Soft Tissue Sarcoma of Lower Extremities Treated by Limb Salvage Surgery and Adjuvant Radiotherapy; Case Series

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Introduction: Soft Tissue Sarcoma (STS) is a rare type of cancer with a dismal prognosis. Early diagnosis has an impact on the outcome of the treatment of soft tissue sarcoma. Soft tissues sarcomas are rare malignant tumors with a low 5-year survival rate even with proper management. Historically, amputation was the only treatment modality but now, Limb salvage becomes a standard of treatment for most soft tissue sarcomas for last decades.

Patients and methods: We report ten patients who underwent limb salvage surgery for treatment of soft tissue sarcoma in lower extremities, in Surgical Oncology Unit, Department of General Surgery, Faculty of Medicine, Tanta University Hospital, from January 2020 to December 2022. Then, patients in our hospital's medical oncology department underwent adjuvant therapy, In order to better understand the presentation, treatments, and results of this uncommon disease, as well as to ascertain whether limb-salvage surgery produces reasonable result.

Results: Limb salvage and favourable oncological outcome was mainly dependent on early diagnostis and treatmeny.

Conclusion: In this series, we found that patients presented early and this led to favorable oncological outcomes, also limb salvage can be achieved for patients with lower extremities STS. Thus, early diagnosis is recommended so as to improve treatment outcome.

Key words: Soft tissue sarcoma, early diagnosis, treatment, limb salvage.

Introduction

A class of uncommon malignant tumors called soft-tissue sarcomas (STS) develops from mesenchymal tissue, which represents less than 1% of all cancer cases. Although STS can affect people of any age, the typical age at diagnosis is between 56 and 65, with the eighth decade being the peak.[1,2]

Although STS can develop anywhere on the body, the thigh is the most often affected location and accounts for 60% of cases in the extremities. Based on their degree of resemblance to mature tissue, the World Health Organization (WHO) has classified STS into more than 100 histologic subtypes. These subtypes vary from one another in terms of biological traits, clinical behavior, and response to treatment.[2,3]

Locally invasive low-grade cancers are possible, but metastasis is uncommon. Higher grade tumors are more likely to be aggressive and have a significant mortality risk because they are more likely to spread to other organs, primarily the lungs.[4]

Certain environmental variables and genetic predispositions have been linked to the formation of specific types of STS, such as neurofibromatosis and Li-Fraumeni syndrome, even though the etiology of the bulk of STS is still unknown. The early signs and symptoms of an STS can vary depending on the tumor's grade, location, and subtype.[4]

Although tumor growth might cause pain by producing a mass effect on nearby neurovascular structures, patients usually present with a growing, painless mass. Some tumors, such as rhabdomyosarcoma in children and liposarcoma in adults, are more likely to appear at a particular age. Likewise, certain STS are more prevalent in specific anatomical regions: liposarcoma is more prevalent in the lower extremities, whereas fibrosarcoma, synovial sarcoma, and epithelioid sarcoma are more prevalent in the upper extremities.[4]

A lower percentage of STS metastasizes to lymph nodes (<5%). Rather they mostly travel through blood stream and may eventually spread to lungs, liver and rarely the brain.[5,6]

As part of a patient's examination into an STS, three factors need to be assessed: (1) local extension; (2) histological diagnosis; and (3) staging of metastases. Creating a treatment plan that is unique to each patient requires careful consideration of each of these data points.[7,8]

Assessment of local extension

The surrounding tissues compress as STS often spreads along tissue planes. STS typically does not penetrate anatomical obstacles such as bone or tissue. An STS seldom infiltrates bone, but when it does, the chances of survival are drastically reduced.[9] Similarly, the microscopic quantity of tumor cells in the edema around an STS as seen by magnetic resonance imaging (MRI) may lead to a local recurrence in the absence of treatment.[10]

Magnetic Resonance Imaging (MRI) is the "Gold

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standard" for determining the local tumor's extent and the edema surrounding it. Although they are rarely necessary, plain radiographs can be used to detect soft-tissue calcification or ossification, bone invasion, and bone remodeling.[10,11]

Histological diagnosis

Before receiving definite treatment, pathological tests should be carried out if there is a risk for an STS in order to identify the histologic subtype and grade. Histologic grade is one of the greatest predictors of metastasis and disease-free survival, and the clinical behavior and responsiveness to treatment may vary among subtypes.[12–17]

In the case of a suspected STS, a biopsy should be carried out before excision. Nowadays, there are two types of biopsies that are frequently used: open biopsy (Incisional, excisional) and needle (Fine needle aspiration, core needle biopsy (CNB)). In an outpatient clinic setting, needle biopsies can be carried out with less time commitment, at a lower cost, with less morbidity and limited soft-tissue contamination.[18-21] FNA might be able to determine whether malignancy is present, but CNB is typically needed since it gives the pathologist a sufficient sample of tissue and it has been suggested that 4-6 tumor tissue cores are required for an accurate diagnosis.[18–22]

The availability of greater tissue is important to improve histologic evaluation and grading with incisional biopsy, which improves prognostic estimation. To reduce the chance of hematoma formation, careful hemostasis is essential. Excisional biopsy of an extremities mass without a conclusive diagnosis is often reserved for small, superficial, and movable masses that are most likely benign.

