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Giant cell tumor of the proximal tibia treated with en-block resection and reconstruction with knee endoprosthesis: A case report

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Abstract
Giant cell tumour (Osteoclastoma) is a benign, locally destructive tumour with low metastatic potential, but it has a tendency to recur after treatment. The primary areas of involvement are the ends of long bones, commonly the distal femur and proximal tibia. The most preferred treatment modality of the giant cell tumour is surgery.

Case report: A 52-year-old male presented with pain and slight swelling localized over the proximal left tibia and limited range of motion in the left knee. After histological confirmation of the diagnosis with open biopsy, en bloc resection of the lesion was made with a reconstruction of a knee joint with semi-constrained knee endoprosthesis and trabecular metal.

Conclusion: Selecting the appropriate treatment method is very important for the recovery of the function of the affected joint and for the whole extremity, as well. There is an advantage of en bloc resection and reconstruction with semi-constrained knee endoprosthesis in combination with trabecular metal in cases with extensive destruction of bone structure, recurrence, pathological fracture or difficulty in reconstruction after intralesional curettage. Advantages in functional aspect of this treatment modality are retaining the stability of the knee joint, substituting the bone defect and fast recovery of the function of the affected joint and limb.

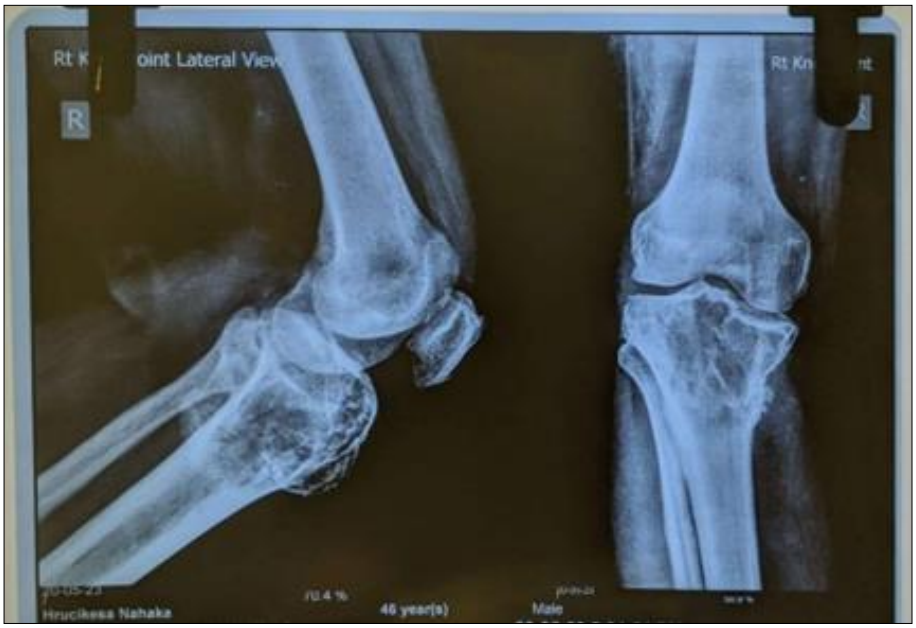
Keywords: Giant cell tumour, Knee Endoprosthesis, En-Bloc Resection

