



Original Article

Early Functional Outcome of Wide Local Excision & Endoprosthetic Reconstruction for Bone Sarcoma at National Institute of Cancer Research & Hospital, Dhaka, Bangladesh

Dey K¹, Rahman MS², Saleheen MS³, Mahmud MS⁴, Kabir SMS⁵, Jamil MAJ⁶, Mazumder SK⁷, Rahman S⁸, Sarkar MAM⁹, Paul A¹⁰

Abstract

Introduction: Wide local excision or limb salvage surgery with endoprosthetic reconstruction is widely accepted as an alternative to amputation in patients with primary bone sarcoma. Musculoskeletal Tumour Society (MSTS) scoring system developed in 1993 is widely used diseases specific evaluation tool for assessment of physical function in patients with bone sarcoma. The aim of this study is to evaluate functional outcome of patients with primary bone sarcoma who were treated with wide local excision (WLE) with endoprosthetic reconstruction (EPR) by maintaining oncological principles.

Methods: It was a prospective observational study at NICRH from July 2020 to October 2021. Out of 43 patients diagnosed with bone sarcoma, 35 patients were evaluated on the basis of the inclusion and exclusion criteria.

Results: In present study, most common 18(51.43%) histopathological types were osteosarcoma. Ewing's sarcoma & chondrosarcoma both were 11(31.43%) and 6(17.14%) patients. WLE with EPR with primary closure was done in 25 (71.43%) patients. Both superficial wound infection & dislocation detected in only 1(2.9%) patient & it was right sided proximal femur ewing's sarcoma. There was no wound dehiscence, DVT within first 6 months follow up postoperatively. Histopathologically all resections were R0. Patients of proximal tibia tumour group had mean MSTS score 23.5(78.33%) ± SD1.17, proximal humerus group had mean MSTS 23.4(78%) ± SD1.87, distal femur group had 22.75(75.83%) ± SD1.21 and proximal femur group had 21.87(72.91%) ± SD3.79. Higher MSTS score indicates better functional outcome. Functional outcomes are excellent in majority 23 (66%) of patients, good in 11 (31%) and poor in only 1 (3%) of patients.

Conclusions: Well planned & performed combined treatment of the patients of bone sarcoma with WLE & EPR lead to good or excellent functional results. Majority (66%) of patients return to near normal life and work with excellent functional outcome. After analyzing the results, it can be concluded that WLE & EPR provide good functional outcome after bone tumour resection.

Key words: Wide Local Excision, Endoprosthetic Reconstruction, Limb Salvage Surgery,

1. Dr. Kallol Dey, Junior Consultant, Surgery, Khulna Specialised Hospital, Khulna.
2. Dr. Md. Setabur Rahman, Professor & Ex-Head of Department of Surgical Oncology, National Institute of Cancer Research and Hospital, Dhaka.
3. Dr. Mohammad Serajus Saleheen, Associate Professor, Orthopaedics Oncology and Musculoskeletal Tumor, National Institute of Traumatology and Orthopaedic Rehabilitation, Dhaka.
4. Dr. Muhammad Sayeed Mahmud, Assistant Professor, Orthopaedics Oncology and Musculoskeletal Tumor, National Institute of Traumatology and Orthopaedic Rehabilitation, Dhaka.
5. Dr. S M Sakib Kabir, Assistant Registrar, Surgery, 250 Bedded General Hospital Khulna..
6. Dr. Md. Abdullah Yusuf Jamil, Junior Consultant, Surgery, Department of Surgical Oncology, NICRH.
7. Dr. Suzon Kumar Mazumder, Consultant, OSD, Department of Surgical Oncology, National Institute of Cancer Research and Hospital, Dhaka.
8. Dr. Sonia Rahman, Junior Consultant, Surgery, Department of Surgical Oncology, NICRH.
9. Dr. Md. Abdul Munim Sarkar, Assistant Professor, Surgical Oncology, Rajshahi Medical College, Rajshahi.
10. Dr. Antara Paul, Medical Officer, OSD, DGHS, Deputation: Department of Gynaecological Oncology, Bangladesh Medical University (BMU), Dhaka.