Staging

The diagnostic workup is completed by staging examinations for both distant and local metastases. The two most used staging techniques are the Musculoskeletal Tumor Society (MSTS) staging system and the American Joint Committee on Cancer (AJCC) staging system. These two staging techniques consider the tumor's local extent (Size and depth for AJCC vs. compartment status for MSTS), histologic grade, and whether metastases are present or not.[23]

With a strong preference for the lungs, extremity STS most frequently metastasize hematogenously, and 10% of patients will have pulmonary illness that can be detected at the time of initial presentation. Systemic staging using a chest computed tomography (CT) scan to assess the lungs should be part of the initial workup. A bone scan can be used to evaluate the rare likelihood of metastatic bone disease, even in cases when osseous metastases are present.[24] In addition to a bone scan, a positron emission tomography (PET) scan may be helpful in staging recurrent sickness. A CT scan of the surrounding lymph nodes should be performed if the biopsy confirms the diagnosis of a subtype of STS that is prone to spread to lymph nodes.[24]

Treatment of soft-tissue sarcomas in lower limbs

Each patient suffering from an upper or lower extremity soft-tissue sarcoma needs a customized therapy regimen. To develop the best possible treatment strategy, a multidisciplinary evaluation of the patient, tumor, and anatomic features is required. Surgery, with or without radiation therapy, is the most effective treatment for the majority of localized extremity STS. Patients with metastatic disease are usually treated with chemotherapy, either at the time of presentation or following the removal of the initial tumor. On occasion, it is also utilized to try to help with local tumor downstaging for very large tumors that would not be amenable to surgery that spares limbs. However, since surgical excision can still lead to long-term survival, isolated lymph node metastases are somewhat of an exception.[6]

Reducing functional impairment while attaining optimal oncologic control is the ultimate goal of treatment. Every patient should be involved in the multidisciplinary decision-making process, and a thorough "risks benefits" discussion is crucial, as it is in all areas of medicine. The term "oncologic control" refers to the utilization of current therapeutic options to reduce the risk of both local and systemic recurrence for each patient. In the past, many soft-tissue sarcomas of the limbs could only be treated by amputation or aggressive resection.[25]

Even while this approach produced a high level of local tumor control at the expense of remaining limb function, it put patients at risk for metastatic illness. The introductions of adjuvant radiotherapy and improvements in cross-sectional imaging, such as MRI, have broadened the grounds for limb salvage by allowing for more conservative resection margins.[25]

When opposed to amputation, contemporary limb-salvage procedures can generally achieve equivalent oncologic management with better functional outcomes. Because of this, initial amputation is rarely necessary for the treatment of extremities STS, unless the disease is extremely widespread and locally invasive.[25]

For all STS cases when surgery will not result in a large negative resection margin, radiation treatment is advised. Preoperative or postoperative adjuvant radiation therapy was the focus of a randomized clinical trial (RCT).[26]

When preoperative radiation therapy is used, surgery is planned for four to six weeks after the radiation treatment concludes. Postoperative radiation therapy, on the other hand, often begins four to six weeks after surgery or once the incision has sufficiently healed. Before surgery, the radiation field encircles the tumor and another surrounding area to account for tissues that may harbor microscopic illness.[27,28]

Surgery

Together with the Sarcoma MDT, the surgeon assesses a tumor's resectability based on its stage, anatomical location, and patient comorbidities. The primary objective of surgery is to remove the tumor completely while preserving a healthy tissue margin. The principles of surgical oncology must be followed when doing excisional surgery, and the anatomical position of the tumor, the sarcoma's histology, and the functional effects of resection must all be taken into account. Adjuvant radiation may not be necessary in some cases because of the widely visible margins in all surgical dimensions. In other situations, leaving a small or designed microscopic positive margin off a crucial structure and adding low-rate neo/adjuvant radiation may be acceptable.[29] The following surgical procedures may be used.[29,30]

Mohs micrographic surgery

A procedure that includes removing the tumor from the skin in tiny layers. The edges of the tumor and every layer removed following surgery are inspected under a microscope to search for cancer cells. Layers are kept off until no more cancer cells are visible. As little natural tissue as possible is removed during this type of surgery, which is commonly done on places like the skin where appearance is important.

- **Wide Local Excision**

  Removal of the tumor along with some healthy tissue around it. The goal is to remove as little normal tissue as possible from malignancies of the head, neck, abdomen, and trunk.

- **Limb-Sparing Surgery**

  When a tumor in an arm or leg is removed without amputation, the limb's functionality and look are preserved. The lost tissue and bone can be replaced with an implant, such as artificial bone, or a graft, which uses tissue and bone from another area of the patient's body.

- **Amputation**

  Surgery to remove a leg or arm entirely or in part. Soft tissue sarcoma is rarely treated by amputation.

- **Lymphadenectomy**

  A surgical operation wherein lymph nodes are excised and tissue samples are examined for cancerous growths under a microscope. Another name for this process is lymph node dissection.

Wide local excision of soft tissue sarcoma was done for all patients in our study and then all patients received conventional dose fractionation adjuvant radiotherapy (50 Gy in 25 fractions, 2 Gy per fraction over 5 weeks).

All patients signed an informed consent, and a cardiologic and anesthetic consultation were done before undergoing any surgical procedure. Any unexpected risks appeared during the course of the research were cleared to the participants after receiving approval from institutional ethical committee (The Tanta University Faculty of Medicine) (Approval code: 36264PR937/11/24).

There were adequate provisions to maintain privacy of participants and confidentiality of data. The results of the study were used as a scientific material only and were not be used by any legal authorities.

Case presentation

Case 1: A 40-year-old woman has had a lump on the lateral side of her left thigh for three months, which has caused her pain and limited use of the leg. This began as a little lump that gradually became larger and was linked to pain. Other systems weren't particularly noteworthy. Upon examination, a lump of roughly 10 × 5 cm was found on the left thigh's lateral aspect. It was misdiagnosed as an abscess. MRI on the lt. thigh showed mass in lateral compartment 8 × 6 cm. CT on chest and abdomen and other studies showed no evidence of distant metastasis. Tru-cut biopsy confirmed the diagnosis of a sarcoma. She was scheduled for surgical excision of the mass. Surgery: wide local excision of the mass with overlying skin, transposition flap was moved from adjacent skin to cover the defect then the donor site was covered with split thickness skin graft **(Fig. 1).** She received antibiotics and analgesics. Ten days later she was discharged. Histopathology of the tumor concluded complete R0 surgical excision of soft tissue sarcoma. After wound healing, she started adjuvant radiotherapy. She was continued to follow-up for two years without distant metastases or local recurrence.

