

LIMB SALVAGE SURGERY IN OSTEOSARCOMA OF LOWER LIMB

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ABSTRACT

This study was limited to the patients with stage-II B osteogenic sarcoma of the lower limb who received their definitive care in department of orthopaedic surgery Mayo Hospital, Lahore between Jan. 1993 to Dec. 1996. Total number of patients included in this study were 11 (9 male and 2 females). The age ranged from 15-25 years mean age being 17.6 years. Treatment protocol followed was that all patient were subjected preoperatively to the neo-adjuvant chemotherapy and radiotherapy, followed by surgery within 7-10 days after completion of neoadjuvant chemotherapy and radiotherapy. In all patients wide margin en bloc excision of the tumors was done and reconstruction of the defect was carried out at the same time. All patients were given adjuvant chemotherapy three weeks after surgery. Reconstruction of the bony defect created by tumor excision was done with custom made prosthesis in seven cases, free fibular grafts in three cases and rotationplasty in one case only. The follow-up period ranged from 12-48 months. Out of 7 custom-made prosthesis, implant failure occurred in one patient about 5 months after surgery and in an other case early deep wound infection occurred. The success rate of custom made prosthesis was about 59%. In one out of 3 cases, in which free fibular graft was done, fracture of the fibular graft occurred. Rotationplasty was carried out in only one case, ended up in Above Knee amputation. In this study only one patient died of the metastasis in the lungs, hence the recurrence rate after wide margin excision was 9%. The experience of "limb salvage surgery in osteogenic sarcoma has shown encouraging outcome".

INTRODUCTION

Nothing is more important than saving a part of human body, being destroyed and crippled by the disease process. Now a days in medical sciences, all efforts are exclusively being concentrated, not only on rendering human life disease free but also keeping it functionally as close to the normal as possible.

Osteosarcoma, which is the most dangerous among the tumors of the musculoskeletal system, occurs predominantly in children and adolescents, especially male between the age of

10 and 15 years but a recent epidemiological study suggests that between 1972 and 1981 age of presentation rose significantly. (Stark et al, 1990).

Before the advent of chemotherapy the outcome for the patients with osteosarcoma was dismal, with a five year survival of 12%, reported by Sir Standford Cade in 1955. Even up to 1970, the treatment of osteogenic sarcoma consisted of radiotherapy and amputation or disarticulation in many cases according to the protocol described by Cade. Despite that the five years survival rate was 25%.

In late 1970's Rosen et al were the first to report the advantages of the primary chemotherapy and delayed surgery (Neo-adjuvant chemotherapy) and adjuvant chemotherapy. This turned out to be the turning point in the treatment of osteosarcoma from amputation or disarticulation to "Limb salvage surgery".

Then in 1977 at the 5th annual meeting of the Japan society for cancer therapy, Sutow reported

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that HD-MIX Leucovorin calcium (Cytovorum factor) rescue therapy for osteosarcoma resulted in a three year survival rate of 79%. This encouraging report further potentiated the efforts towards the limb salvage surgery.

With this treatment protocol in the prognosis for the patient with osteosarcoma has improved in the late 1970's and early 1980 : in reports from a number of centers 60-80% of the patients with osteosarcoma are now projected to 5 years survival.

The purpose of this study was to find out.

1. Prevalance of osteogenic sarcoma amongst the musculoskeletal tumor cases in Mayo Hospital, Lahore.
2. Evaluation of the effectiveness of the neo-adjuvant chemotherapy and radiotherapy.
3. Assessment of surgical techniques used in tumor resection and reconstruction of the defects so produced.
4. Overall functional ability of the lower limb after various reconstruction procedures.

PATIENTS AND METHODS

The current case series was limited to the patients with stage II B osteogenic sarcoma of lower limb skeleton who received their definitive surgical case between Jan. 1993 and Dec. 1996 in the department of orthopaedic surgery Mayo Hospital, Lahore.

Total number of patients which were included in this study were 11, (9 males and 2 females) the age ranged from 10-25 years mean 17.6 years.

All patients have a clinical history including complete physical examination. the laboratory tests carried out were complete blood count, serum alkaline phosphatase, serum calcium and phosphates and before administering neo-adjuvant chemotherapy renal studies such as serum creatinine and blood urea nitrogen were also done.

