



Results of Resection of Tumors around Knee with Reconstruction Using Arthrodesis or Endoprosthetic Reconstruction

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Abstract

Juxta articular tumors are most common around knee. Wide resection and reconstruction with arthrodesis or Endoprosthesis, for patients with more biologically aggressive, recurrent tumors, is an attractive option.

Materials And Methods: 27 patients with mean age of 28.8yrs with , GCT – 21 , Ewings sarcoma – 1 , Chondroblastoma – 1 , Chondrosarcoma – 1, Fibrosarcoma – 1, Fibroma – 1, Benign fibrous histocytoma – 1, 24 benign and 3 malignant were treated from 2004 – 2013 . Wide resection and arthrodesis with dual free fibular graft and intramedullary nail for 19 patients and Endoprosthetic reconstruction for 8 patients. 17 were in distal femur and 10 were in proximal tibia. 17 were females and 10 were males. Mean follow up of 69.4 months. Functional evaluation done using modified system of Musculoskeletal Tumor Score.

Results: In Resection Arthrodesis out of 19 patients 15 patients had excellent results, 3 patients had good results.1 patient had fair result. In Endoprosthetic reconstruction out of 8 patients 6 patients had excellent results, 2 patients had good results. Out of the 19 patients who underwent resection arthrodesis 1 patient has soft tissue recurrence , 2 patients has fibular graft site fracture, 1 patient has non union at graft host interface, 1 patient has superficial infection. Out of the 8 patients who underwent endoprosthetic reconstruction 1 patient has soft tissue recurrence of tumor, 1 patient has aseptic loosening of implant , 1 patient has superficial wound infection.

Conclusion: Following wide resection of juxta articular tumors reconstruction with arthrodesis and reconstruction with endoprosthesis have good and comparable results .Both procedures give good and satisfactory results with arthrodesis being a very low cost alternative.

Keywords: Tumors around knee, Resection Arthrodesis, Endoprosthetic reconstruction.

Introduction

Juxta articular tumors are most common around knee joint. Before 1970, management of aggressive benign, recurrent and malignant bone tumors was amputation. Development of more effective chemotherapeutic agents and treatment protocols in 1970s and 1980s, survival rates improved, which allowed the focus of management to shift to limb preservation.¹ CT and MRI allow the precise visualization of the anatomic location of a tumor and its relation to surrounding structures. Preoperative planning has been advanced through the use of these modalities, fostering better patient selection for specific treatment strategies and lowering the morbidity of biopsy and subsequent resection.^{2,3} Currently 80% to 85% of patients with primary malignant bone tumors involving the extremities can be treated safely with wide resection and limb preservation.⁴ Multimodality therapy has increased long term survival rates of patients with chemotherapy sensitive tumors to 60% to 70%.^{1,5} However, reconstruction of large bone defects after resection of tumor with a wide margins remains a major challenge.

The various options for reconstruction after resection of tumor around knee include ⁶

1. Endoprosthetic replacement
2. Osteoarticular allograft
3. Allograft prosthesis composite
4. Resection arthrodesis
5. Ilizarov lengthening
6. Rotationalplasty
7. Vascularized or conventional autograft techniques

Prosthesis replacement after resection of bone tumors around knee joint has been demonstrated to provide good function in most cases. However unfortunately, prosthesis related complications still remain an unresolved problem. Improvement in patient survival has led to subsequent surgical resection of the prosthesis and a result of increases in prosthesis related complications like aseptic

loosening, periprosthetic infections, wear of joint components, dislocations, breakage of prosthesis and fatigue fractures. Endoprosthetic replacement incurs high cost, requires adequate motor reconstruction and repeated surgeries. An Arthrodesis is less attractive initially, but once it is achieved it provides a stable limb and the patient is unlikely to require revision surgery and also cost effective.

Aims and Objectives

1. To assess the functional outcomes of limb salvage surgeries for tumors around knee with Resection Arthrodesis and Total knee replacement with endoprosthesis
2. To provide well functioning tumor free and painless limb
3. To assess the recurrence rates of tumor after surgery
4. To assess the problem and complications that occurs during and after surgery and treatment
5. To compare functional outcomes of Resection Arthrodesis and Total Knee Replacement with Endoprosthesis

Materials and Methods

This is a prospective and retrospective descriptive study, includes operations that were undertaken between January 2004 and January 2014 for tumors around knee and including the patients who are fulfilling the inclusion and exclusion criteria.

