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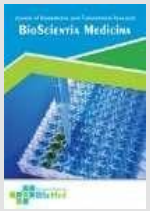

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Immediate Reconstruction of Massive Gluteal Defects Following Giant Malignant Peripheral Nerve Sheath Tumors Excision: Application of the Fasciocutaneous Rotational Flap in a Resource-Stratified Setting

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A B S T R A C T

Background: Malignant peripheral nerve sheath tumors (MPNSTs) are aggressive soft tissue sarcomas often requiring radical excision. In the gluteal region, achieving oncological clearance for giant tumors creates massive defects characterized by dead space and tension. This study evaluates the utility of the fasciocutaneous rotational flap for immediate closure when free tissue transfer is unavailable. **Case presentation:** A 56-year-old female presented with a rapidly enlarging, Grade III MPNST on the right buttock measuring 18 cm in diameter. Wide local excision resulted in a defect measuring 18 cm by 16 cm by 10 cm, exposing the gluteus maximus. Due to resource limitations preventing intraoperative frozen section analysis, wide anatomical clearance was prioritized. Immediate reconstruction was performed using a random-pattern fasciocutaneous rotational flap based on inferior gluteal artery perforators. The flap arc length measured 52 cm with a 1:3.25 defect-to-arc ratio. Postoperative histopathology confirmed Grade III MPNST with positive deep margins (R1), necessitating adjuvant radiotherapy. The flap healed completely by day 14 without necrosis, and the patient was discharged on day 5. At the 3-month follow-up, the wound remained stable with no dehiscence during radiation. **Conclusion:** The gluteal fasciocutaneous rotational flap is a robust technique for closing massive defects where primary closure is impossible. While it provides excellent durable coverage for adjuvant therapy, the inability to confirm negative margins intraoperatively poses significant oncological risks. Immediate flap coverage should be weighed carefully against staged reconstruction in resource-stratified settings.

1. Introduction

Malignant peripheral nerve sheath tumors (MPNSTs) constitute a distinct and formidable subset of soft tissue sarcomas, presenting a unique challenge to the multidisciplinary oncological team. Accounting for approximately 5% to 10% of all sarcoma diagnoses, these aggressive neoplasms arise from the Schwann cells or pluripotent cells of the neural crest, specifically originating within peripheral nerve branches or the nerve sheath itself. The biological behavior of MPNSTs is characterized by rapid cellular proliferation, a high propensity for local recurrence, and an alarming rate of distant metastasis, particularly to the lungs.[1] The pathogenesis of MPNST is frequently linked to neurofibromatosis type 1 (NF1), an autosomal dominant genetic disorder. In patients with NF1, the malignant transformation often occurs within pre-existing plexiform neurofibromas, driven by the biallelic loss of the NF1 tumor suppressor gene and subsequent accumulation of p53 mutations.[2] However, a significant minority of cases—approximately 50% in some series—occur sporadically in the general population. These sporadic cases, distinct from their syndromic counterparts, present a

diagnostic and therapeutic conundrum. Lacking the clinical stigmata of NF1 to trigger early surveillance, sporadic MPNSTs often present as large, neglected masses. They are frequently misdiagnosed initially as benign neural swellings or lipomas, leading to delayed intervention and allowing the tumor to undergo high-grade transformation before definitive therapy is initiated. Histopathologically, these high-grade lesions exhibit a marble-like appearance with hypercellular fascicles, high mitotic activity (Ki-67 >5%), and extensive areas of necrosis and hemorrhage, indicating a tumor that has outgrown its blood supply.[3]

Despite advances in chemotherapy and radiation, the mainstay of curative treatment for MPNST remains wide surgical resection with negative microscopic margins (R0 resection). The prognostic significance of surgical margins cannot be overstated; incomplete resection is the strongest predictor of local recurrence and disease-specific mortality.[4] However, achieving oncological clearance is frequently complicated by the anatomical location of these tumors. MPNSTs have a predilection for the proximal extremities and the trunk, specifically following the distribution of major nerve trunks like the sciatic nerve in the gluteal region. In the gluteal region, the term wide excision implies a profound disruption of pelvic anatomy. The buttock is not merely a depot of adipose tissue; it is a complex functional unit comprised of the gluteus maximus, medius, and minimus muscles, which are critical for ambulation and hip stability.[5] Furthermore, sarcomas in this region often possess a pseudocapsule—a compressed layer of reactive tissue that macroscopically appears distinct but microscopically contains satellite tumor cells. To bypass this zone of infiltration, the surgeon must resect a significant volume of unaffected skin, subcutaneous tissue, and muscle. When the tumor is giant—defined in this context as exceeding 10-15 cm in diameter—the ablative phase of surgery results in a massive three-dimensional defect that exposes critical neurovascular structures, the pelvic ring, or the femur.[6]