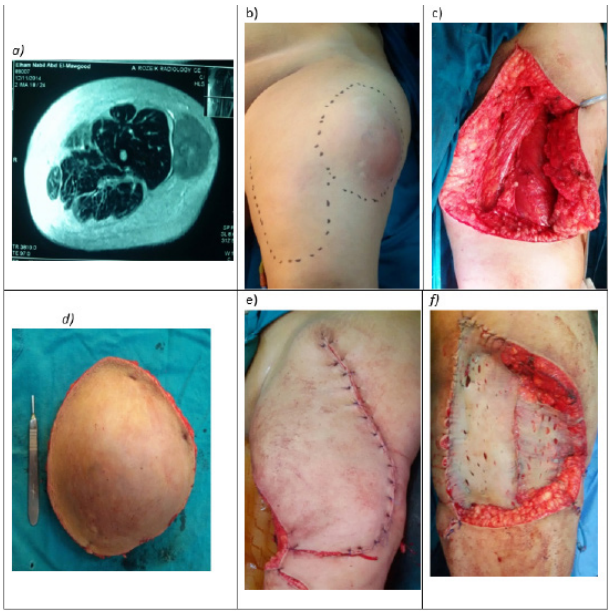

Fig 1: A) MRI on the Ll. thigh showing mass, B) Mass in lateral aspect of upper thigh, C) Surgical excision of mass, D) Mass after excision involving overlying skin, E) Transposition flap was moved to cover the defect, F) The donor site was covered with split thickness skin graft.

Case 2: A 45-year-old woman complained of a big, painful lump and had trouble flexing her right knee for a year. The inability to flex the knee past 90 degrees was the first sign of this. At first, it wasn't terrible, but with time, she began to experience intense discomfort, and the mass in her popliteal fossa was quite limited when she bent her knee. no past trauma. A healed immobile painful lump in the right popliteal fossa was discovered during a local examination of her right knee. An 18 x 3 × 4 cm heterogeneous soft tissue tumor in the posterior distal thigh on a right thigh MRI suggested liposarcoma. Tru-cut biopsy was done which revealed liposarcoma. CT on chest and abdomen and other studies showed no evidence of distant metastasis. Surgical excision of the mass was done. Surgery: wide local excision of the mass, excision of perineureum o adjacent nerves (Sciatic, tibial and common peroneal nerves), excision of adventitia of adjacent popliteal vessels with ligation of feeders blood vessels away from tumor. After one week, areas of superficial necrosis were noticed in edge of skin flap. Conservative measures with continues dressing on the wound till healing was completed after one month. Histopathology of the tumor concluded complete R0 surgical excision of soft tissue sarcoma **(Fig. 2).** She started adjuvant radiotherapy under oncology care. Follow up was continued for 20 months without distant metastases or local recurrence.

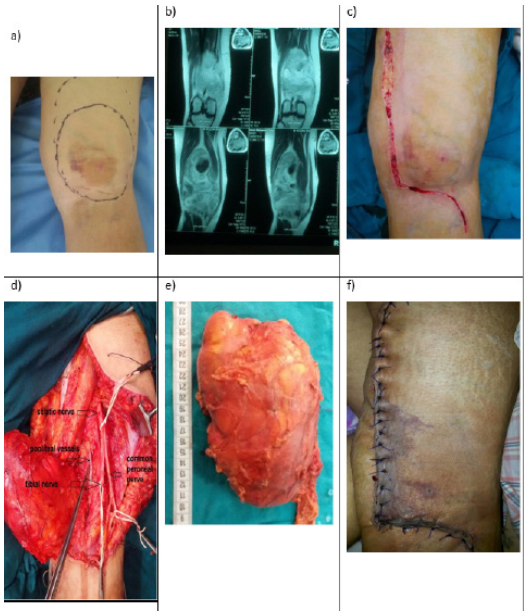

Fig 2: A) Mass in posterior lower third thigh invadiding popliteal fossa, B) MRI on knee joint showing the mass, C) The incision of skin for tumor excision, D) Preservation of vessels and nerves during excision, E) The tumor after excision, F) Superficial necrosis in edges of skin flap after one week of operation.

Case 3: A 55-year-old man arrived at our clinic after experiencing increasing edema in his left leg for six months. Upon local examination, a lump of 10 × 5 cm was found on the anterior part of the left thigh's middle third. He had no peripheral lymphadenopathy and an unremarkable systemic examination. An MRI showed a 10×5×4 cm soft tissue mass in the left thigh's anterolateral muscle compartment, which originated from the vastus lateralis. Atypical oval or spindled-shaped cells that suggested soft tissue undifferentiated sarcoma were seen in the mass's tru-cut biopsy. CT on chest and abdomen and other studies showed no evidence of distant metastasis. He consented for surgical excision of the mass which was done successfully. Surgery: wide local excision of mass with vastus lateralis muscle with intermuscular septa and underlying periosteum of femur with preservation of motor nerves of other quadriceps muscles. Histopathology of the tumor concluded complete R0 surgical excision of soft tissue sarcoma **(Fig. 3).** Then, He recieved adjuvant radiotherapy. Follow up period lasts for one and half year without distant metastases or local recurrence.