Roentgenographic studies consisted of the x-rays of the affected bone and chest, total body bone scan C.T. scan of the involved extremity was done

for staging the local extent of the disease and CT scan of the chest to rule out any metastasis.

In some cases, MRI was also performed to visualize the intramedullary and soft tissue extension of the tumour. Based on the result of the different imaging techniques, the staging of the tumor was done according to the Enneking staging system.

In the treatment protocol all the patients were subjected preoperatively to neo-adjuvant chemotherapy and radiotherapy followed by surgery within 7 to 10 days. In all patients wide margin en bloc excision of the tumor was done and the reconstruction of the defect so produced was carried out at the same time and then all patients were given adjuvant chemotherapy about three weeks after surgery.

Neo-adjuvant chemotherapy:

1. Inj. Adriamycin 90 mg/m²iv over three days.
2. Inj. Cisplatinum 120 to 200 mg/m² I/A over three days.

Then on day 5, preoperative radiotherapy started with the dose of 180 cGy twice daily for ten days a total dose of 3600 cGy was given to all patients.

The post-operative adjuvant chemotherapy was administered about three weeks after surgery the doses of Inj. Adriamycin and Inj. Cisplatinum were the same as preoperatively but the adjuvant chemotherapy was repeated after 28 days till the total dose of adriamycin i.e. 540 mg/m².

Following wide margin en bloc excision of the tumor, the reconstruction was done with custom-made prosthesis in seven cases, free fibular graft in three cases and rotationplasty in one case only. the follow-up period was 12 to 48 months. During the treatment and the first year following the cessation of the chemotherapy patient received roentgenograms of the involved extremity and chest monthly and total body bone scan every three months. During the next two years x-ray of the involved estermity and the chest were done every three months and total body bone scan ever four months.

Inclusion criteria for patients:

1. Patient must be having stage II B Osteosarcoma without any detectable metastasis.
2. Patient must not be having any pathological fracture preoperatively.
3. Patient must be physically fit to undergo extensive surgical procedure and rehabilitation.
4. Renal functions of the patient must not be compromised.

Exclusion criteria for patient:

1. Patient having any detectable metastasis.
2. Patient having any complication of biopsy, particularly infection.
3. Patient with compromised renal function.
4. Patient having vascular involvement of the tumor.

RESULTS

The incidence of osteogenic sarcoma amongst the tumor cases of the musculoskeletal system presented in Mayo Hospital Lahore is 16%. the incidence of osteosarcoma among the primary malignant bone tumors is about 50% i.e., the highest percentage in malignant bone tumors. Gender distribution of the osteogenic sarcoma is 58.5% male and 31.5% female. But in the present study only the patient having osteosarcoma of the bones of the lower limb were included.

Table 1: Patient Data.

Gender	Male	N = 9
	Female	N = 2
Age at operation	17.7 years*	(10-25 years)
Follow up	25 months*	(12-48 months)

*Mean values

The average of respective values given in parenthesis.

Table 2: Location.

Bone	No. of Cases	Percentage
Distal Femur	6	54.5%
Proximal tibia	5	45.5%

Table 3: Side of Limb Involved.

Side	No. of Cases	Percentage
Right Lower Limb	8	72.7%
Left Lower Limb	3	27.3%

In 7 out of 11 cases, reconstruction was done with custom made prosthesis. Implant failure occurred in one patient about 5 months after surgery. Implant was removed and segment transport done by applying N-A (Naseer Awais) external fixator and the patient remained disease free even after 48 months of follow-up. In second case, early deep infection occurred along with skin necrosis the implant was removed and segment transport done by applying N-A external fixator. The patient remained disease free after 48 months of follow-up. In third case in which custom made prosthesis was used the patient died of chest metastasis about 18 months after surgery. This means the success rate of custom made prosthesis is 59%.

In three cases reconstruction was carried by free fibular graft and minimal fixation with K-wire and POP application. Two cases engender good result but in one case fracture of the grafted fibula occurred. The success rate in free fibular graft is about 66.6% but all these patients remained disease free even after 48 months of follow-up.

Rotationplasty was carried out in only one case which ended up in above knee amputation during early postoperative days i.e. failure rate of rotationplasty was 100% in this study but the patient remained disease free even after 25 months of follow-up.

Table 4: Comparison of different procedures.