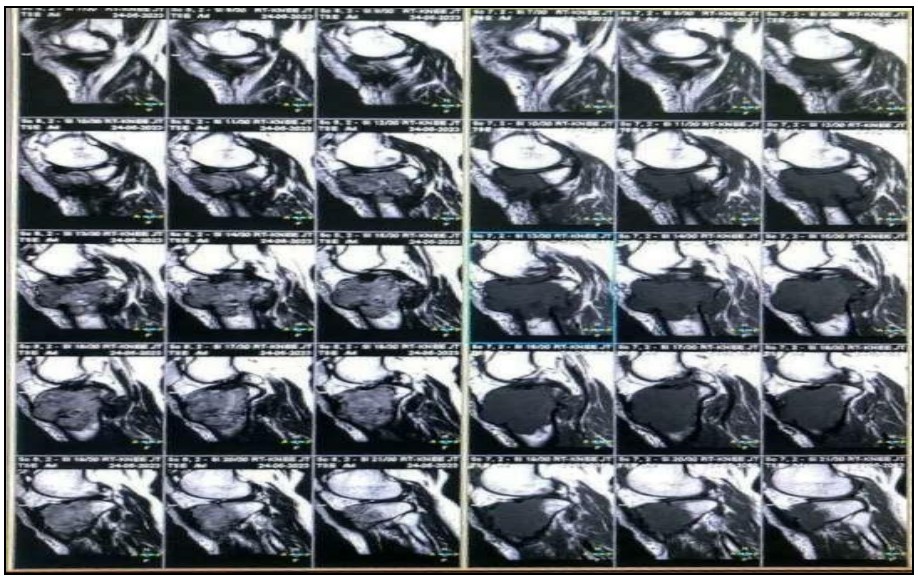
Introduction

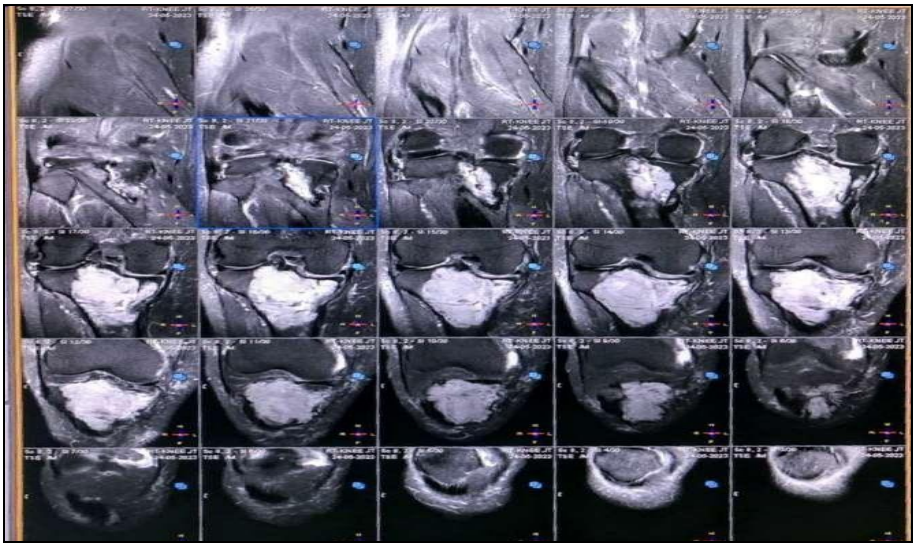
Giant cell tumor (osteoclastoma) is a benign, locally destructive tumor composed of three types of cells. Type I cells look like fibroblasts, produce collagen, and have capacity to proliferate. This population of cells share some features of mesenchymal stem cells and is likely the tumor component of giant cell tumor. Type II cells are interstitial but resemble the monocyte/macrophage family and express surface receptors. Type III cells are multinucleated giant cells that share characteristics of and have morphologies similar to those of osteoclasts. In some cases the lesion primarily manifests semi-malignant characteristics or secondary malignant transformation. Lung metastasis occurs in 3-5% of cases [1]. Giant cell tumor has propensity to locally recur after treatment but has a low metastatic potential. The tumor is not uncommon representing around 4–5% of all primary bone neoplasms, and more than 20% of benign primary bone tumors. Young adults are commonly affected and peak incidence is seen around 20–45 years of age and it occurs slightly more often in females than in males. The primary areas of involvement are ends of long bones commonly the distal femur, proximal tibia, proximal humerus and styloid process of distal radius [1, 2]. The macroscopic appearance of giant cell tumor is usually quite characteristic. The lesion is soft and dark brown, sometimes intermingled with areas that are yellow, corresponding to xanthomatous areas or white, corresponding to fibrous areas [3]. Giant cell tumors are highly vascular, often producing blood-filled cystic cavities with variable degrees of cortical expansion and disruption, however, the periosteum is rarely breached [1, 3]. Radiologically, the characteristic appearance of giant cell tumor is an eccentric geographical lytic lesion without matrix formation typically localized between the epiphysis and the metaphysis. Computed tomography scan provides a good evaluation of cortical continuity.

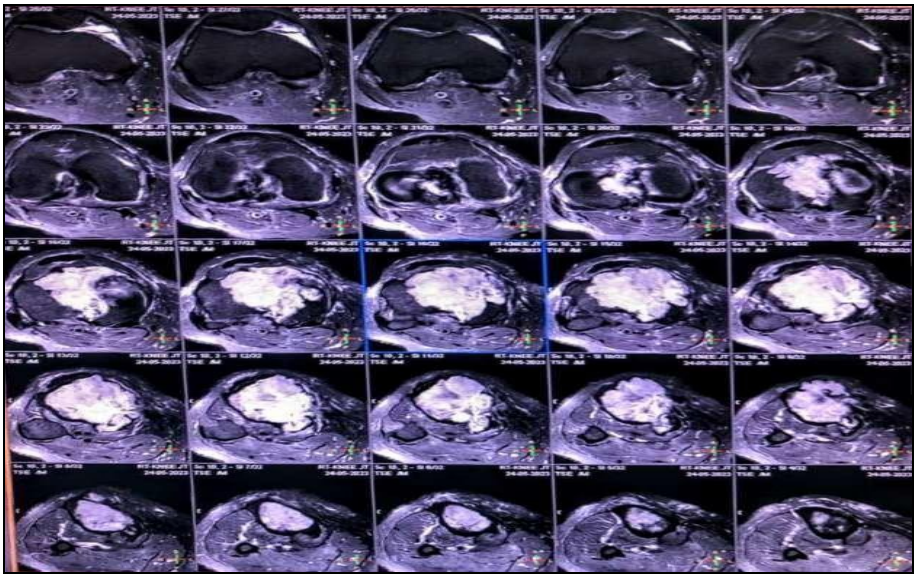
Magnetic resonance imaging is the investigation of choice for surgical planning especially in aggressive, forms where soft tissue extension needs accurate assessment [6]. Biopsy is mandatory to confirm a diagnosis and is achieved via core-needle or open biopsy [1]. Pain is the most common presenting symptom, along with swelling, deformity of joint, joint effusion and limited range of motion. Pathological fractures are seen in around 10-30% of patients [1, 2, 4]. The treatment can commence after the diagnostic protocol is completed. In some cases, especially in the cases of semi-malignant and malignant characteristics of the lesion, combination of surgical treatment and radiation therapy is used. The surgical treatment of giant cell tumor mainly includes intralesional curettage and its modifications and resection with reconstruction. The treatment with intralesional curettage has local recurrence rate of 10% to 20% while en block resection produces the lowest recurrence rate [1, 5].

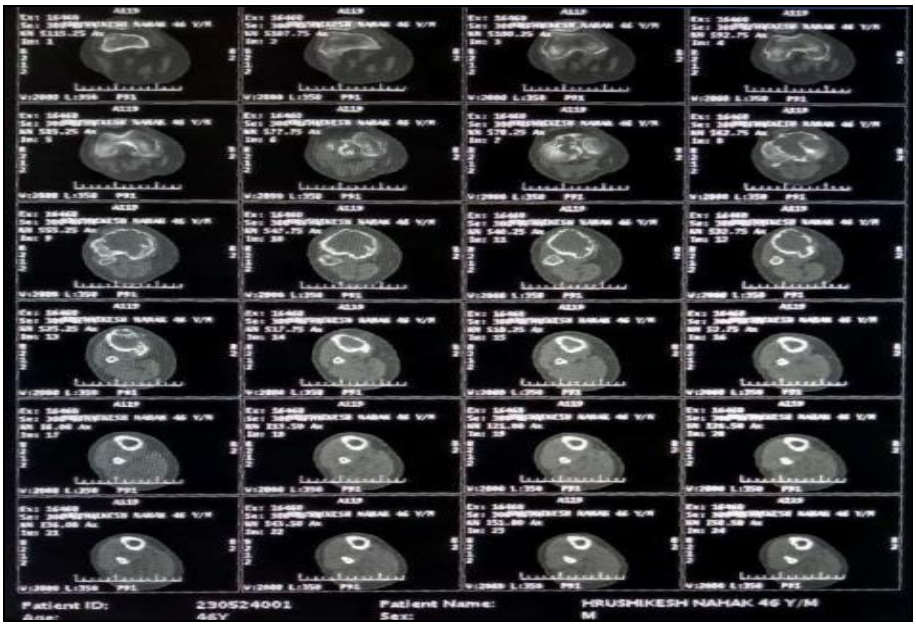
Case report: We report a case of a 52-year-old male presented at our ANH NRI Institute of Medical Sciences with pain and slight swelling localized over the proximal left tibia and limited range of motion in the left knee. After the admission and completing of the laboratory examinations, radiographic investigations have been made. Massive lytic, well-defined lesion, with secondary cortical breakthrough and typical involvement of the distal part of the extensor apparatus (Lig. patellae proprium) was visualized. After completing the clinical examinations, with open biopsy and histological confirmation of giant cell tumor and after the detailed pre-operative planning, the surgical procedure was performed. Using the medial parapatellar approach and utilizing the approach made for biopsy, exposure and removal of the tumor were managed in strict accordance with the principles of surgical treatment of bone tumors. Complete removal of the lesion was followed by implantation of the semi-constrained knee endoprosthesis. Tibial component was implanted and fixed using bone cement. Trabecular metal cone augment was used for substituting the bone defect and achieving anatomical reconstruction. Once the distal femur was completely prepared, implantation of the femoral component with adequate spacer followed. The femoral component was fixed with bone cement, as well, In the whole procedure, special attention was dedicated on the preservation of the collateral ligaments and reconstruction of the extensor apparatus. At last, motion and stability of the knee joint was checked.