The creation of such extensive defects introduces a secondary, yet equally critical, challenge: reconstruction. The gluteal region is a unique anatomical zone subjected to high physiological stress. It serves as the primary weight-bearing surface during sitting and endures significant shearing and tensile forces during the flexion and extension of the hip.[7] Consequently, primary closure of large defects is rarely feasible. The skin of the buttock, particularly in the lateral and gluteal fold regions, has limited laxity. Attempting to force primary closure under high tension invariably leads to tissue strangulation, ischemia, and subsequent wound dehiscence. Furthermore, the excision of a large volume of the gluteus maximus muscle creates a substantial dead space—a cavernous void between the skin and the deep pelvic fascia. If this space is not adequately obliterated with viable tissue, it becomes a reservoir for seroma formation. In the context of oncological surgery, a seroma is not a benign nuisance; it is a fertile culture medium for bacteria, significantly increasing the risk of deep surgical site infections (SSIs). The stakes of wound failure in sarcoma patients are exceptionally high. The current standard of care for high-grade MPNSTs often involves adjuvant radiotherapy to sterilize microscopic residual disease. However, radiotherapy cannot be safely administered to an open, infected, or dehisced wound. Therefore, a failure to achieve secure, durable wound closure leads to prolonged recovery times and critical delays in starting adjuvant therapy, potentially compromising the patient's overall survival.[8]

Given these high stakes, the reconstructive phase of sarcoma surgery must be viewed as an integral component of the oncological treatment plan. The reconstructive ladder offers various options, ranging from skin grafts to free tissue transfer. While skin grafts are technically simple, they are suboptimal for gluteal defects due to their lack of bulk (failing to fill dead space) and poor durability against shearing forces. At the other end of the spectrum, free tissue transfer (free flaps) is often considered the gold standard for massive defects, as it allows the

importation of large volumes of vascularized tissue from distant sites.[9] However, the application of free flaps is constrained by logistic and economic realities. Free tissue transfer requires specialized microsurgical equipment, highly trained personnel, and prolonged operative times, which increase the anesthesia risk for often-comorbid cancer patients. In resource-stratified settings—defined here as surgical centers that may lack immediate access to microsurgery, advanced intraoperative monitoring, or frozen section analysis—reliance on free flaps is often impractical. In such environments, the surgeon must rely on robust local options that balance oncological safety with technical feasibility. This necessitates a re-evaluation of the fasciocutaneous rotational flap. The gluteal region is richly vascularized by perforators from the superior and inferior gluteal arteries, which supply the overlying skin and fascia in a random pattern. This vascular anatomy allows for the elevation of large, robust tissue paddles that can be rotated to cover adjacent defects without the need for microsurgical anastomosis. Unlike myocutaneous flaps (such as V-Y hamstring advancement) that sacrifice functional muscle units, fasciocutaneous flaps preserve the remaining gluteal musculature, maintaining ambulatory function. Furthermore, these flaps are technically straightforward, possess a similar texture and thickness to the excised tissue, and minimize donor site morbidity.

Despite the clear need for such robust reconstruction techniques, the existing literature on MPNSTs is heavily skewed towards histopathology, genetics, and systemic therapies. There is a paucity of literature detailing the specific surgical geometry required to close defects larger than 15 cm following sarcoma resection. Most surgical reports focus on smaller defects or rely on free flap data from high-resource centers.[10] This study aims to bridge that gap by providing a detailed technical and clinical analysis of the strategic management of a massive gluteal defect (18 cm x 16 cm). We present the case of a Grade III sporadic MPNST treated with wide excision and immediate reconstruction using a gluteal fasciocutaneous rotational flap. The novelty of this study lies in its focus on the feasibility of converting a massive, high-tension defect into a primary healing wound using local tissue rearrangement in a resource-stratified setting. We specifically address the biomechanical design of the flap, the management of dead space, and the complex decision-making required when performing immediate reconstruction in the absence of intraoperative margin confirmation. This report seeks to validate the fasciocutaneous rotational flap as a versatile, workhorse solution for the surgical oncologist facing giant pelvic defects.

