marginal excision of these tumours (7,8,15). However in line with the literature (5,9,11,12,14), we also believe that an attempt to preserve the common peroneal nerve may result in inadequate surgical margins, thereby increasing the chances for local recurrence. This may necessitate an above-knee amputation in a patient who could have been managed by limb salvage if the peroneal nerve had been sacrificed in the primary surgery. Moreover, it does affect the overall survival rate of the patients. In conclusion, foot drop is a lesser price to pay in comparison to endangering the survival of the patient owing to recurrence of the tumour. Furthermore, the functional outcome in our patients was acceptable despite common peroneal nerve sacrifice, and it can further be improved by subsequent tendon transfers, if needed.

The surgical biopsy should be carefully planned according to tumour biopsy principles. We always approach the proximal fibula through the lateral compartment. En bloc resection is planned only after careful assessment of biopsy findings and after a formal course of neoadjuvant chemotherapy.

On the other hand, we believe that an above knee amputation is preferable to limb salvage when confronted with the following situations: gross invasion of the tibia, extensive multicompartiment involvement especially of the posterior deep compartment, multicompartiment contamination from a previous biopsy or attempted resection, anomalous vascular patterns, especially absent posterior tibial artery, and intraarticular extension of the tumour. The tibialis anterior artery is ligated routinely to secure a safe margin; this poses no problems to lower limb viability as long as the posterior tibial artery is preserved. The peroneal artery may also be sacrificed, if needed to achieve adequate surgical margins. A preoperative angiogram is a must to rule out possible anatomic variations – the posterior tibial artery is absent in 5% of normal extremities (10) – and tumour spread in and around the posterior

tibial artery in large-size tumours. En bloc resection cannot be performed in the presence of significant obstruction of the posterior tibial artery. In such cases a bypass procedure or an amputation should be considered.

The LCL is the main resistor to varus loading in a partially flexed knee (6). The biceps femoris imparts a posteriorly directed force to the proximal tibia and the iliotibial band giving anterior stability, reducing the strain on the anterior cruciate ligament (3). The iliotibial band helps to control both the anterior and mediolateral motions of the knee (1). En bloc resection of the proximal fibula detaches the attachments of these structures, contributing to lateral instability of the knee joint (2). These lateral supporting structures thus need to be meticulously repaired to prevent post operative knee instability. Our method of reattaching the LCL and biceps to the lateral aspect of the proximal tibia has shown good results, although it delays the rehabilitation program due to post operative above-knee cast immobilisation. Although some authors have reported good function after resection without ligament reconstruction (4), we prefer reattaching the LCL because our technique is simple, associated with minimal morbidity and good functional outcome.

Synovial fistula was the most important complication in our study, which was observed in the second patient we treated. It required alternate day dressings and took 3 weeks to completely heal. It was understood that inappropriate closure of the postero-lateral capsule of the knee joint was instrumental in the development of this synovial fistula. In all the subsequent patients, it was made sure to meticulously close the postero-lateral capsule of the knee joint and none of the patients developed the same complication.

We accept that both neoadjuvant and post-operative chemotherapy play an important role in the management of osteosarcoma. Our results with Malawer type II resection with combination chemotherapy have been very encouraging, suggesting that proximal fibula osteosarcoma carries a good prognosis if sound oncological margins are achieved during the initial surgery. Thus, we strongly recommend that proximal fibula osteosarcoma

should be managed without any attempts to preserve the common peroneal nerve by Malawer type II resection. In addition, lateral soft tissue structures should be meticulously reconstructed to prevent post operative knee instability and to ensure a good functional outcome.

REFERENCES

1. **Butler DL, Noyes FR, Grood ES.** Ligamentous restraints to anterior-posterior drawer in the human knee. A biomechanical study. *J Bone Joint Surg* 1980 ; 62-A : 259-270.
2. **Draganich L F, Nicholas R W, Shuster J K et al.** The effects of resection of the proximal part of the fibula on stability of the knee and on gait . *J Bone Joint Surg* 1991 ; 73-A : 575-583.
3. **Draganich LF, Vahey JW.** An in vitro study of anterior cruciate ligament strain induced by quadriceps and hamstrings forces. *J Orthop Res* 1990 ; 8 : 57-63.
4. **Einoder PA, Choong PF.** Tumors of the head of the fibula : good function after resection without ligament reconstruction in 6 patients. *Acta Orthop Scand* 2002 ; 73 : 663-666.
5. **Erler K, Demiralp B, Ozdemir MT, Basbozkurt M.** Treatment of proximal fibular tumors with en bloc resection. *Knee* 2004 ; 11 : 489-496.
6. **Grood ES, Noyes FR, Butler DL, Suntay WJ.** Ligamentous and capsular restraints preventing straight medial and lateral laxity in intact human cadaver knees. *J Bone Joint Surg* 1981 ; 63-A : 1257-1269.
7. **Hayashi K, Tsuchiya H, Yamamoto N, Takeuchi A, Tomita K.** Functional outcome in patients with osteosarcoma around the knee joint treated by minimized surgery. *Int Orthop* 2008 ; 32 : 63-68.
8. **Kanazawa Y, Tsuchiya H, Nonomura A et al.** Intentional marginal excision of osteosarcoma of the proximal fibula to preserve limb function. *J Orthop Sci* 2003 ; 8 : 757-761.
9. **Lushiku HB, Gebhart M.** Osteosarcoma of the proximal fibula : report of 3 cases. *Acta Chir Belg* 1997 ; 97 : 260-263.
10. **Malawer MM.** Surgical management of aggressive and malignant tumors of the proximal fibula. *Clin Orthop Relat Res* 1984 ; 186 : 172-181.
11. **Natarajan M, Paraskumar M, Rajkumar G et al.** Limb salvage in aggressive and malignant tumours of the fibula. *Int Orthop* 2004 ; 28 : 307-310.
12. **Ozaki T, Hillmann A, Lindner N, Winkelmann W.** Surgical treatment of bone sarcomas of the fibula. Analysis of 19 cases. *Arch Orthop Trauma Surg* 1997 ; 116 : 475-479.
13. **Schenck RC.** Injuries to the knee : injuries to the collateral ligaments of the knee. In : Bucholz RW, Heckman JD (eds). *Rockwood and Green's Fractures in Adults*. Lippincott Williams and Wilkins, Philadelphia, 2001, 5, pp 1884-1892.
14. **Takahashi S, Ogose A, Tajino T, Osanai T, Okada K.** Osteosarcoma of the proximal fibula : an analysis of 13 cases in the northern Japan. *Ups J Med Sci* 2007 ; 112 : 366-372
15. **Yan TQ, Yang RL, Guo W.** [The clinical outcome of proximal fibular osteosarcoma with en-bloc resection.] (in Chinese). *Zhonghua Wai Ke Za Zhi* 2008 ; 46 : 661-663.