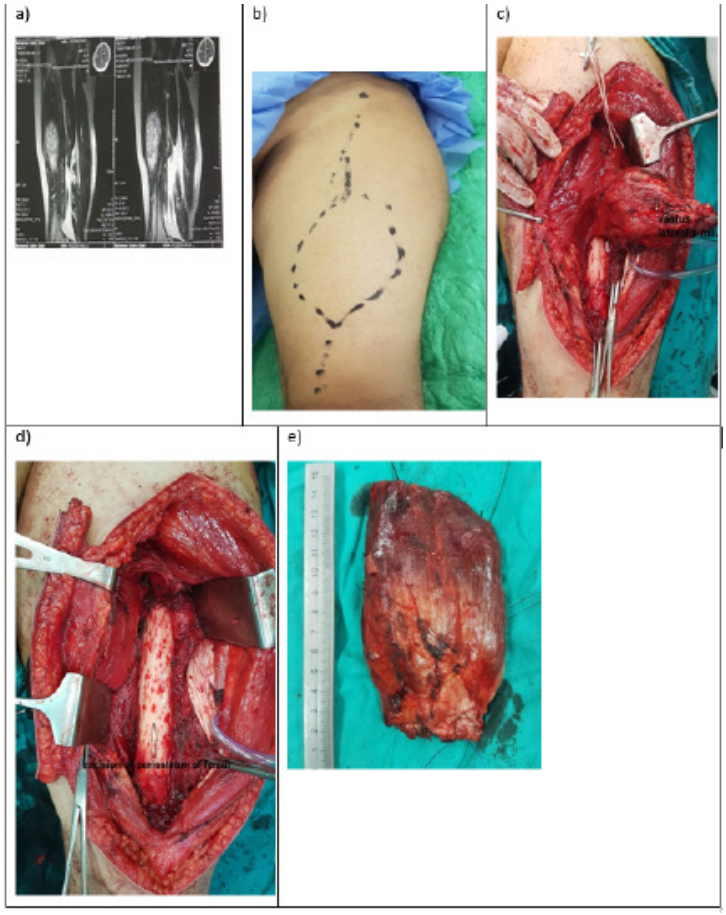

Fig 3: A) MRI on the Lt. thigh showing the mass, B) Marking of incision, C) Mass in vastus lateralis muscle, D) Excision of periostum of femur after excision of mass, E) The resected specimen shows enblock resection of muscular part including intermuscular septa and periosteum of femur.

Case 4: A 45-year-old woman has been experiencing pain from a lump on the upper lateral aspect of her left leg for the past four months. This began as a little lump that gradually became larger and was linked to pain. A lump, around 8 by 5 cm in size, was located on the top portion of the left thigh's lateral aspect. MRI of lt. Thigh showed mass invading upper part of tensor fascia lata measuring about 8 × 6 × 4 cm. Tru-cut Biopsy was taken from mass and revealed fibrosarcoma. CT on chest and abdomen and other studies showed no evidence of distant metastasis. She was scheduled for surgical excision of the mass. Surgery: wide local excision of the mass with preservation of tendinous part of tensor fascia lata to maintain pelvic stability and stability of knee joint. Histopathology of the tumor concluded complete R0 surgical excision of soft tissue sarcoma **(Fig. 4).** Then she received adjuvant radiotherapy. She was continued to follow-up for two years without distant metastases or local recurrence.

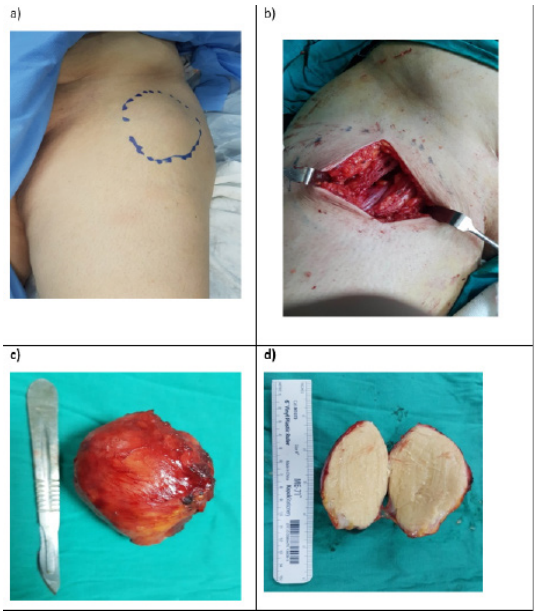

Fig 4: A) Mass in anterolateral aspect of the thigh, B) Surgical excision of the mass, C) The mass after surgical excision, D) Opening of the mass.

Case 5: A 50-years-old male with the history of mass on the upper part of the medial aspect of his left thigh for five months. It was progressive increasing in size associated with pain. Other systems were unremarkable. On examination; There was an mass in the femoral triangle of the left thigh, measuring approximately 10 by 8 cm. MRI of lt. Thigh showed mass invading upper part of medial muscular compartment measuring about 10 × 8 × 3 cm. open incisional biopsy was taken from mass and revealed sarcoma. CT on chest and abdomen and other studies showed no evidence of distant metastasis. He was scheduled for surgical excision of the mass. Surgery: enblock excision of mass with parts of pectineus and adductor longus muscles with preservation of femoral vessels and femoral nerve. Five days later he was discharged. Histopathology of the tumor concluded complete R0 surgical excision of soft tissue sarcoma **(Fig. 5).** He received adjuvant radiotherapy. He was continued to follow-up for 1.5 years without distant metastases or local recurrence.

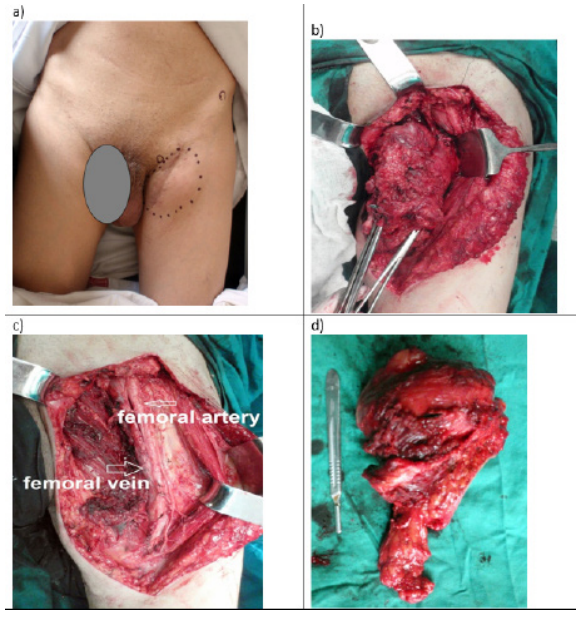

Fig 5: A) Sarcom in femoral triangle, B) Surgical excision of mass, C) Preservation of the femoral vessels, D) The mass after surgical excision.