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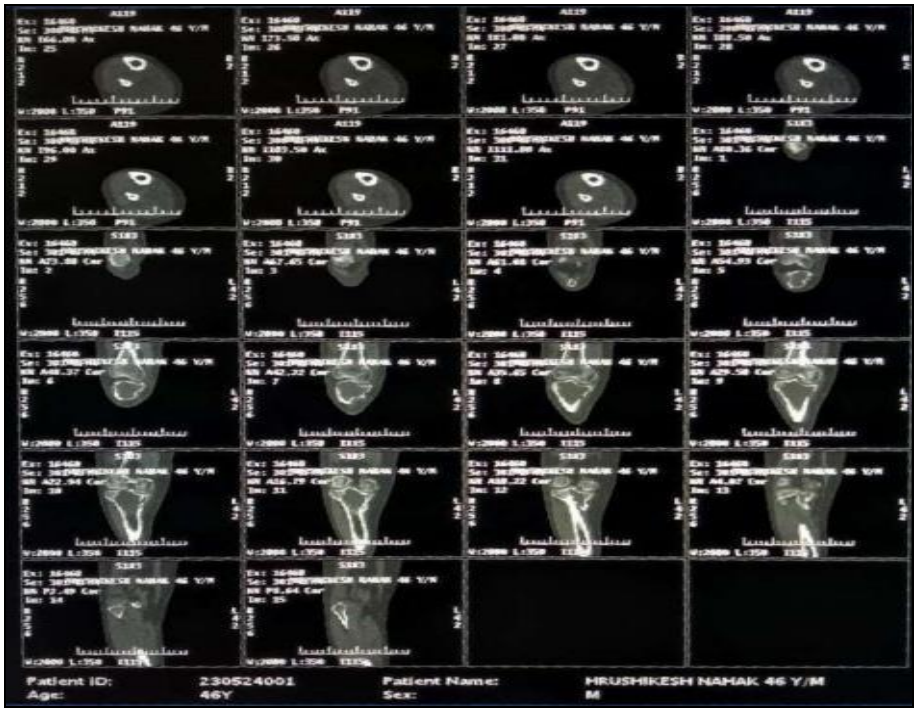