Inclusion Criteria:

- Tumors that can be excised with adequate margins
- Expected Local recurrence rate equivalent or less than those with amputation
- Best expected survival rate
- Administration of adjuvant chemotherapy as scheduled in case of malignant tumors

Exclusion Criteria:

- Displaced pathological fracture with huge hematoma and extensive contamination

- In appropriate biopsy procedure
- Biopsy site complications
- Poor soft tissue conditions after chemotherapy or radiotherapy

Method of Study

After admission and complete history, all patients were clinically examined in detail with special regard to the following points.

1. Local examination of the swelling.
2. Tenderness, effusion and limitation of movement in the contiguous joint.
3. Regional draining lymph nodes.
4. Secondary deposits especially in the chest.
5. Functional derangement.

Investigations

All cases were investigated radiologically, biochemically and pathologically. Plain radiographs were the most important radiological tools. All tumors were radiographed in at least two different planes, anteroposterior and lateral including the nearest joint. Magnetic resonance imaging scans will be performed in all cases to know the extent of lesion. In all cases, the chest was radiographed to detect possible chest metastasis irrespective whether the symptoms were present or not. Computerized tomography scan was performed to the patients with doubtful metastasis and for tumors with pathological fractures. Technetium 99 bone scan was done in cases of malignant bone tumors to look for other skeletal sites for metastasis.

After radiographs, all routine blood investigations like complete haemogram, serology for HIV, HBsAg, blood grouping were performed.

All the cases presumptively diagnosed were subjected to Fine Needle Aspiration Cytology for histopathological confirmation of diagnosis. If the diagnosis was not confirmed by FNAC then open biopsy. All the surgeries are done by senior

faculty. The placement of an open biopsy incision is critical. Incisions are given vertically and placed in a manner that would allow for complete excision of the biopsy track at the time of definitive treatment. Soft tissue seedling of the tumor is avoided by splitting the muscles rather than developing flaps. Cortical windows were made carefully to avoid spillage of tumor and adequate tissue was taken for histological diagnosis. Meticulous haemostasis is achieved by gel foam as and when necessary.

The biopsy material was reviewed and examined by the same Pathologist and the histological findings were confirmed by an experienced musculoskeletal pathologist. If the diagnosis was malignant bone tumor then patient is being subjected to Neo adjuvant chemotherapy. After histopathological diagnosis all the tumors were staged according to Enneking's staging system.

27 patients with mean age of 28.8yrs (Table 1) with , GCT – 21 , Ewings sarcoma – 1 , Chondroblastoma – 1 , Chondrosarcoma – 1, Fibrosarcoma – 1, Fibroma – 1, Benign fibrous histiocytoma – 1(Table 2) , 24 benign and 3 malignant were treated at single hospital from 2004 – 2013 . Wide resection and arthrodesis with dual free fibular graft and intramedullary nail for 19 patients and Endoprosthetic reconstruction for 8 patients. 17 were in distal femur and 10 were in proximal tibia. 17 were females and 10 were males . Mean follow up of 69.4 months. Functional evaluation done using modified system of Musculoskeletal Tumor Score (Enneking WF 1987)¹¹

Surgical procedure

Resection Arthrodesis: A wide resection was performed in all the patients using the medialparapatellar and subvastus incisions for lower femoral GCTs and the same incision extended distally for the upper tibial tumors. The incision, however, had to be modified if the previous biopsy/ surgery done at other hospitals. Arthrodesis was done with long IM nail and dual

free fibular graft was done in 19 cases . A long IM nail was placed in a retrograde fashion, extending from the greater trochanter to distal tibial metaphysis. Dual free fibular grafts were placed spanning the resection length . The patients were allowed partial weight-bearing with a long leg cast by about 28 weeks postoperatively. The patients however, returned to vigorous activity at an average of 52-56 weeks. The average time to fusion was 52 weeks.