Case 6: A 68-year-old man arrived at our clinic after experiencing increasing swelling in his left leg for nine months. Upon local examination, a lump around 10 × 8 cm in size was found on the anterior part of the left thigh's middle third. MRI was done and revealed soft tissue mass in anterior muscular compartment (Rectus femoris muscle) of left thigh measuring 10 × 8 × 5 cm. Tru-cut biopsy of the mass showed atypical spindled shaped cells suggestive of soft tissue undifferentiated sarcoma. CT on chest and abdomen and other studies showed no evidence of distant metastasis. He consented for surgical excision of the mass which was done successfully. Surgery: wide local excision of the mass enblock with rectus femoris muscle and overlying skin. Histopathology of the tumor concluded complete R0 surgical excision of soft tissue sarcoma **(Fig. 6).** Then he received adjuvant radiotherapy. Follow up was continued for 18 months without distant metastases or local recurrence.

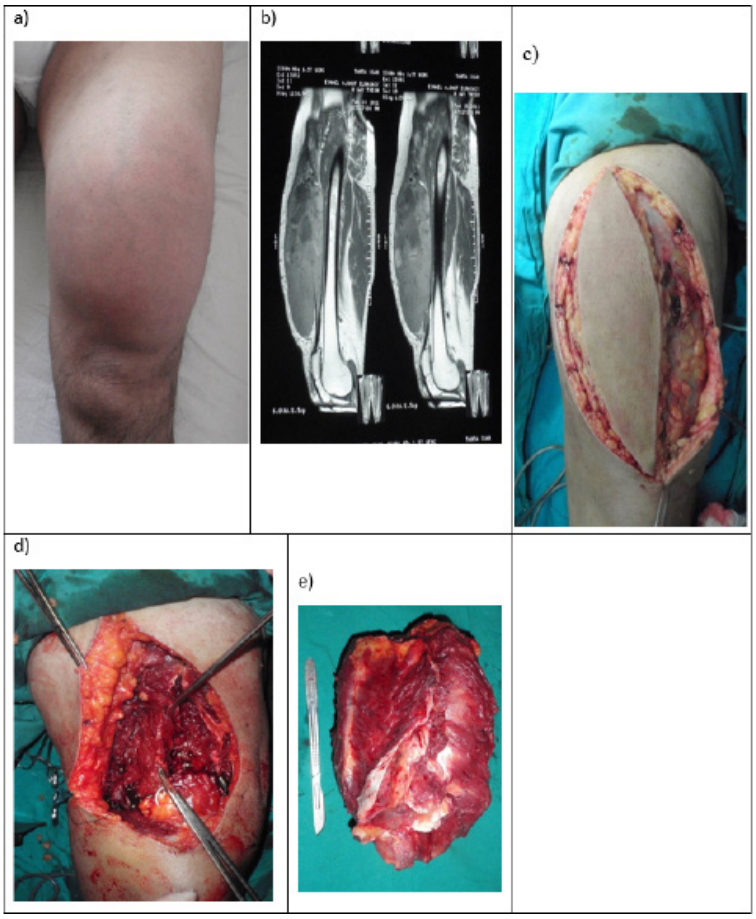

Fig 6: A) Mass in anterior aspect of thigh, B) MRI on the the thigh showing mass, C) Excision of the skin overlying the mass, D) Surgical excision of the mass with rectus femoris muscle, E) The specimen includes the mass and rectus femoris muscle.

Case 7: A 57-year-old woman arrived at our clinic after experiencing recurring swelling in her right leg for six months. Upon local examination, there was no peripheral lymphadenopathy and a tumor measuring roughly 5×3 cm on the back of the right leg. An MRI showed a 5×4×3 cm soft tissue mass in the right leg's posterior muscle compartment. When the lump was removed through an open incisional biopsy, unusual spindled-shaped cells that were suggestive of soft tissue sarcoma were found. The CT chest showed no signs of lung metastases. She consented for surgical excision of the mass which was done successfully. Surgery: wide local excision of the mass with peroneus longus and brevis muscles. Histopathology of the tumor concluded complete R0 surgical excision of soft tissue sarcoma **(Fig. 7).** Then she recieved adjuvant radiotherapy. Follow up period was continued for 15 months without distant metastases or local recurrence.

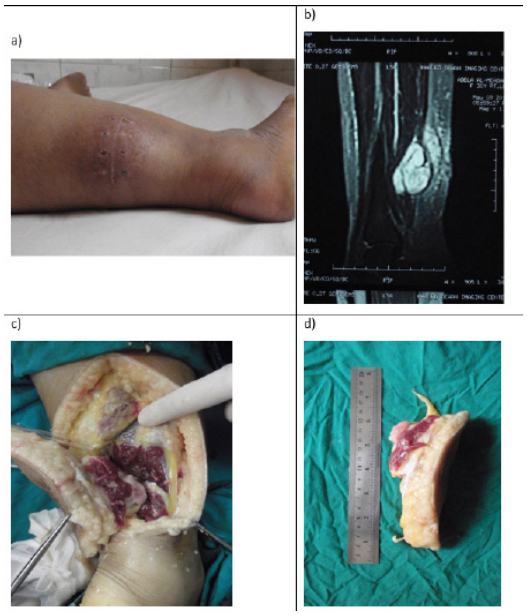

Fig 7: A) Sarcoma in posteriolateral aspect of leg, B) MRI on leg showing the mass, C) Surgical excision of the mass, D) The mass after excision.

Case 8: A 58-year-old man arrived at our clinic after experiencing edema in his right leg that had been getting worse for seven months. Upon local examination, there was no peripheral lymphadenopathy and a tumor of roughly 10 × 7 cm on the right leg's anterolateral aspect. An MRI showed a soft tissue mass measuring 11 × 8 × 4 cm in the right leg's anterolateral muscle compartment. Atypical spindled-shaped cells that suggested soft tissue undifferentiated sarcoma were seen in the mass's tru-cut biopsy. CT on chest and abdomen and other studies showed no evidence of distant metastasis He consented for surgical excision of the mass which was done successfully. Surgery: wide local excision of mass enblock within tibialis anterior muscle with preservation of anterior tibial artery and deep peroneal nerve. Histopathology of the tumor concluded complete R0 surgical excision of soft tissue sarcoma **(Fig. 8).** Then he recieved adjuvant radiotherapy. Follow up period was continued for 16 months without distant metastases or local recurrence.