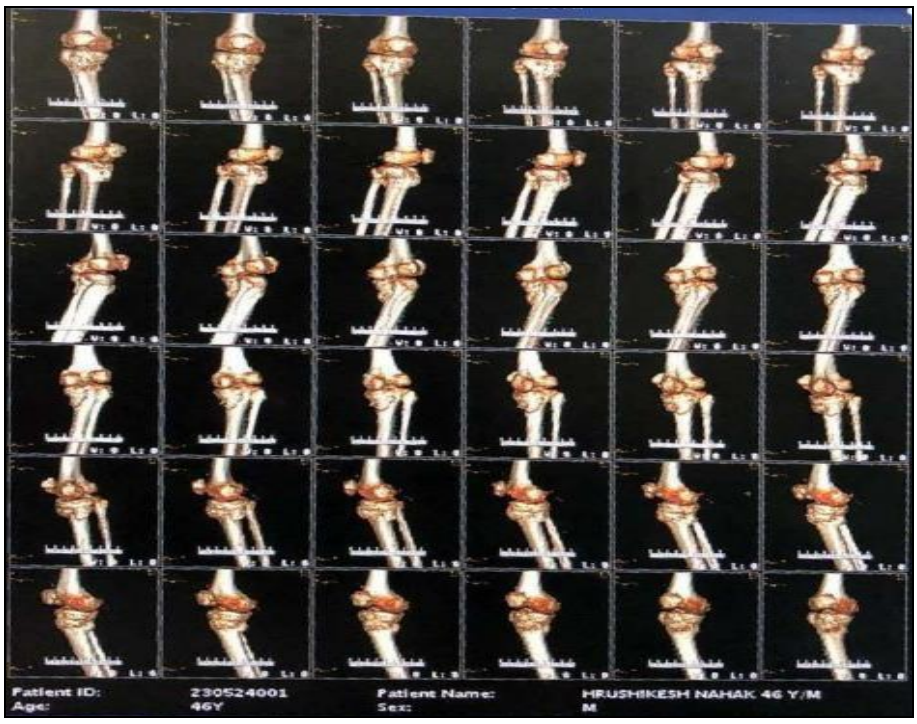

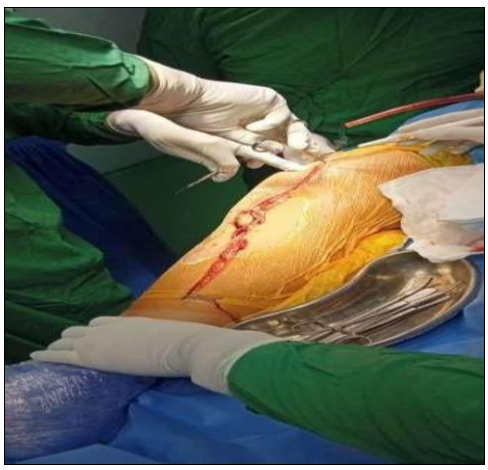

Fig 1: Medial parapatellar incision

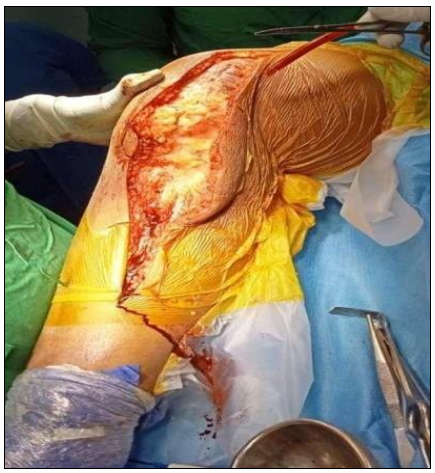

Fig 2: Elevating skin along with facisocutaneous layer

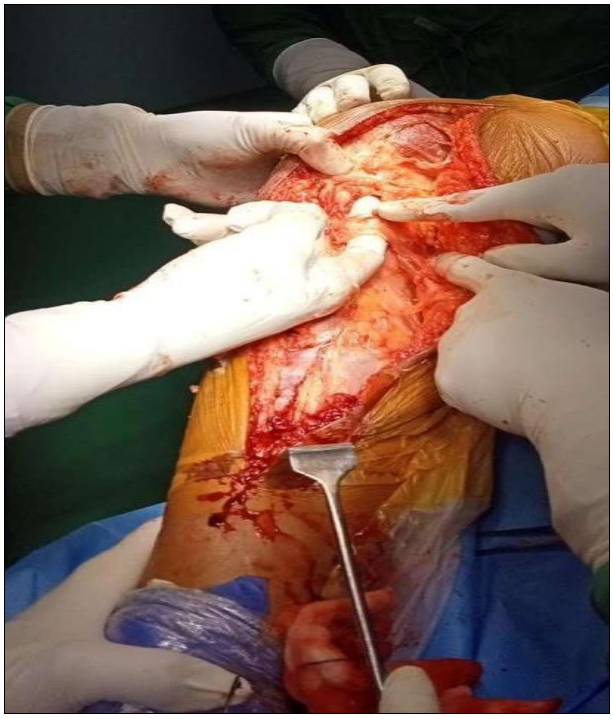

Fig 3: Incision of pes *anserinus muscles*

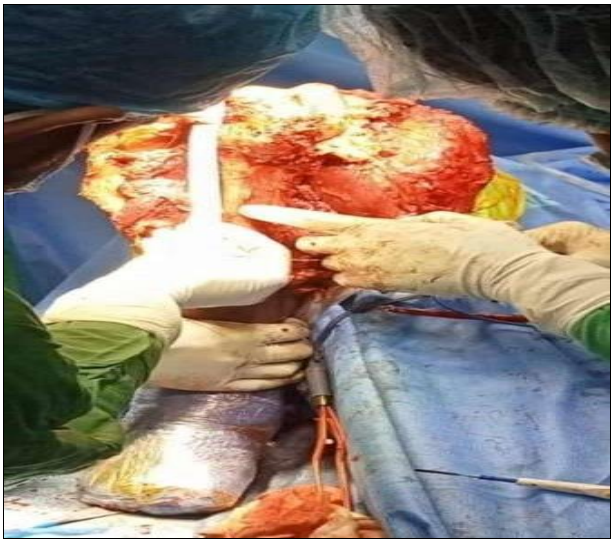

Fig 4: Measuring the length of proximal tibial bone to be excised

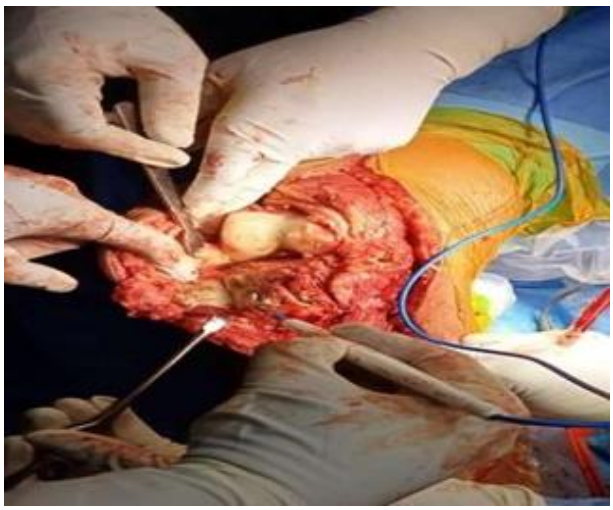

Fig 5: Medial patellar arthrotomy with elevation of patella tendon from tibial tuberosity

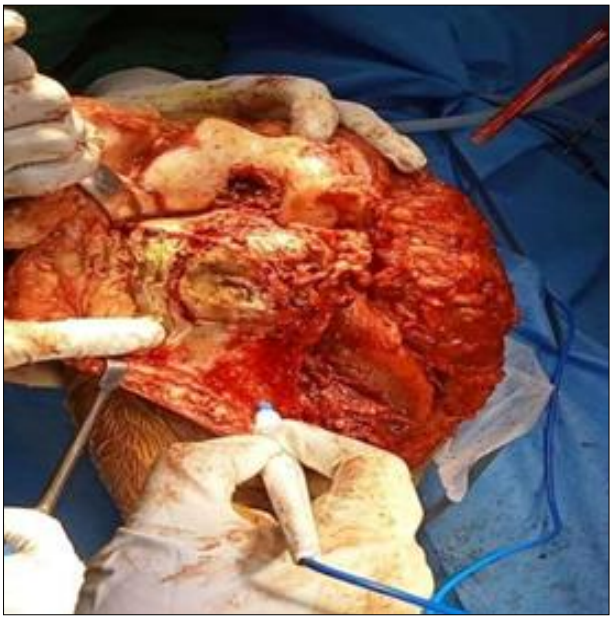

Fig 6: Dissecting muscles from the lateral part of proximal tibia to identify proximal tibiofibular joint