Corresponding author: Dr. Kallol Dey, FCPS (Surgery), MS (Surgical Oncology), Junior Consultant, Surgery, Khulna Specialised Hospital, Khulna. E-mail:dr.kaloldey22@gmail.com

Introduction

Bone sarcoma, tumours of putative mesenchymal origin account for less than 1% of adult solid malignant cancers. Bone sarcoma mainly 3 types: osteosarcoma, chondrosarcoma and ewing's sarcoma. Bone sarcoma can occur throughout the musculoskeletal system, osteosarcoma more common in appendicular skeleton mainly in distal femur (32%), proximal tibia (15%), proximal humerus (8%), proximal femur (5%). Ewing's sarcoma favours axial skeleton with pelvis/sacrum (22%), shoulder girdle (12%), proximal femur (10%), rib (8%), chondrosarcoma mainly occur in central region pelvis/sacrum (26%), shoulder girdle (14%), proximal femur (12%) & rib (11%).¹ . Amputation had been the standard method of treatment for most bone sarcoma, but advances in diagnostic imaging, chemotherapy, radiation therapy & surgical technique for resection & reconstruction now allow limb salvage to be a reasonable option for most patients of bone sarcoma instead of amputation². The success of limb sparing surgery is the result of combined understanding of biology, staging of tumour, improved reconstructive technique & use of chemotherapy properly for bone sarcoma³. There are so many options for reconstruction following limb salvage surgery like endoprosthetic reconstruction, allograft prosthetic composite, allograft using donated bone extracorporeal sterilization and reimplantation of patients own bone, vascularized and nonvascularized autograft and arthrodesis. An endoprosthesis is artificial device to replace a missing bodily part that is placed inside the body (It is modular type, titanium material, high density polyethylene bearing surface and fixed by cementing). The limb sparing procedure with endoprosthetic reconstruction (EPR) for distal femoral tumour did not shorten diseases free interval/compromise long term survival, cosmesis & function better with preservation of knee motion & ability to ambulate⁴ & for proximal femoral EPR implant survival is 77% at ten years and 57% at twenty years. There are many advantages of wide local excision (WLE) with EPR like immediate weight bearing, maintenance of joint mobility and early return of activities of daily living⁵. Complications of EPR include wound infection, aseptic loosening, local osteolysis, joint contracture, dislodgement/dislocation, neurovascular injury, rotational deformity and leg length discrepancy⁶. We used Musculoskeletal Tumour Society Scoring (MSTS) system, which developed in 1985 & revised in 1993 &

measure early functional outcome & quality of life after WLE with EPR of primary bone sarcoma⁷. MSTS score contain six categories: pain, function, emotion for both upper & lower limb and hand positioning, dexterity, lifting ability for upper limb & support, walking, gait for lower limb. Each of these categories is assigned a value of 0-5 points & total summed score is divided by the maximum possible score (30 points) and then multiplied by 100 to obtain final MSTS score. The aim of this study is to observe early functional outcome & different post-operative complications of bone sarcoma. The aim of this study is to evaluate functional outcome of patients with primary bone sarcoma who were treated with wide local excision (WLE) with endoprosthetic reconstruction (EPR) by maintaining oncological principles.

Materials and methods

This was a prospective observational study & conducted at department of Surgical Oncology, National Institute of Cancer Research & Hospital, Mohakhali, Dhaka from July 2020 to October 2021. My study population were all bone sarcoma patients admitted in the Department of Surgical Oncology, NICRH, Dhaka for limb sparing surgery. My sampling method was purposive sampling. Our total selected cases were 43 but 8 patients were lost to follow-up due to covid situation. Finally, the targeted sample size = 35. Inclusion criteria was patient diagnosed with bone sarcoma of the extremities, AJCC staging T1/ T2, N0, MO, Grade 1,2,3 and patient of bone sarcoma age more than 12 years. Exclusion criteria was major neurovascular involvement, huge ulcerating/fungating tumour, large tumour not responding to NACT, poorly placed biopsy incision, secondary metastasis. Early functional outcome were evaluated at first 6 months after WLE with EPR by MSTS scoring system and different post-operative complications and surgical resection margins were also evaluated. Collected data were checked and edited first. They had been processed with the help of software IBM SPSS (Statistical Product and Service Solutions) version 27.0. Continuous data expressed as mean \pm SD, whereas categorical data were expressed with rate, ratio and proportion. The analysis was done by using independent sample 't' test for continuous variables and fisher's exact test for categorical variables. All reported *p* value <0.05 was taken significant and confidence interval at 95% level.