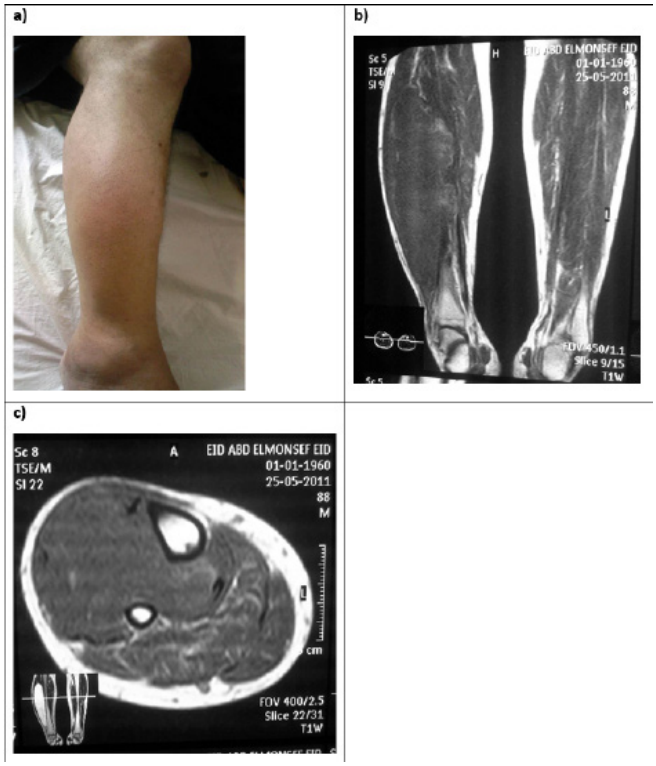

Fig 8: A) Mass in anterolateral aspect of rt leg, B,C) MRI on rt leg showing the mass.

Case 9: A 62-year-old female presented to our clinic with a history of left ankle swelling for 5 months. On local examination, there was a mass on the anterior aspect of the left ankle measuring about 7 × 5 cm. MRI was done and revealed soft tissue mass in left ankle measuring 5 × 4 × 3 cm. Tru-cut biopsy of the mass showed atypical spindled shaped cells suggestive of soft tissue sarcoma. CT on chest and abdomen and other studies showed no evidence of distant metastasis. She consented for surgical excision of the mass which was done successfully. Histopathology of the tumor concluded complete R0 surgical excision of low grade soft tissue sarcoma **(Fig. 9).** Then she received adjuvant radiotherapy. Follow up period was continued for 12 months without distant metastases or local recurrence.

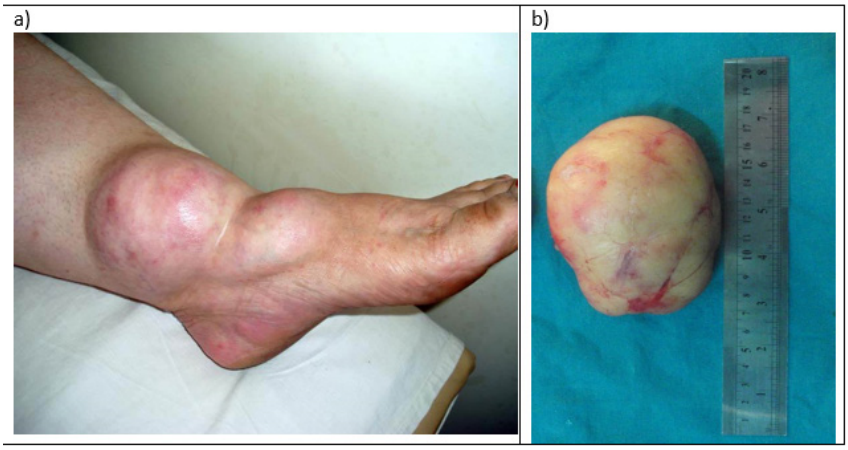

Fig 9: A) Mass in anterior aspect of ankle, B) The mass after excision.

Case 10: A 60-year-old man came in with a 6-month history of increasing swelling in his right leg. Upon local examination, a lump of approximately 15 × 8 cm was found on the anterior part of the right thigh's top third. An MRI showed a 13.5 × 8 cm soft tissue mass in the right thigh's anterior muscle compartment. Atypical spindled-shaped cells that suggested soft tissue undifferentiated sarcoma were seen in the mass's tru-cut biopsy. CT on chest and abdomen and other studies showed no evidence of distant metastasis. He consented for surgical excision of the mass which was done successfully. Surgery: wide local excision of mass enblock with rectus femoris and superficial part of vastus intermedius muscle. Histopathology of the tumor concluded complete R0 surgical excision of low grade soft tissue liposarcoma **(Fig. 10).** She was given antibiotics, analgesics, and wound care after surgery before being released. Then he received adjuvant radiotherapy. Follow up period was continued for 12 months without distant metastases or local recurrence.

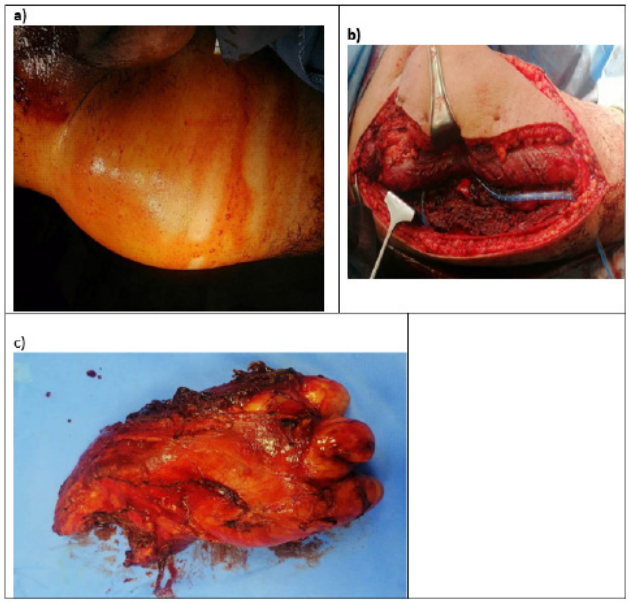

Fig 10: A) Mass in anterior aspect of upper third of thigh, B) Surgical excision of mass and insertion of drain, C) The mass after excision.