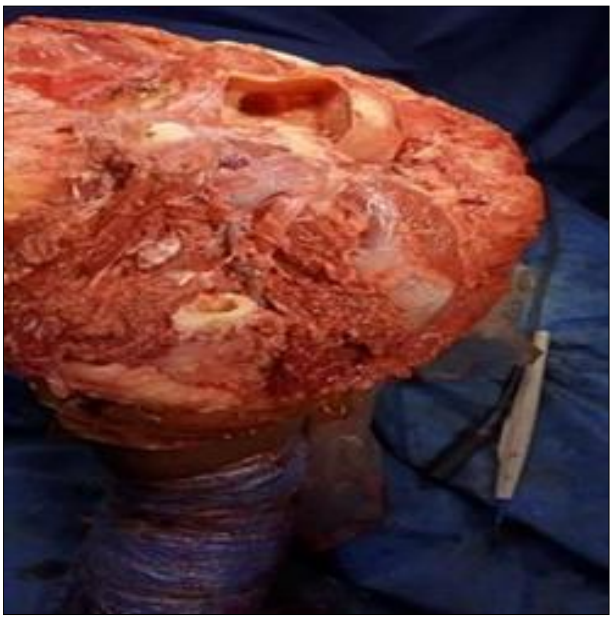

Fig 7: End picture after preparation of distal femur

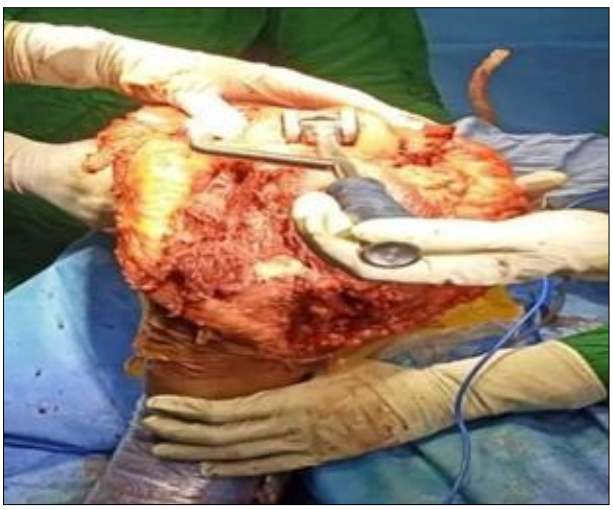

Fig 8: Preparation of hinge screw from lateral to medial

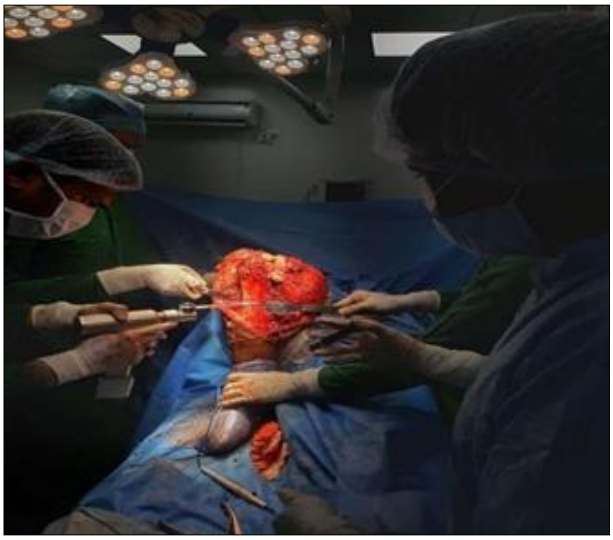

Fig 9: Sawing the proximal tibia bone

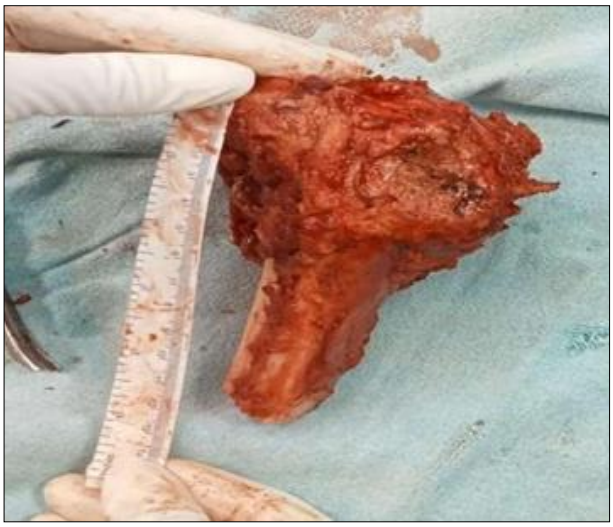

Fig 10: En bloc of proximal tibia resected

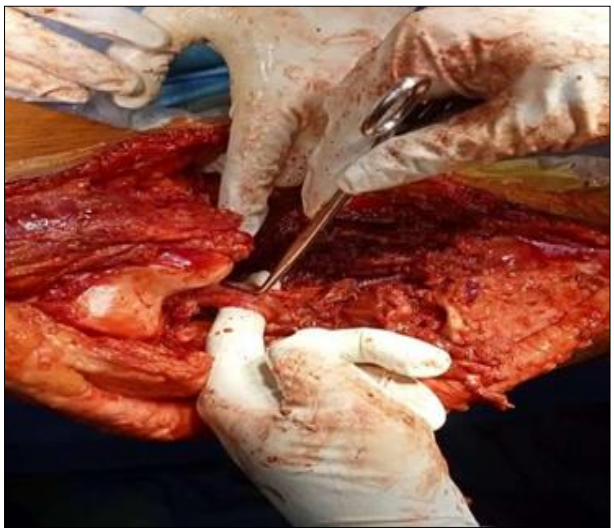

Fig 11: Identification of ant. tibial artery, post tibial artery, peroneal

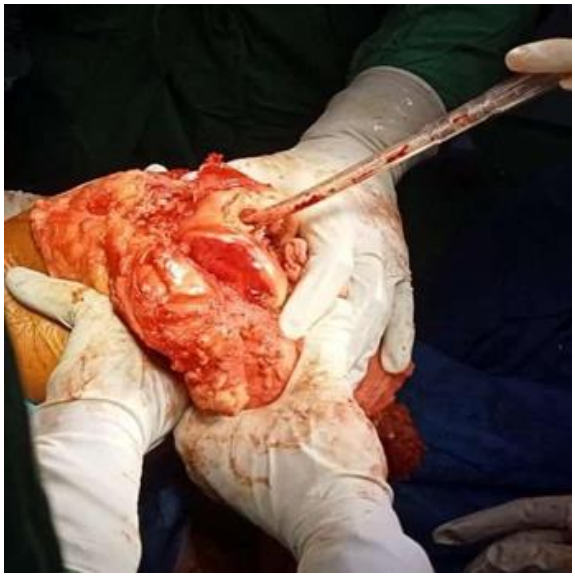

Fig 12: Prep of femoral stem