Results

A total of 35 (out of 43) patients entered in the study. Majority 21(60%) patients were in age group of 13-22 years & age of youngest & oldest were 13 years & 51 years respectively (mean \pm SD 24.45(\pm 11.04). The male to female ratio was 1.9:1. (Table I).

Table I. Age and sex distribution of study population

Age	Frequency	Percentage
13-22	21	60.0
23-32	6	17.1
33-42	4	11.4
43-52	4	11.4
Mean(\pm SD)	24.45(\pm 11.04)	
Gender		
Male	23	65.71
Female	12	34.28

The tumor mostly located at right lower extremity 17(48.57%) and majority 29 (82.9%) patients received NACT & pain was the most common feature in 24(68.6%) patients (Table II).

Table-II: Clinical presentation and site of tumor of study population

Clinical presentation	Frequency	Percentage
Pain	24	68.6
Weight loss	14	40
Anaemia	9	25.7
Previous NACT	29	82.9
Anatomical site		
Rt lower extremity	17	48.57
Lt lower extremity	13	37.14
Rt upper extremity	3	8.57
Lt upper extremity	2	5.71

Majority 29(82.85%) of tumors were stage IIB. WLE with EPR with primary closure done at 25(71.43%) cases & flap coverage done for rest of the cases (Table III).

Table III: TNM staging, and Types of Surgery of study population

TNM staging	Frequency	Percentage
IA	1	2.85
IIA	5	14.28
IIB	29	82.85
Types of Surgery		
WLE with EPR with Primary closure	25	71.43
WLE with EPR with Flap coverage	10	28.57

All of resection were R0. Osteosarcoma was the most common histopathological types (Table IV).

Table IV. Surgical resection margin & Histopathological type of tumor

Surgical resection margin	Frequency	Percentage
R0	35	100
R1	0	0.0
Histopathological types		
Osteosarcoma	18	51.42
Ewing's sarcoma	11	31.42
Chondrosarcoma	6	17.14

There were no wound dehiscence, DVT but both wound infection and dislocation developed in only 1 (2.9%) patient in my six months follow-up period (Table V).

Table V. Postoperative Complications

Postoperative Complications	Frequency	Percentage
Wound dehiscence	0	0.0
DVT	0	0.0
Wound infection	1	2.9
Dislocation	1	2.9

Majority 12 (34.3%) of WLE with EPR performed at distal femur region followed by proximal tibia 10 (28.6%), proximal femur 8 (22.9%) & then proximal humerus 5 (14.3%) (Table VI).

Table VI. Tumor site specific EPR

Tumor site specific EPR	Frequency	Percentage
Distal femur EPR	12	34.3
Proximal tibia EPR	10	28.6
Proximal femur EPR	8	22.9
Proximal humerus EPR	5	14.3

Mean MSTS score for female 23.08(76.94%)±SD 1.44 compared to 22.73(75.79%)±SD 2.37 for male (*p* value 0.96) by independent sample ‘t’ test (Table VII).

Table VII. Mean MSTS score according to sex

Gender	n	Mean MSTS	SD	<i>p</i> value
Male	23	22.79	2.37	0.96
Female	12	23.08	1.44	

Upper limb (proximal humerus) group had mean MSTS 23.4 (78%)±SD 1.14 compared to lower limb (proximal femur, distal femur & proximal tibia) group had mean MSTS 22.7 (75.6%)±SD 2.20 (*p* value 0.54). *p* value reached by independent sample ‘t’ test (Table VIII).