2. Case Presentation

In adherence to the ethical standards of the Helsinki Declaration and institutional protocols, written informed consent was obtained from the patient prior to the documentation of this case. The patient provided explicit permission for the publication of her clinical data, including the detailed surgical history and accompanying intraoperative photography, with the understanding that her anonymity would be preserved.

A 56-year-old female presented to the oncology surgical clinic with a chief complaint of a massive, painful, and disfiguring mass located on the right buttock. The clinical history was significant for the chronic nature of the lesion; the mass had been present for approximately four years. According to the patient, the lesion initially manifested as a small, painless, subcutaneous nodule, comparable in size to a ping-pong ball. For the first three years, the growth was indolent. However, over the 12 months preceding her admission, the tumor exhibited a phase of exponential biological aggression, enlarging to roughly 15 times its original volume (Table 1).

This rapid expansion was accompanied by a deterioration in the local tissue quality. Six months prior to presentation, the patient noted the development of a spontaneous central ulceration. This ulcer was refractory to conservative management and local wound care, becoming increasingly painful and malodorous. The mechanical bulk of the tumor,

combined with the pain from the ulceration, had a profound impact on the patient's functional status and quality of life, rendering her unable to sit or lie in the supine position for extended periods. Her medical history was otherwise unremarkable; crucially, she had no personal history of Neurofibromatosis Type 1 (NF1), no cutaneous café-au-lait macules, and no known family history of soft tissue sarcomas or genetic cancer syndromes.

Upon physical examination, the patient appeared clinically cachectic, suggesting a systemic catabolic state often associated with large tumor burdens. The local examination revealed a massive, exophytic, and multilobulated neoplasm occupying the majority of the right gluteal region. Palpation confirmed the mass was firm and fixed to the underlying deep structures, indicating likely infiltration of the gluteal fascia or musculature. The external dimensions of the tumor were measured at approximately 18 cm in diameter. The integument overlying the tumor was severely compromised; the skin was distended, shiny, and exhibited marked venous congestion, indicative of the high vascular demand of the sarcoma. The central aspect of the mass featured a necrotic, excavated ulcer measuring 5 cm by 4 cm. This area was covered with a purulent discharge and exhibited contact bleeding upon manipulation. Regional lymph node examination revealed no palpable inguinal lymphadenopathy. A focused neurovascular examination of the right lower extremity demonstrated preserved motor and sensory function in the distribution of the sciatic nerve, suggesting that despite the tumor's posterior location, the main nerve trunk remained functionally intact.

Preoperative laboratory analysis was consistent with chronic disease. The patient exhibited a hemoglobin level of 10.2 g/dL, indicating a normocytic anemia likely secondary to chronic inflammation and intratumoral hemorrhage. Her serum albumin was borderline at 3.5 g/dL, while renal and hepatic function panels were within normal limits. Chest radiography was performed to screen for pulmonary metastases, the most common site of distant spread for high-grade sarcomas; the lung fields were clear. To delineate the anatomical extent of the disease, Magnetic Resonance Imaging (MRI) with contrast was performed. The imaging revealed a large, well-defined, yet heterogeneously enhancing mass measuring 7.7 cm by 11 cm by 12.4 cm, situated in the posterolateral pelvic soft tissue. T2-weighted sequences demonstrated internal hypointense areas consistent with extensive intratumoral necrosis and hemorrhage. Anatomically, the mass was located posterior to the gluteus maximus muscle. Crucially for surgical planning, the MRI confirmed that there was no deep infiltration into the pelvic bones, the hip joint capsule, or the femur, and a fat plane appeared to be preserved between the tumor and the sciatic nerve. An incisional biopsy was performed to establish a histopathological diagnosis. The pathology report indicated a malignant spindle cell neoplasm. Immunohistochemical staining showed the tumor cells were positive for S100 and Ki-67 (with a proliferation index greater than 5%) and negative for CD34. These findings confirmed the diagnosis of a Grade III malignant peripheral nerve sheath tumor (MPNST).