Discussion

A rare class of cancerous tumors are soft tissue sarcomas. The 5-year survival rate is between 62% to 84%, even with the right treatment.[31] A review at a professional clinic to evaluate potential treatment options is essential; many are treated with substantial local excision and careful examination.[32,33] For soft tissue sarcoma to be successfully treated, early detection is essential.[32,33] Soft tissue sarcoma frequently goes undiagnosed for a variety of reasons, including presentational misunderstanding as benign tumors. Both physicians and patients mistake them for benign tumors because most of them are painless, mobile, and develop slowly. As a result, important testing like biopsies are neglected.[31]

In our cases, all of the patients were diagnosed with soft tissue sarcoma prior to surgery and had a biopsy before surgical excision. Surgical excision, with or without radiation, is the most successful treatment for soft tissue sarcomas. Chemotherapy is usually recommended for patients who present with metastases or deep tissue invasion.[34,35] Adjuvant radiation therapy was administered to all patients in this series following surgery (50 Gy in 25 fractions, 2 Gy per fraction over 5 weeks). In our investigation, there were no instances of local recurrence or distant metastasis during the follow-up period. It has been shown that radiation therapy enhances the disease's oncologic control.[36]

For many years, limb salvage has been the accepted method of treating the majority of soft tissue sarcomas. According to recent research, the rate of amputations has been as low as 4.1%.[37,38] Because of the proper preoperative evaluation in all of our cases, limb salvage was successful for every patient. This emphasizes the value of teaching physicians, the general public, and early referral for early diagnosis and effective treatment in order to increase health-seeking behavior. In order to determine the factors influencing delayed diagnosis, soft tissue sarcoma risk factors, and long-term outcomes, more cross-sectional research with a larger sample size can be conducted.

Conclusion

If the necessary therapy modalities are combined carefully, patients with lower limb soft tissue sarcoma may be able to salvage their legs with a satisfactory outcome. At the moment, primary amputation is often reserved for situations in which the tumor has invaded a bone, joint, or significant neurovascular structure and in which even marginal resection is impractical. Because of the significant risk of local recurrence or impaired limb function, amputation was favored in these circumstances. Therefore, the creation of a precise interdisciplinary surgical plan requires a thorough reevaluation of the patient after adjuvant treatment. Lastly, big specialized centers should provide tailored therapy due to the intricacy of a multidisciplinary approach.

References

1. Siegel RL, Miller KD, Jemal A: Cancer statistics, 2015. ***CA Cancer J Clin.*** 2015; 65(1): 5–29.
2. Pollock RE, Karnell LH, Menck HR, Winchester DP: The National Cancer Data Base report on soft tissue sarcoma. ***Cancer.*** 1996; 78(10): 2247–2257.
3. Fletcher CD: The evolving classification of soft tissue tumours – an update based on the new 2013 WHO classification. ***Histopathology.*** 2014; 64(1): 2–11.
4. Gerrand CH, Bell RS, Wunder JS, Kandel RA, O'Sullivan B, Catton CN, et al: The influence of anatomic location on outcome in patients with soft tissue sarcoma of the extremity. ***Cancer.*** 2003; 97(2): 485–492.
5. Fong Y, Coit DG, Woodruff JM, Brennan MF: Lymph node metastasis from soft tissue sarcoma in adults. Analysis of data from a prospective database of 1772 sarcoma patients. ***Ann Surg.*** 1993; 217(1): 72–77.
6. Riad S, Griffin AM, Liberman B, Blackstein ME, Catton CN, Kandel RA, et al: Lymph node metastasis in soft tissue sarcoma in an extremity. ***Clin Orthop Relat Res.*** 2004; 426: 129–134.
7. Casali PG, Blay JY, experts ECECP: Soft tissue sarcomas: ESMO Clinical Practice Guidelines for diagnosis, treatment and follow-up. ***Ann Oncol.*** 2010; 21(Suppl 5): 198–203.
8. Clark MA, Fisher C, Judson I, Thomas JM: Soft-tissue sarcomas in adults. ***N Engl J Med.*** 2005; 353(7): 701–711.
9. Ferguson PC, Griffin AM, O'Sullivan B, Catton CN, Davis AM, Murji A, et al: Bone invasion in extremity soft-tissue sarcoma: Impact on disease outcomes. ***Cancer.*** 2006; 106(12): 2692–2700.
10. White LM, Wunder JS, Bell RS, O'Sullivan B, Catton C, Ferguson P, Bet al: Histologic assessment of peritumoral edema in soft tissue sarcoma. ***Int J Radiat Oncol Biol Phys.*** 2005; 61(5): 1439–1445.
11. Wu JS, Hochman MG: Soft-tissue tumors and tumor like lesions: A systematic imaging approach. ***Radiology.*** 2009; 253(2): 297–316.
12. Biau DJ, Ferguson PC, Turcotte RE, Chung P, Isler MH, Riad S, et al: Adverse effect of older age on the recurrence of soft tissue sarcoma of the extremities and trunk. ***J Clin Oncol.*** 2011;

29(30): 4029–4035.

13. Kransdorf MJ, Murphey MD: Radiologic evaluation of soft-tissue masses: A current perspective. ***Am J Roentgenol.*** 2000; 175(3): 575–587.

14. Pisters PW, Leung DH, Woodruff J, Shi W, Brennan MF: Analysis of prognostic factors in 1,041 patients with localized soft tissue sarcomas of the extremities. ***J Clin Oncol.*** 1996; 14(5): 1679–1689.

15. Coindre JM, Terrier P, Guillou L, Le Doussal V, Collin F, Ranchere D, et al: Predictive value of grade for metastasis development in the main histologic types of adult soft tissue sarcomas: A study of 1240 patients from the French Federation of Cancer Centers Sarcoma Group. ***Cancer.*** 2001; 91(10): 1914–1926.