Table VIII: Mean MSTS score according to tumor site

Tumor site	n	Mean MSTS	SD	<i>p</i> value
Lower limb	30	22.76	2.20	0.54
Upper limb	5	23.40	1.14	

Detailed MSTS analysis (over 5 points assessment) revealed that for pain component upper limb (proximal humerus) group had a mean of 4.2 compared to 4.0 for lower limb (proximal femur, distal femur, proximal tibia) group, not a significant difference (*p*=0.67). The mean functional score for upper limb group was 4.6 compared to 3.8 for lower limb groups, not a significant difference (*p*=0.69). The mean emotional component score for upper limb group was 4.2 compared to 3.5 for lower limb groups, not significantly differences (*p*=0.82). *p* value reached by fisher’s exact test. The mean hand positioning, manual dexterity & lifting ability for upper limb were 3.6, 3.8 and 3.8 respectively. The mean support, walking & gait for lower limb were 3.80, 3.80 and 3.83 respectively (Table IX).

Table-IX: Detailed mean MSTS score (n=35)

Components of MSTS		Limb		<i>p</i> -value
		Upper	Lower	
MSTS Pain	3	0	3	0.67
	4	4	24	
	5	1	3	
	2	0	2	
	3	0	2	
MSTS Function	4	5	26	0.69
	2	0	2	
	3	0	2	
	4	5	26	
	5	0	2	
MSTS Emotion	2	0	3	0.82
	3	2	10	
	4	3	15	
	5	0	2	
	4	3	15	
MSTS LL Support	2	-	1	
	3	-	4	
	4	-	25	
	2	-	1	
MSTS LL Walking	3	-	4	
	4	-	25	
	2	-	1	
	3	-	4	
MSTS LL Gait	2	-	1	
	3	-	3	
	4	-	26	
	2	1	-	
MSTS UL Hand Positioning	4	4	-	
	3	1	-	
MSTS UL Manual Dexterity	4	4	-	
	34	14	—	
MSTS UL Lifting Ability				

Patients of proximal tibia group had mean MSTS score 23.5(78.33%)± SD1.17, proximal humerus group had mean MSTS 23.4(78%)± SD1.87, distal femur group had mean MSTS 22.75(75.83%)±SD1.21 and proximal femur group had mean MSTS score 21.87(72.91%)±SD3.79.(Table X).

Table-X: Distribution of patients for mean MSTS score according to tumour site

Tumour Endoprosthesis	Mean MSTS	SD
Proximal tibia EPR	23.50	1.17
Proximal humerus EPR	23.40	1.14
Distal femur EPR	22.75	1.21
Proximal femur EPR	21.87	3.79

Functional outcomes were excellent in majority 23 (66%) of patients, good in 11 (31%) and poor in only 1 (3%) of patients. (Table XI).

Table-XI. Distribution of patients according to functional outcome by MSTS score

Functional Outcome	Frequency	Percentage
Excellent	23	66
Good	11	31
Poor	1	3
Total	35	100

Discussion

Historically treatment of patients with malignant bone tumors of the lower extremity was limited to amputation. With improved systemic therapies and the development of limb salvage procedures, this approach has become the standard of care and endoprosthetic reconstruction the most common technique.⁹ Currently, wide surgical resection with tumour-free margin is the best means of local treatment followed by reconstruction of the resected bone with endoprosthesis. This kind of treatment can be used in about 80–90% of patients, giving them the best option to achieve good functional effect and reducing the risk of disability.¹⁰ A total of 43 patients of primary bone sarcoma (osteosarcoma, ewing's sarcoma & chondrosarcoma) were enrolled but 8 patients were lost to follow-up due to covid situation and finally 35 patients were evaluated.