Endoprosthesis	N = 7
Success rate	N = 4 (59%)
Free Fibular Graft	N = 3
Success Rate	N = 2 (66.6%)
Rotationplasty	N = 1
Success Rate	N = 0

In this study only one patient died on the metastasis in the lungs about 18 months after

Surgery i.e. the recurrence rate after wide margin **excision** is 9%.

Table 5: Product Limit Estimates of Disease Free Outcome at 1 year and 2 years.

Variables	Number (%)	1 Year	2 Years
Distal Femur	6 (54%)	100%	83%
Proximal tibia	6 (45.5%)	100%	100%
Gender			
Male	9 (82%)	100%	88.5%
Female	2 (18%)	100%	100%
Age			
10-15	4 (36.5%)	100%	75%
16-20	4 (36.5)	100%	100%
21-25	3 (27%)	100%	100%
Custom prosthesis	7 (63.5%)	100%	85.9%
Free Fibular Graft	3 (27.5%)	100%	100%
Rotationplasty	1 (9%)	100%	100%

In this study only one patient got infected during early post-operative days. This mean the infection rate is 9%.

Functional outcome of the limb salvage surgery of lower limb was done by using Enneking % Rating system. According to this system 3 patients showed excellent results, 4 good, 2 fair and 2 poor.

Table 6: Grading of functional outcome of limb salvage surgery of lower limb by using Enneking % Rating.

Procedure	Excellent	Good	Fair	Poor
Custom Prosthesis	3	2	1	1
Free Fibular Graft	-	2	1	-
Rotationplasty	-	-	-	1
Total	3	4	2	2



Fig. 1a: Preoperative photograph of patient showing swelling of the distal part of right thigh.

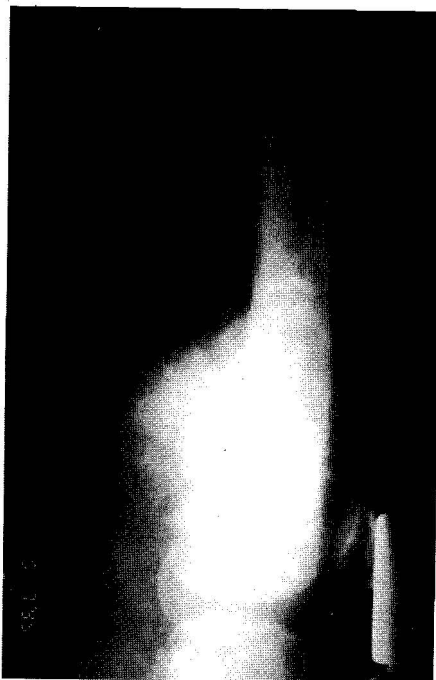


Fig. 1b: Preoperative x-rays showing sun-ray appearance and condmans triangle in osteosarcoma of the distal femur.



Fig. 1c: Preoperative taken during biopsy procedure of the distal femur.

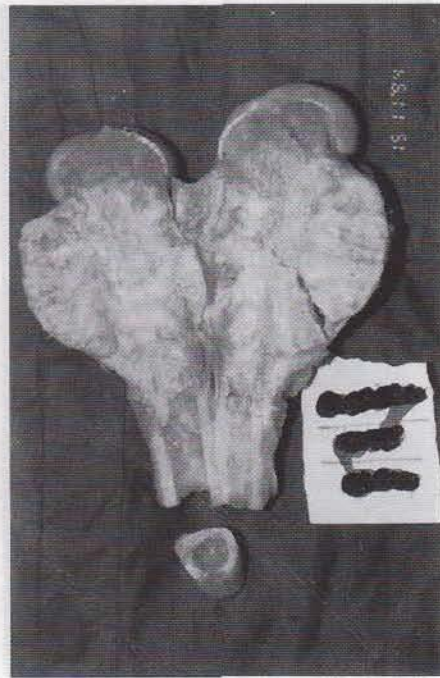


Fig. 1d: Longitudinally cut section of resected osteosarcoma of the distal femur.

DISCUSSION

The experience of limb salvage surgery is growing around the world. A discouragingly common cause of amputation is osteosarcoma of the distal femur, which is the most common primary bone tumor. The most commonly used technology used in the treatment of osteosarcoma of the distal femur is the endoprosthesis. The endoprosthesis is a prosthetic device that is inserted into the distal femur after resection of the tumor. The endoprosthesis is a prosthetic device that is inserted into the distal femur after resection of the tumor.