16. Coindre JM: Grading of soft tissue sarcomas: Review and update. ***Arch Pathol Lab Med.*** 2006; 130(10): 1448–1453.

17. Zagars GK, Ballo MT, Pisters PW, Pollock RE, Patel SR, Benjamin RS, et al: Prognostic factors for patients with localized soft-tissue sarcoma treated with conservation surgery and radiation therapy: An analysis of 1225 patients. ***Cancer.*** 2003; 97(10): 2530–2543.

18. Ball AB, Fisher C, Pittam M, Watkins RM, Westbury G: Diagnosis of soft tissue tumours by Tru-Cut biopsy. ***Br J Surg.*** 1990; 77(7): 756–758.

19. Welker JA, Henshaw RM, Jelinek J, Shmookler BM, Malawer MM: The percutaneous needle biopsy is safe and recommended in the diagnosis of musculoskeletal masses. ***Cancer.*** 2000; 89(12): 2677–2686.

20. Verheijen P, Witjes H, van Gorp J, Hennipman A, van Dalen T: Current pathology work-up of extremity soft tissue sarcomas, evaluation of the validity of different techniques. ***Eur J Surg Oncol.*** 2010; 36(1): 95–99.

21. Adams SC, Potter BK, Pitcher DJ, Temple HT: Office-based core needle biopsy of bone and soft tissue malignancies: An accurate alternative to open biopsy with infrequent complications. ***Clin Orthop Relat Res.*** 2010; 468(10): 2774–2780.

22. Khoja H, Griffin A, Dickson B, Wunder J, Ferguson P, Howarth D, Kandel R: Sampling modality influences the predictive value of grading in adult soft tissue extremity sarcomas. ***Arch Pathol Lab Med.*** 2013; 137(12): 1774–1779.

23. Wunder JS, Healey JH, Davis AM, Brennan MF: A comparison of staging systems for localized extremity soft tissue sarcoma. ***Cancer.*** 2000; 88(12): 2721–2730.

24. Dadia S and Grimer R: Characteristics, diagnosis and treatment of bone and soft tissue sarcomas. ***Br J Hosp Med (Lond).*** 2007; 68(11): 589–593.

25. Ghert MA, Abudu A, Driver N, Davis AM, Griffin AM, Pearce D, et al: The indications for and the prognostic significance of amputation as the primary surgical procedure for localized soft tissue sarcoma of the extremity. ***Ann Surg Oncol.*** 2005; 12(1): 10–17.

26. O'Sullivan B, Davis AM, Turcotte R, Bell R, Catton C, Chabot P, et al: Preoperative versus postoperative radiotherapy in soft tissue sarcoma of the limbs: A randomised trial. ***Lancet.*** 2002; 359(9325): 2235–2241.

27. Griffin AM, Dickie CI, Catton CN, Chung PW, Ferguson PC, Wunder JS, et al: The influence of time interval between preoperative radiation and surgical resection on the development of wound healing complications in extremity soft tissue sarcoma. ***Ann Surg Oncol.*** 2015; 22(9): 2824–2830.

28. O'Sullivan B, Griffin AM, Dickie CI, Sharpe MB, Chung PW, Catton CN, et al: Phase 2 study of preoperative image-guided intensity-modulated radiation therapy to reduce wound and combined modality morbidities in lower extremity soft tissue sarcoma. ***Cancer.*** 2013; 119(10): 1878–1884.

29. Andrew J. Hayes, Ioanna F. Nixon, Dirk C. Strauss, Beatrice M. Seddon, Anant Desai, Charlotte Benson, et al: UK guidelines for the management of soft tissue sarcomas. ***British Journal of Cancer.*** 2024.

30. Davis AM, O'Sullivan B, Turcotte R, Bell R, Catton C, Chabot P, et al: Late radiation morbidity following randomization to preoperative versus postoperative radiotherapy in extremity soft tissue jsarcoma. ***Radiother Oncol.*** 2005; 75(1): 48–53.

31. Park JH, Kang CH, Kim CH, Chae IJ, Park JH: Highly malignant soft tissue sarcoma of the extremity with a delayed diagnosis, Available from: ***World J. Surg. Oncol.*** 2010; 23(8): 84.

32. Lima M, Di Salvo N, Cordola C, D'Antonio S, Libri M, Maffi M, et al: Laparoscopy-assisted versus open surgery in treating intestinal atresia: single center experience, ***J Investig Surg Off J Acad Surg Res.*** 2022: 1–6.

33. Dubayova T, van Dijk JP, Nagyova I, Rosenberger J, Havlikova E, Gdovinova Z, et al: The impact of the intensity of fear on patient's delay regarding health care seeking behavior: A systematic

review, Available from: ***Int. J. Public Health.*** 2010; 55(5): 459-468.

34. Ramu EM, Houdek MT, Isaac CE, Dickie CI, Ferguson PC, Wunder JS: Management of soft-tissue sarcomas; treatment strategies, staging, and outcomes, Available from, ***SICOT-J [Internet].*** 2017; 20(3).

35. Daniel L. Robert E, Marc H, Cynthia W: Soft tissue Sarcoma of the foot. ***Can J Surg.*** 2010: 53(6): 424:431.

36. Davis AM, O'Sullivan B, Turcotte R, Bell R, Catton C, Chabot P, et al: Late radiation morbidity following randomization to preoperative versus postoperative radiotherapy in extremity soft tissue sarcoma. ***Radiother. Oncol. J. Eur. Soc. Ther. Radiol. Oncol.*** 2005; 75(1): 48–53.

37. Smith HG, Thomas JM, Smith MJF, Hayes AJ: Strauss, Major amputations for extremity soft-tissue sarcoma. ***Ann Surg Oncol.*** 2018; 25(2): 387–393.

38. Popov P, Tukiainen E, Asko-Seljaavaara S, Huuhtanen R, Virolainen M, Virkkunen P, et al: Soft tissue sarcomas of the lower extremity: surgical treatment and outcome. ***Eur. J. Surg. Oncol. J. Eur. Soc. Surg. Oncol. Br. Assoc Surg Oncol.*** 2000; 26(7): 679-685.