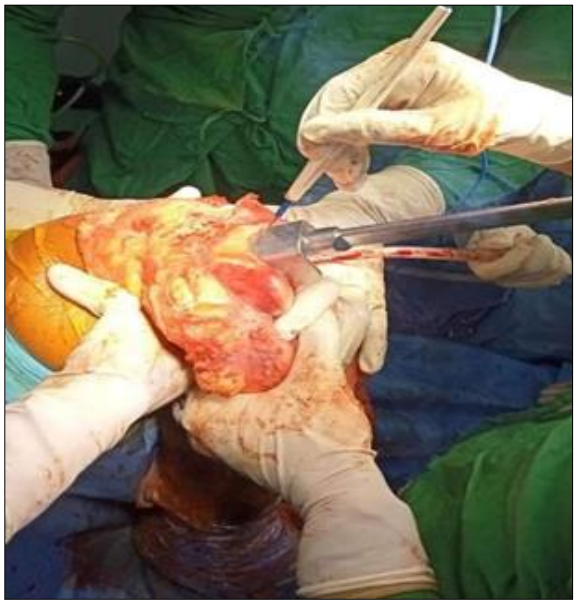

Fig 13: Box cut of distal femur

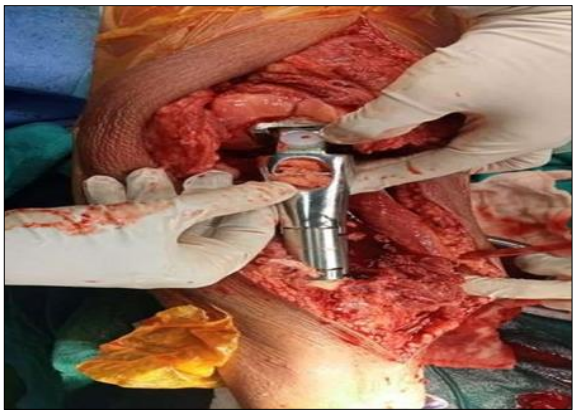

Fig 14: Impaction of the bone graft on the implant groove

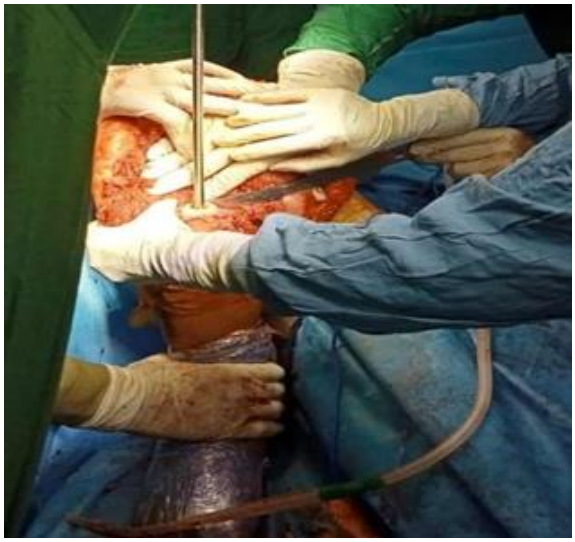

Fig 15: PREPA of tibia stem with consecutive reamers

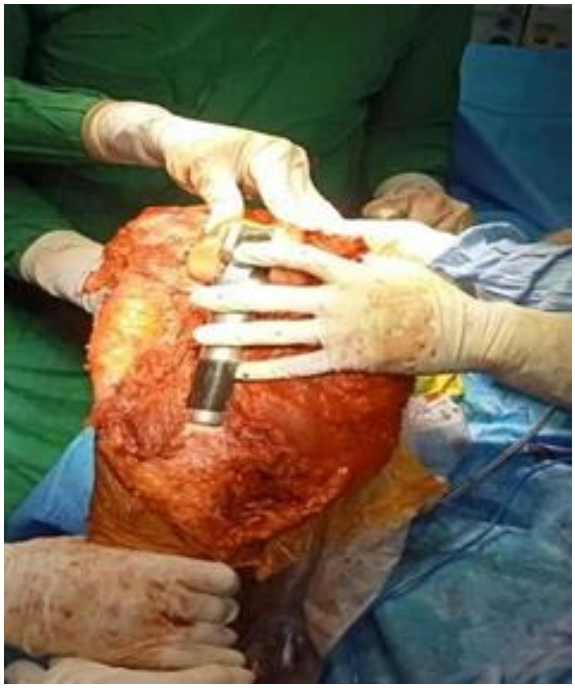

Fig 16: Implant of distal femur and proximal tibia

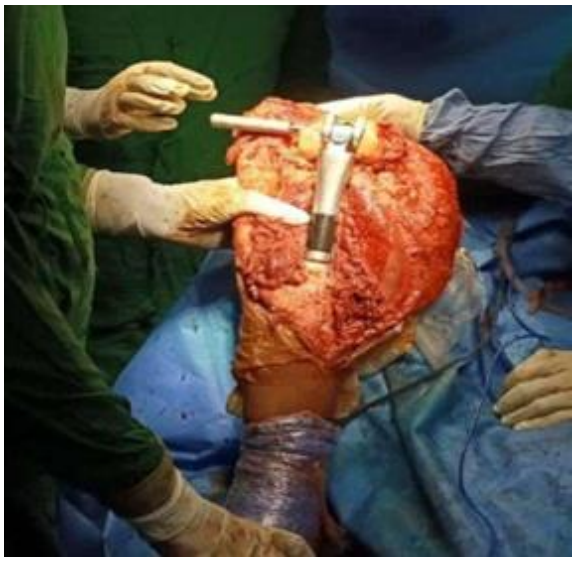

Fig 17: Trial implant with check of movements

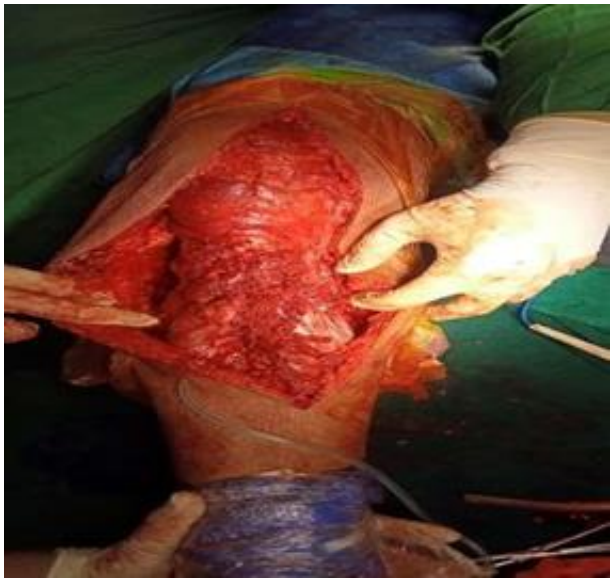

Fig 18: Prosthesis completely encirclled by muscle flap

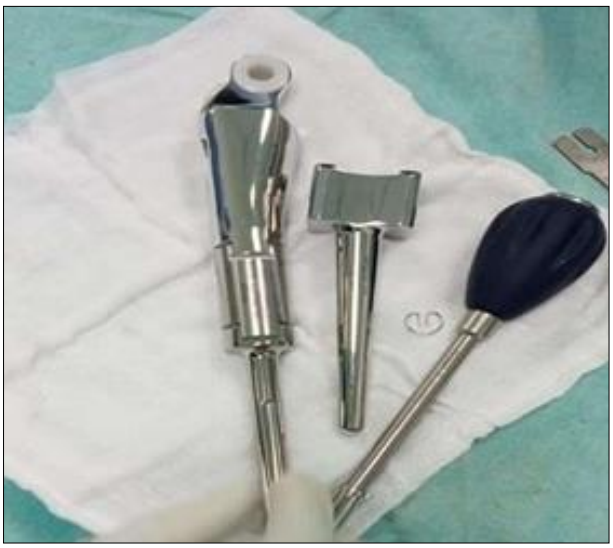