In this current study it was observed that mean (\pm SD) age of the subjects was 24.45(\pm 11.04). Majority 21(60%) were in age group of 13-22 years. 6(17.1%) patients were in age group of 23-32 years, 4(11.4%) patients of 33-42 and rest 4(11.4%) were in age group 43-52 years. The youngest and the oldest patients were 13 and 51 years respectively. One study in U.K observed the mean \pm SD age was 26 \pm 12.36, which is closely resembled with the current study.¹¹ But another study in U.S.A observed the mean age was 38.1 \pm 27.1 years which are higher with the current study.¹² Majority 23 (65.7%) were males and 12 (34.3%) were females. The male to female ratio was 1.9:1 which is closely resembled with a study in China.² Similar observation regarding male predominant was also observed by another study.¹¹ Majority (85.71%) of tumour were in lower extremity,

among them right lower extremity was involved in 17(48.57%), left lower extremity involved in 13(37.14%), right upper extremity involved in 3(8.57%) and left upper extremity involved in 2(5.71%) patients. Almost similar type of result found in a study of U.S.A¹³.

In this current study pain was the most common presenting feature in majority of patients 24(68.6%). Whereas weight loss present in 14 (40%) of patients. Only 9(25.7%) patients were anaemic. Majority 29(82.9%) patients (both osteosarcoma & ewing's sarcoma) received NACT prior to WLE with EPR. Only 6 (17.1%) patients of chondrosarcoma did not receive NACT & majority 29(82.85%) of the tumours were stage IIB, 5(14.28%) were stage IIA & only 1(2.85%) was stage IA. One study in Poland found that majority 39(43.33%) were in stage IIB & 33(36.66%) stage IIA and only 4(4.44%) stage IA which is closely resembled with this current study findings.¹⁴

In this present study WLE with EPR with primary closure was done in 25(71.43%) patients, WLE with EPR with flap coverage (medial gastrocnemius muscle) was done in 10 (28.57%) patients & histopathologically all of our surgical resections were R0. A study in Poland found that all of their surgical resections were R0 which is similar with this current study findings.¹⁰ Again another study found that histopathological resection R0 was performed in 142 (81%) patients and R1 resection in 31 (18.85%) patients and our study results are better than this study findings.¹⁴ In present study, osteosarcoma was the most common 18 (51.42%) histopathological type & similar type of result found in Netherland.¹⁵

In this present study both superficial wound infection & dislocation were detected in only 1(2.9%) patient. It is right sided proximal femur ewing's sarcoma. This patient was immunocompromised and peroperatively more soft tissue were resected. So superficial wound infection and dislocation were developed at three months of my follow-up. No revision surgery was done for this patient, just only prolong broad spectrum antibiotic & chemotherapy going on. One study in Malaysia found that infection developed in 7(12.9%) patients (5 in the proximal tibia group and 2 in the distal femur group) which is higher than my study result.⁵ Again, in a different study in Turkey it was found that 15(17.8%) patients of endoprosthetic reconstruction has failed (dislocation in 5, infection in 5, structural/mechanical failure in 2, local recurrence

in 2 & aseptic loosening in only 1 patients of lower extremity bone sarcoma).¹⁶ Another study in Singapore found that two patients had subluxation of the hip endoprosthesis.³ One required revision surgery as it was infected as well as subluxated. The other patient was able to ambulate with crutches. None had implant loosening, breakage or periprosthetic fractures. There were no wound dehiscence and DVT at my 6 months follow-up postoperatively. Comparing with these studies, my study result regarding postoperative complications is better than other studies probably due to my follow-up period was only six months.

Majority 12(34.3%) of WLE with EPR done at distal femur region. 10(28.6%) were in proximal tibia region, 8(22.9%) in proximal femur region & then 5(14.3%) in proximal humerus region. Similar result also observed by a study in Pakistan & Germany and found that majority of patients underwent WLE with EPR at distal femur region.^{8,17} Mean MSTS score for women 23.08(76.94%)±SD 1.44 compared to 22.73 (75.79%)±SD 2.37 for men ($p=0.9$ not significant). A study in China found no significant difference of the MSTS score between men & women (21.1±7.1 vs 21.4±7.7, $p=0.6$ also not-significant) which is closely resembled with my study results.²

