Case Report

A SUCCESSFUL LIMB-SPARING APPROACH IN SYNOVIAL SARCOMA OF THE FOOT: A CASE REPORT

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ABSTRACT

Synovial sarcoma, although rare, is commonly diagnosed in patients under 20 years of age. This case presents the case of a 21-year-old female with synovial sarcoma affecting the 1st to 3rd metatarsal and tarsal bones. She underwent extensive tumor resection, followed by fibula free flap. The fibula was reconstructed into an L-shape to provide structural support. A bypass was performed because of compromised blood flow to the first digit, but the digit failed. Skin necrosis occurred after tumor dissection, necessitating a second reconstruction with an anterolateral thigh flap (ALT) after six weeks. At the years follow-up, the reconstruction was stable, and radiation therapy further improved the outcomes. The patient's gait was satisfactory, with special shoes for weight bearing. This case demonstrates the potential of limb-sparing surgery with free fibula flaps for synovial sarcoma resection, which offers promising functional and psychological benefits.

Key words: *Synovial sarcoma; Free flap; Microsurgery*

Sarkoma sinovial, meskipun jarang, umumnya didiagnosis pada pasien di bawah usia 20 tahun. Kasus ini melaporkan seorang wanita berusia 21 tahun dengan sarkoma sinovial yang mempengaruhi tulang metatarsal ke-1 hingga ke-3 serta tulang tarsal. Pasien menjalani reseksi tumor ekstensif yang diikuti dengan rekonstruksi menggunakan flap fibula bebas. Fibula direkonstruksi menjadi bentuk L untuk memberikan dukungan struktural. Prosedur bypass dilakukan karena aliran darah ke jari kaki pertama terganggu, tetapi jari tersebut tidak dapat diselamatkan. Nekrosis kulit terjadi setelah diseksi tumor, sehingga diperlukan rekonstruksi kedua dengan flap paha anterolateral (ALT) enam minggu kemudian. Pada tindak lanjut satu tahun, rekonstruksi tetap stabil, dan terapi radiasi memberikan hasil yang lebih baik. Pola berjalan pasien memuaskan dengan penggunaan sepatu khusus untuk menopang berat badan. Kasus ini menunjukkan potensi operasi penyelamatan ekstremitas dengan flap fibula bebas dalam reseksi sarkoma sinovial, yang memberikan manfaat fungsional dan psikologis yang menjanjikan.

Kata Kunci: *Sarkoma sinovial; Flap bebas; Bedah mikro*

Conflicts of Interest Statement:
The author(s) listed in this manuscript declare the absence of any conflict of interest on the subject matter or materials discussed.

INTRODUCTION

Foot and ankle tumors are rare, comprising only 4-5% of all musculoskeletal tumors, with malignant sarcomas accounting for just 1-2%. Most cases originate from mesenchymal tissues, including soft tissues and bone sarcomas. Synovial sarcoma, a rare subtype, represents 5-10% of all soft tissue sarcomas, with 30% of cases diagnosed in individuals under 20 years of age. The anatomical complexity of the foot and ankle and rarity of these tumors pose significant surgical challenges.[1]

The primary goal of managing foot and ankle tumors is complete excision with clear margins to minimize recurrence while preserving

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function. Historically, amputation has been the standard treatment because of difficulties in achieving adequate margins without compromising foot function. Advances in imaging, surgical techniques, and reconstructive options have enabled limb-sparing procedures to offer improved functional and psychological outcomes. However, inconsistent results from studies on limb salvage, including higher recurrence rates and complications in some cases, highlight the need for individualized approaches.[2]

Amputation remains associated with significant physical and psychological burden, including depression, altered gait, and increased suicide risk. Limb-sparing techniques, facilitated by advancements in microsurgery and flap reconstruction, can provide comparable or superior oncologic and functional outcomes, making them preferable options when feasible.[3,4] This case study explored the benefits and challenges of limb-sparing surgery in managing foot synovial sarcoma while adhering to oncologic principles.

CASE REPORT

A 21-year-old female presented with a 12 × 8 × 7-cm mass on the left foot, suspected to be a synovial sarcoma. Initially planned for below-knee amputation, the decision was made after consultation to proceed with extended local tumor excision. Radical resection involved the 1st to 3rd metatarsals and portions of the tarsal bones, guided by frozen sections, to ensure appropriate surgical margins. Pathology confirmed synovial sarcoma with a white-grayish myxoid mass with calcifications.

Figure 1. Preoperative evaluation. A: The lateral view of the patient's left foot x-rays. B: clinical condition of patient's left foot.

Reconstruction of the complex mid-to-forefoot defect was performed using an osteocutaneous free fibular flap , with 18 cm of the fibula harvested and split into L-shaped segments. An arterial bypass was performed using the peroneal artery and vein to supply the 1st digit.

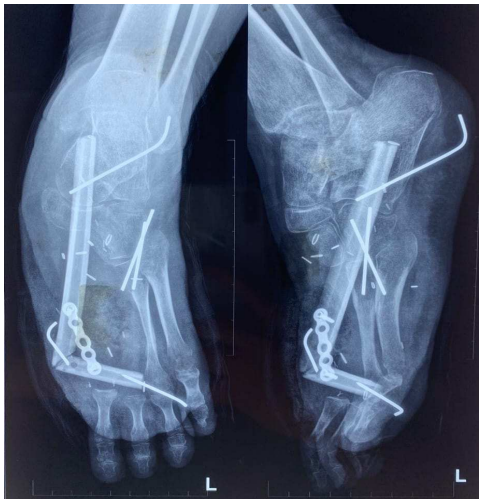

Figure 2. Postoperative x-rays, anteroposterior and lateral view of patient's left foot.