Fig 19: Endoprosthetic proximal tibia implant with distal femoral stem

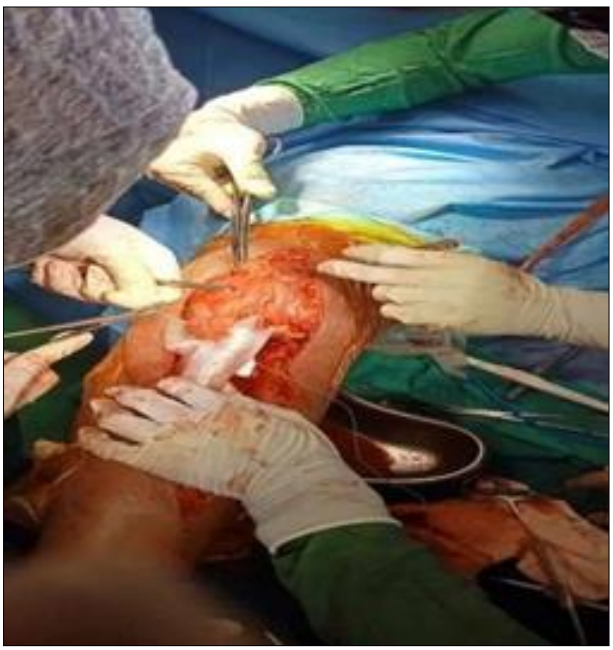

Fig 20: Cementation of distal femur implant

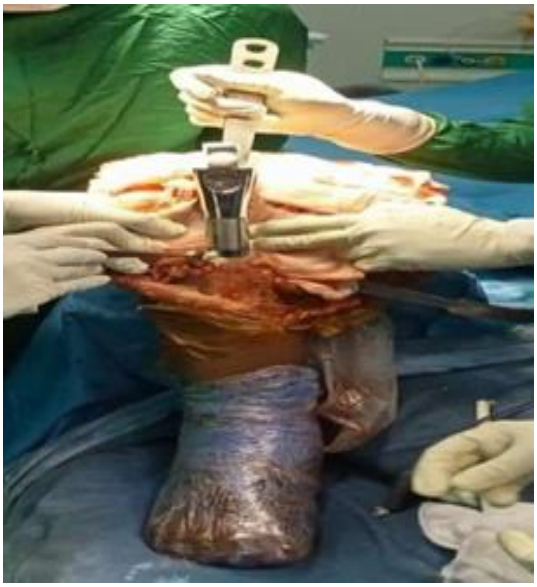

Fig 21: Cementation of proximal tibial implant

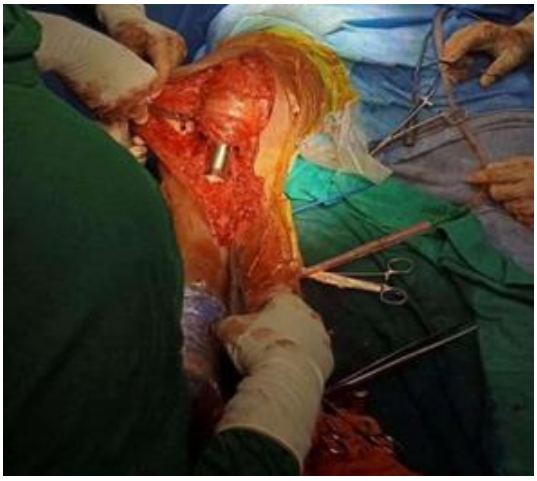

Fig 22: Suture of soleus MS to cover distal prosthesis

Fig 23: Patella tendon suturing

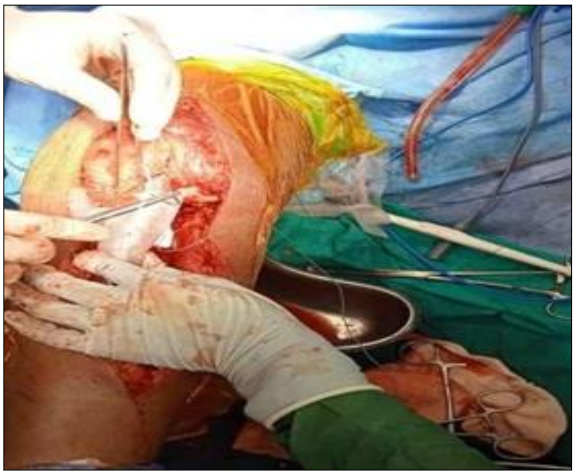

Fig 24: Repair of extensor mechanism by suturing the patellar tendon to the graft and the groove with ethibond and mesh repair