In this present study, it was observed that, upper limb (proximal humerus) group had higher mean MSTS 23.4(78%) compared to lower limb (combined proximal femur, distal femur & proximal tibia) group 22.7(75.6%). Similar type of results also found in Singapore that upper limb procedure 27(90%) had higher mean MSTS score compared with lower limb procedures 23.1(77%).³

On detailed MSTS analysis (over 5 points assessment) revealed that mean MSTS score for pain, function, emotion, support, walking & gait of lower limb were 4.0, 3.8, 3.5, 3.8, 3.8 and 3.83 respectively. A similar type of result in Poland found that mean MSTS of that six component were 4.3, 3.7, 4.3, 4.2, 4.2 and 3.7 respectively.¹⁴ Again the mean MSTS score for pain, function, emotion, hand positioning, manual dexterity and lifting ability of upper limb were 4.2, 4.6, 4.2, 3.6, 3.8 and 3.8 respectively. A similar type of result in Japan found that mean MSTS score of that six component were 5, 4, 4, 4, 5 and 4 respectively.⁷

Again in this current study, it was observed that mean MSTS score for pain component of upper limb (proximal humerus) group 4.2 compared to 4.0 for lower limb (proximal femur, distal femur, proximal tibia) group, not a significant difference ($p=0.67$). The mean functional score for upper limb group was 4.6 compared to 3.8 for lower limb groups, not a significant difference ($p=0.69$). The mean emotional component score for upper limb group was 4.2 compared to 3.5 for lower limb groups, not significantly different ($p=0.82$). Compared to a study in Malaysia on detailed MSTS analysis (over 5 point assessments) revealed that for the pain component, the proximal tibia group had a mean of 3.9 compared to 4.2 for distal femur group, not a significant difference ($p=2.91$).⁵ The mean functional score for the distal femur group was 3.3 compared to 3 in the proximal tibia group, also not a statistically significant difference ($p=3.8$). The mean emotional component score for the distal femur group was higher 3.2 vs. 2.8 for proximal tibia group, not significantly different ($p=7.6$).

In this present study, patients of proximal tibia tumour group had mean MSTS score 23.5(78.33%)±SD1.17, proximal humerus group had mean MSTS was 23.4(78%)±SD1.87, distal femur group had mean MSTS 22.75(75.83%)±SD1.21 and proximal femur group had mean MSTS 21.87(72.91%)±SD 3.79. One study in Poland found that mean MSTS 25.5(85%) at both proximal humerus and distal femur group and mean MSTS 24.3(81%) for proximal femur and 22.5(75%) at proximal tibia group.¹⁴ But in another study in Germany best MSTS score 24.9(83%) found at proximal tibia replacement followed by distal femur replacement 24(80%).¹⁸ Both of these two study results are closely resembled with my study results.

Regarding functional outcome at first six months postoperative follow-up, majority 23 (66%) were excellent, 11 (31%) were good and only 1 (3%) was poor. One study in Pakistan found excellent outcome in 18 (52.9%), good outcome in 6 (17.6%), fair outcome in 5 (14.7%) and poor outcome were reported in 6 (17.6%) cases.⁸ Another study in U.S.A found good or excellent functional outcome in 94 (85.4%) patients, moderate in 9 (8.2%) patients & poor in 7 (6.4%) patients.⁴ So our functional outcome is better than both of these two study findings. Limited postoperative follow-up time and small sample size. Similar type of study can be done with large sample size & long follow-up time.

Conclusion

Well planned & performed combined treatment of the patients of bone sarcoma with WLE & EPR lead to good-excellent functional results. Majority (66%) of patients return to near normal life and work with excellent functional outcome. After analyzing the results it can be concluded that WLE & EPR provide good functional outcome after bone tumour resection.

Conflict of interest: No conflict of interest.

Ethical Approval: Approved from Ethics Committee of National Institute of Cancer Research and Hospital (NICRH), Mohakhali, Dhaka, Bangladesh.

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