Figure 3. Postoperative evaluation. clinical condition of patient's left foot (day-3).

Despite the initial recovery, the deep branch of the anterior tibial artery to the 1st digit was compromised on day 10, leading to hallux ischemia and necrosis, necessitating amputation. Six weeks post-surgery, an anterolateral thigh (ALT) free flap was used to cover the dorsal defect, and the patient completed radiotherapy. At six months, the fibula showed stable positioning and some bone fusion, enabling the patient to walk without difficulty. After 2 years, the skin flap and bone remained intact despite radiation therapy. Although the plantar surface lacked an arch, the patient's gait was satisfactory with occasional discomfort during prolonged

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walking. A revision to thin the fibula and the ALT flap was planned.

Figure 4. Postoperative evaluation after 2 years..

DISCUSSION

Limb-sparing surgery has gained prominence as the preferred approach in managing sarcomas of the foot, often combined with radiotherapy to reduce recurrence rates. Studies by Kaixu Yu (2022) support its efficacy in improving overall and progression-free survival. In our case, a 21-year-old female with synovial sarcoma underwent successful limb-sparing surgery with no recurrence observed over two years of follow-up, despite not resorting to below-knee amputation, which remains the traditional gold standard treatment. A pivotal randomized trial in 1982 and subsequent studies involving over 1,000 patients demonstrated no significant differences in disease-free survival between the limb-sparing and amputation groups, cementing the role of limb-sparing surgery as a standard of care for soft tissue sarcomas.

Hayakawa et al. reported five-year overall survival rate of 94.7% for limb-sparing surgery cases compared to 55.6% for amputation cases, underscoring the superiority of limb-sparing procedures when feasible.[5] However, achieving clear surgical margins remains challenging in anatomically complex and constrained spaces of the foot. Intraoperative frozen section analysis allowed us to achieve secure margins (1.5–2 cm) in a single attempt, as confirmed by microscopic pathology. This technique minimizes the risk of recurrence, which is particularly crucial in cases where wide resection without clear margins compromises the outcomes.

The functional and psychological implications of treatment choices are critical, especially in young and productive patients. Although amputation is definitive, it poses significant emotional trauma, leading to higher risks of depression, demoralization, and even suicide. Conversely, limb-sparing approaches offer better psychological outcomes and preserve the patient's quality of life and self-image. However, the associated health-related costs, spanning multiple reconstructive surgeries, rehabilitation, and prosthetic needs, can impose financial burdens on patients and their families. Transparent discussions about expectations and potential outcomes are essential to aligning treatment goals with patient preferences and realities.[6]

Reconstruction of complex mid-to-forefoot defects, such as those in this case, presents significant challenges. The intricate anatomy and functionality of the foot require precise reconstruction not only to close the defect, but also to restore its structural and weight-bearing capabilities.[5] The midfoot serves as a stable platform critical for transferring forces through the foot arches, while its disruption affects the transverse and longitudinal arches, leading to gait and functional impairments[7].

Among the various reconstruction options, the free fibula osteocutaneous flap is a versatile solution. Its length, cortical density, and vascularized nature make it ideal for creating a stable framework for mid-to-forefoot defects.[8] In our case, the fibula was reconstructed into an L-shape, effectively replacing the longitudinal rays of the foot, including those of the metatarsals and cuneiform bones. Its compact structure allows osteotomies without compromising vascular integrity. Additionally, the fibular skin paddle closely resembled the dorsal foot skin, ensuring optimal soft tissue coverage.

Studies have shown superior outcomes with vascularized bone grafts over avascular grafts, with bone union rates ranging from 86% to 100% and union intervals of 7–12 months in oncologic defect reconstructions. Partial weight bearing can typically be initiated at three months, with radiographic evidence of bone union at four–six months.[9] Stress fractures remain a notable complication, occurring in 7.7%–22.2% of cases. To mitigate this risk, we implemented a phased rehabilitation protocol that initially restricted weight bearing and gradually increased the load with walking aids, coupled

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with routine radiologic monitoring of fibular hypertrophy.

Donor site morbidity is another critical consideration, with reported complication rates of 15–55%. These include wound healing, stiffness, nerve injury, and claw toe deformities. In our case, the hallux did not survive because of arterial compromise, necessitating its eventual amputation.[9] While this was a setback, the overall reconstructive outcomes were satisfactory, with stable grafts and functional improvements observed at the follow-up.

CONCLUSION

In our experience, the chimeric osteocutaneous free fibular flap proved effective in reconstructing complex mid-to-forefoot defects, with early fusion of fibula osteotomies and other bones showing promising results. Despite the loss of the 1st to 3rd metatarsals and tarsal bones, fibula osteotomy was able to bear load, allowing the patient to walk. Importantly, no recurrence was reported after two years, indicating that foot synovial sarcoma recurrence can be prevented by a combination of radiotherapy and secure margin resection. The most rewarding outcome was the patient's ability to resume daily activities, which may improve prognosis. Based on this, we recommend considering limb-sparing surgery for young and productive patients with synovial sarcoma or other soft tissue foot malignancies.

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