Endoprosthetic Replacement: Extended medial parapatellar approach encircling the biopsy scar was used in all our cases. This approach aids in vascular dissection, so that the popliteal vessels can be isolated and the tumor dissection carried out. For distal femoral tumors we used the technique of sleeve resection of quadriceps musculature. The main objective of this technique is to excise a sleeve of quadriceps musculature all around the tumor but retain the functioning rectus femoris tendon. The excision removes a portion of the vastus lateralis, medialis and intermedius, as is deemed necessary in the particular case, but preserves enough musculature to provide soft tissue cover for the prosthesis and retain adequate extension power. By this technique, we were able to attain a balance between achieving an adequate surgical margin and retaining sufficient functioning musculature. For proximal tibial lesions resection of the tumor bearing part and a medial gastrocnemius rotation flap was used to cover the prosthesis. The extensor mechanism was repaired by direct suturing of the patellar tendon to the transposed flap.

Table 1 (Age distribution)

AGE IN YEARS	NO. OF CASES	% OF CASES
11 – 20	4	15%
21 – 30	14	52%
31 – 40	6	22%
41 – 50	2	7%
>51	1	4%

Prosthesis: Two types of prosthesis were used , one with rotating axis mechanism (Figure 1) and other with out rotating axis mechanism(Figure 2). The rotating axis mechanism provides 30° of rotation between the femoral and tibial component and hence decreases the risk of implant loosening. Post operatively range-of-motion and strengthening exercises are begun from 3rd postoperative day and protected ambulation with walker support and knee brace are started.

Results

The minimum follow-up was 11 months and the maximum follow-up was 117 months with an average of 69.4 months. Functional results were analysed using Enneking criteria ¹¹. In Resection Arthrodesis out of 19 patients 15 patients had excellent results (Figure 3), 3 patients had good results. 1 patient had fair result (Table 3). In Endoprosthetic reconstruction out of 8 patients 6 patients had excellent results(Figure 4), 2 patients had good results (Table 4). Out of the 19 patients who underwent resection arthrodesis 1 patient has soft tissue recurrence, 2 patients has fibular graft site fracture(Figure 5), 1 patient has non union at graft host interface , 1 patient has superficial infection. Out of the 8 patients who underwent endoprosthetic reconstruction 1 patient has soft tissue recurrence of tumor, 1 patient has aseptic loosening of implant after 66 months of primary surgery(Figure 6) , 1 patient has superficial wound infection.

Table 2 (Type of Tumor)

Type	NO. OF CASES	% OF CASES
GIANT CELL TUMOR	21	77.7%
CHONDROBLASTOMA	1	3.7%
CHONDROSARCOMA	1	3.7%
FIBROSARCOMA	1	3.7%
EWINGS SARCOMA	1	3.7%
DESMOPLASTIC FIBROMA	1	3.7%
BENIGN FIBROUS HISTOCYTOMA	1	3.7%

Table 3 (Resection Arthrodesis Functional Outcome)

GRADE	NO. OF CASES	% OF CASES
EXCELLENT	15	78.9%
GOOD	3	15.8%
FAIR	1	5.3%
POOR	0	0

Table 4 (Endoprosthesis Reconstruction Functional Outcome)

GRADE	NO. OF CASES	% OF CASES
EXCELLENT	6	75%
GOOD	2	25%
FAIR	0	0
POOR	0	0

Table 5 (comparison of results of resection arthrodesis of our study with other study)

Study	A.A. Bassiony et al 2009 ²⁵	Our study
Number Of Cases	8	9
Mean age	37yrs	27.2yrs
Mean Follow Up	48.75 months	84.4 months
Time for graft union	14.5 months	13 months
Functional scores	20-27/30	19-29/30

Table 6 comparison of results of endoprosthetic reconstruction with other study)

Study	<i>DA Rubio et al 2013</i> ²¹	Our Study
Number of cases	22	8
Mean Age	18 yrs	32.8 yrs
Mean follow up	56 months	33 months
Functional scores	23-30/30	25-30/30

Figure 1



Rotating platform

Figure 2



Without Rotating platform

Figure 3



73 months follow up

Figure 4



36 months follow up

Figure 5



Figure 6



Discussion

Juxta articular tumors are more common around knee. In early 1970's management of aggressive, recurrent and malignant bone tumors was amputation. With the advent of neoadjuvant chemotherapy, modern imaging techniques and development in surgical techniques enables limb salvage surgery with well functioning tumor free painless limbs. Wide resection of the tumor creates massive bone and soft tissue defects. Reconstruction of residual defect after wide resection is a challenging event.