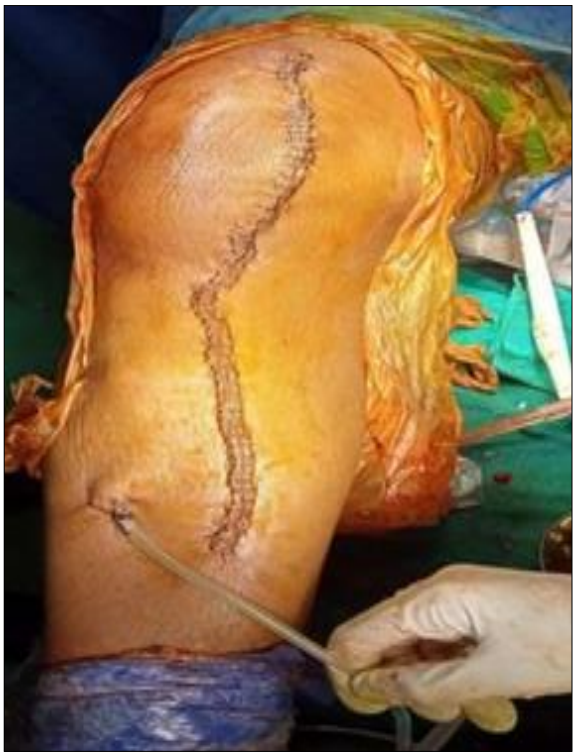

Fig 25: Skin closure with drain and staples

Fig 26: Histopathology section

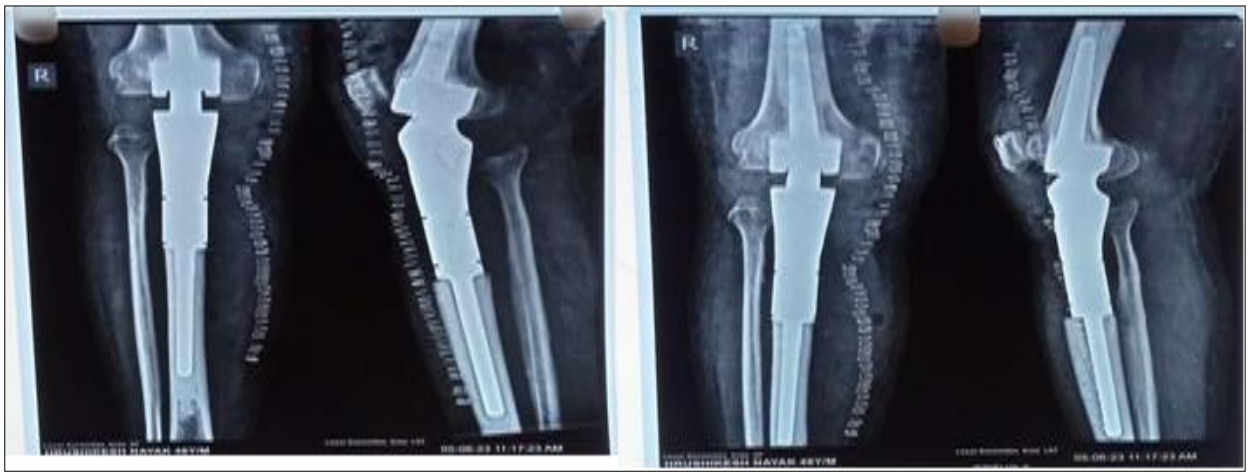

Fig 27: Post Op X ray

Discussion

Clinical symptoms in patients with Giant Cell tumor are non-specific. They include pain usually reduced by rest, local swelling and limitation of range of motion in the adjacent joints. When a lesion is located in the spine, neurologic symptoms may be present [6]. The imaging features of giant cell tumor are characteristic. It is a purely osteolytic, radiolucent lesion with narrow zone of transition lacking sclerotic margins, revealing geographic bone destruction and usually no periosteal reaction. The cortex is expanded and thinned with frequent breach of the tumor in the soft tissue.

For the accurate evaluation of the soft tissue involvement, magnetic resonance imaging is investigation of choice. Giant cell tumor typically shows low to intermediate signal intensity on T1 weighted images and intermediate to high intensity on T2 images.

Scintigraphy may show more intense uptake of the tracer around the periphery of the lesion than within the lesion itself and is presumably caused by hyperemic changes in the bone surrounding the tumor [4, 5, 6]. The imaging appearance and staging of giant cell tumor have not accurately reflected the ultimate clinical outcome, but nevertheless several investigators, including Enneking, Campanacci, and Bertoni, have developed staging systems based on imaging and histologic appearance of this tumor.

The tumor has been classified into three types by Campanacci. Type 1 or inactive lesions, with well-defined borders, intact cortex and benign histologic appearance. Type 2 or active tumors, demonstrates a more aggressive radiographic appearance, with extensive remodelling of bone, thin cortex but without loss of continuity and intact periosteum and still a benign histologic pattern. Type 3 or aggressive tumors, reveals aggressive growth with breakthrough the cortex and extension into adjacent soft tissues, but remains histologically benign, although distant metastases, predominantly to the lungs may occur [4].

Approximately 5% of giant cell tumors are malignant de novo. Having no characteristic imaging features, malignant lesions cannot be diagnosed radiologically. It is also well known that benign giant cell tumor may evolve into malignant lesion [4, 5]. Giant cell tumors in bones around knee joint are clinically challenging in orthopaedics, as the knee joint is the most important weight-bearing joint with high functional requirements. The main aim of the treatment is complete removal of the tumor at the same time preserving the function of the joint as much as possible.

The most common treatment of giant cell tumor is surgical removal using the following different modalities: curettage and bone grafting, curettage and chemical cytotoxic agents such as phenol, zinc chloride, alcohol, hydrogen peroxide, carbolic acid, curettage and physical agents (polymethylmethacrylate and cryosurgery), heat cauterization of the walls of the lesion (using electrocautery), extended curettage with high-speed burr and adjuvants, primary resection for expendable bones, wide excision and reconstruction using grafts or custom prosthesis.

Radiation therapy can be used for incomplete resection at surgically difficult sites and embolization, for unresectable tumors (pelvic and sacral tumors). This can also be used prior to surgical excision of large tumours [4, 5].

En bloc resection of major joints produces massive bone defects and it is a technically difficult procedure with many early and late complications. The progress in biomedical engineering along with better surgical techniques has improved overall longevity of endoprosthesis [7].

In recent years, technological advances have led to the use of computer-assisted surgery and computer-aided design (CAD) in many medical fields including Orthopaedics. Clinicians have managed to integrate CT imaging, MRI and computer-aided design (CAD) into surgical planning and custom-made implants design. Data collected from computed tomography and magnetic resonance imaging can be input in computer software to produce three-dimensional (3D) models of the tumor extent. Using computer-assisted surgery, accuracy of resection of bone tumors can be improved and with computer-aided design (CAD) custom endoprosthesis construction can be made [9, 10, 11]. 3D printing technology is also used to manufacture porous metal cone augments used in the reconstruction of massive bone defects [11, 12]. In the past three decades overall 10-year prosthetic survival rate after endoprosthetic replacement has improved from 20% to 80% [13]. However, endoprosthesis loosening, the major long-term complication after prosthetic replacement has a reported incidence rate of 7%–30%. The incidence gradually is increasing along with longer follow-ups [12, 13].

Conclusion

The key factor of good prognosis in this type of tumors is an early diagnosis and a radical treatment. Giant cell tumors often occur in bones around the weight-bearing joints and directly affect the function of the extremity. The ideal aim in the management of giant cell tumors is to eradicate the tumor with complete joint salvage. Selecting the appropriate treatment method is very important for the recovery of the function of the affected joint and also for the whole extremity. There is an

advantage of En Bloc Resection and reconstruction with, knee endoprosthesis in combination with trabecular metal in cases with extensive destruction of bone structure, recurrence, pathological fracture or difficulty in reconstruction after intralesional curettage. Advantages in functional aspect of this treatment modality are retaining the stability of the knee joint, substituting the bone defect and fast recovery of the function of the affected joint and limb

Conflict of Interest
Not available

Financial Support
Not available

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