Despite its long history, the endoprosthesis has not been widely used until recently. The endoprosthesis has been widely used in the past, but its use has increased in the past few years. The endoprosthesis is a prosthetic device that is inserted into the distal femur after resection of the tumor.

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Fig. 1e: Endoprosthesis being inserted, having resected osteosarcoma of the distal femur.



Fig. 1f: Postoperative x-rays of the patient with endoprosthetic reconstruction.



Fig. 1g: Postoperative functional evaluation of the patient after endoprosthetic reconstruction.

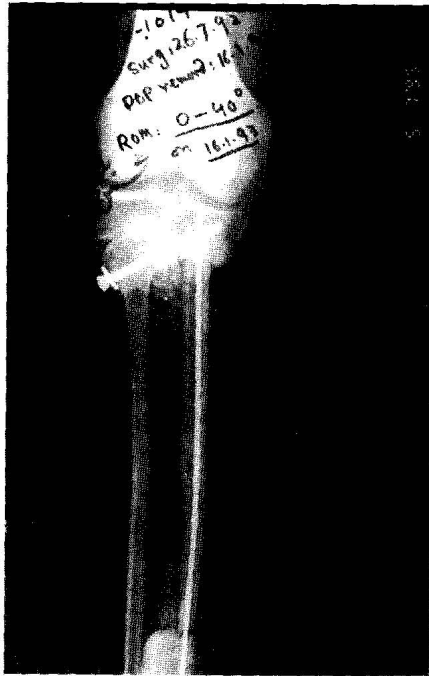


Fig. 2: Postoperative x-rays of the patient showing centralization of the ipsilateral fibula and free fibular grafting of the contralateral fibula. Fixation done with kirschner wire and a cancellous screw.

DISCUSSION

The experience of "Limb Salvage Surgery" in osteogenic sarcoma of the appendicular skeleton is discouragingly limited in Pakistan. There are many a reasons for this limited experience, one of which is the non-availability of the advanced technology used in the formation of implants and second is the lack of facilities for most sophisticated investigations used for staging tumors.

Despite all these handicaps, a humble beginning in this area was made in Mayo Hospital, Lahore in 1990. The current study is the continuation of the same study. The present study has tentatively been restricted to the lower limb because the incidence of the osteogenic sarcoma in the lower limb skeleton is very high i.e., 50% (Enneking et al., 1989).

The wide margin resection, which was used in all cases, local recurrences are caused by skip lesion in the bone or soft tissue. Earlier evaluation

of the medullary cavity with bone scan and CT scan was rather inaccurate. Today MRI scan showing the extent of the tumors in the medullary cavity far more accurately (Kropej et al., 1991).

The over all disease free survival rate is 91% at the end of 4 years. This is far more than disease free survival of 77% at five years and 74% at ten years in various centers of the world (Glasser et al., 1991). This could be due to shorter period of follow up in this study.

Because of good result as compared to other procedures, endoprosthesis are being increasingly preferred by patients in most of the centers (Kropej et al., 1991). In the current study 59% success rate of the endoprosthesis has encouraged the surgeon as well as patient, to prefer it over other procedures

Although the result of free fibular graft are not bad, owing to prolonged rehabilitation, the patient predilection for endoprosthesis is much more.

The acceptance of rotationplasty has been lowest on the table because of its awkward appearance, that is why this procedure is not so frequently being done in our center.

Finally it can be concluded that still there is a lot of work to be done in this field pertaining to the gait analysis, oxygen consumption and the best treatment of the complication that will inevitably occur in limb salvage surgery.

CONCLUSION

1. Preoperative staging of osteogenic sarcoma is most important in planning the surgical treatment and reconstructive option.
2. No invasive procedure should be done before staging the patient's disease.
3. Magnetic resonance imaging (MRI) is of immense value in determining the intramedullary as well as soft tissue extent of the osteogenic sarcomas.
4. Biopsy incision should only be given after discussing it with the surgeon who is going to operate later on.
5. Implants for different options should be at hand while operating.
6. Preoperative template formation should be exercised so as to avoid any difficulty during surgery.
7. Postoperative rehabilitation of the patient undergoing limb salvage surgery needs great attention to have good functional outcome.
8. Finally this costly treatment could be offered to the population of the developing countries with very low cost.

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