Resection arthrodesis of the knee has been found to be a useful procedure for tumors around the knee. While reconstruction with prosthesis and allografts provides better function to the limb in the short term by restoring the joint motion, they may not be an ideal choice for young vigorous adults with a normal life expectancy.

These patients are likely to outlive the expected life of a hinged prosthesis even after one or more revisions. It provides stable limb suitable for patients who physically have intense occupation but results in sacrifice of Range of Motion. Average time for graft incorporation was 13 months and the results in our study were comparable to those reported by A.A. Bassiony et al 2009²⁵ (Table 5).

Endoprosthetic replacement provides early resumption of knee function with unassisted ambulation and least rates of recurrence. The possible complications include flap necrosis, secondary infection, aseptic loosening fracture and breakage. One of the major technical issues of distal femoral resection is the relationship between quadriceps excision and gait which may influence implant failure and gait pattern. By following the sleeve resection of quadriceps musculature, we were able to achieve an excellent or good functional outcome in 89% of patients when compared with 84% reported by Mittermeyer et al²⁶. The medial gastrocnemius rotation flap has provided a very satisfactory method of

overcoming the two major problems in managing proximal tibial tumors, namely, providing soft tissue cover for the metallic endoprosthesis and maintaining the continuity of extensor mechanism as described by Malawar and McHale et al¹⁰. It is high cost and requires repeated surgeries. Patients long term survival and the prosthesis survival remains issues. The results of our study are comparable to those of study conducted by DA Rubio et al 2013²⁷ (Table 5). The risk of implant loosening can be reduced by using endoprosthesis with rotating hinge platform.

In our study the functional results of Resection arthrodesis is excellent in 78.9%, good in 15.8% and fair in 5.3% patients and in Endoprosthetic reconstruction excellent in 75% and good in 25% patients according to Revised Musculoskeletal Tumor Society Rating Scale.

There are no studies comparing the functional outcomes of resection arthrodesis and endoprosthetic reconstruction. In our study both resection arthrodesis and endoprosthetic reconstruction has excellent to good functional outcomes according to Revised Musculoskeletal Tumor Society Score. Randomization in our study was done based on affordability of surgery. Patients who were affordable were treated with endoprosthetic replacement and those who were not affordable were treated with resection Arthrodesis. Patients who received an arthrodesis had a more stable limb and performed the most demanding physical work. but they had difficulty in sitting. However, endoprosthetic patients have to live more sedentary life due to a feeling of weakness and instability.

Recurrence rates in our study was two (7.4%) out of 27 patients had a local recurrence of tumor at a mean of 69.4 months of follow up. All the recurrences have occurred within 2 years after the index operation. Two recurrences were soft tissue recurrences and was treated with excision of the soft tissue swelling.

In our study Of 27 patients 19 underwent Resection Arthrodesis while 8 underwent Endoprosthetic replacement. Out of the 19 patients who underwent resection arthrodesis 1 patient had soft tissue recurrence treated with excision of the tumor, 2 patients had fibular graft site fracture treated 1 with above knee pop cast and other with ilizarov, 1 patient had non union at graft host interface treated with bone grafting , 1 patient had superficial infection treated with regular dressings.

Out of the 8 patients who underwent endoprosthetic reconstruction 1 patient had soft tissue recurrence of tumor, treated with excision of tumor, 1 patient had aseptic loosening of implant treated with revision of prosthesis, 1 patient had superficial wound infection treated with regular wound dressings.

Conclusion

Advent of Neoadjuvant chemotherapy, Modern imaging analysis and development in surgical techniques has revolutionized limb salvage surgery in the management of musculoskeletal tumors. Limb salvage surgery provides painless, tumor free and functional limb. Resection arthrodesis , provides stable limb suitable for patients who physically have intense occupation but results in sacrifice of Range of Motion. It is an ideal choice for young vigorous adults with a normal life expectancy. These patients are likely to outlive the expected life of a hinged prosthesis even after one or more revisions. Endoprosthetic replacement provides early resumption of knee function with unassisted ambulation. Endoprosthetic replacement is more suitable for elderly people with more sedentary life .Endoprosthetic replacement requires multiple surgeries during their life time because of implant loosening. Both the procedures have low recurrence rates for tumor .Both Resection Arthrodesis and Endoprosthetic replacement has excellent and good functional outcomes with resection arthrodesis being low cost effective with the sacrifice of knee range of motion.

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