The patient was scheduled for wide local excision with immediate reconstruction. The operation was conducted in a resource-stratified clinical setting where intraoperative frozen section analysis was not available to confirm clear margins in real-time. Consequently, the surgical strategy relied heavily on gross anatomical clearance and the preoperative imaging findings. Under general anesthesia, the patient was positioned prone to maximize exposure of the gluteal region. The operative field was prepped and draped to allow access to the right buttock, lateral hip, and posterior thigh. An extensive elliptical incision was designed, incorporating the previous biopsy scar and the central ulceration, with a 2-cm clinically clear margin of healthy skin peripheral to the tumor borders. Dissection proceeded through the subcutaneous fat down to the deep gluteal fascia. Intraoperatively, the tumor was found to be densely adherent to the underlying musculature.

Table 1. Summary of Clinical Findings on Admission

CLINICAL DOMAIN	DETAILED FINDINGS
Patient Demographics	**Age/Sex:** 56-year-old Female **Comorbidities:** None reported (Sporadic case) **Genetic History:** No history of Neurofibromatosis Type 1 (NF1); No family history of sarcoma
History of Present Illness	**Chief Complaint:** Massive, painful mass on right buttock **Duration:** 4 years total duration **Progression:** Indolent nodule for 3 years; exponential 15-fold growth in last 12 months **Functional Impact:** Inability to sit or lie supine due to pain and bulk
Local Physical Examination (Right Gluteal)	**Mass Size:** ~18 cm diameter (externally) **Morphology:** Exophytic, multilobulated, firm, and immobile **Skin Condition:** Distended with visible venous congestion **Ulceration:** **Central necrotic ulcer (5 cm x 4 cm)** with purulent discharge and contact bleeding
Regional & Systemic Examination	**General Appearance:** Clinically cachectic **Lymph Nodes:** No palpable inguinal lymphadenopathy **Neurovascular Status:** **Intact** (Motor and sensory function preserved in right lower extremity)
Laboratory Investigations	**Hemoglobin:** 10.2 g/dL (Normocytic Anemia) **Albumin:** 3.5 g/dL (Borderline) **Organ Function:** Renal and Liver function tests within normal limits
Radiographic Imaging (MRI)	**Dimensions:** 7.7 cm x 11 cm x 12.4 cm **Characteristics:** Heterogeneously enhancing; internal hypointense areas consistent with necrosis **Anatomical Relation:** Located posterior to gluteus maximus; **No deep infiltration** into pelvic bones, hip joint, or femur **Metastatic Screen:** Chest X-ray negative for pulmonary metastasis
Pre-operative Biopsy	**Diagnosis:** Malignant Peripheral Nerve Sheath Tumor (MPNST), Grade III **Immunohistochemistry:** **Positive:** S100, Ki-67 (>5%); **Negative:** CD34

To adhere to oncological principles and ensure a wide margin, a significant portion of the gluteus maximus muscle was included in the resection. The tumor was lifted off the deeper pelvic structures, carefully preserving the sciatic nerve, which was identified deep to the resection plane. The excised specimen was massive, measuring 18 cm by 16 cm by 10 cm and weighing approximately 1.5 kg.

Following the ablation, the surgical team was confronted with a massive soft tissue defect measuring 18 cm (vertical) by 16 cm (horizontal) by 10 cm (depth). The defect floor consisted of the remaining deep fibers of the gluteus maximus, the gluteus medius, and the exposed lateral aspect of the greater

trochanter. The sheer width of the defect (16 cm) combined with the poor laxity of the buttock skin, made primary closure impossible. Simple skin grafting was deemed inappropriate due to the need for durable coverage over the bony prominence of the trochanter and the anticipated need for adjuvant radiotherapy.

A decision was made to perform an immediate tissue rearrangement using a gluteal fasciocutaneous rotational flap (Table 2). This flap was selected for its reliability and ability to recruit tissue from the laxity of the lateral hip and thigh. The flap was designed extending from the lateral aspect of the defect. The pivot point was established at the inferolateral aspect of the defect, near the greater trochanter. The superior incision line extended from the top of the defect in a curvilinear fashion towards the iliac crest and then curved inferiorly down the lateral thigh. To achieve adequate rotation without excessive tension, a large arc was required. The total length of the flap incision (arc length) measured 52 cm. Given the defect width of 16 cm, this provided a defect-width to flap-length ratio of approximately 1:3.25. This ratio is critical in rotational flap mechanics to ensure the line of greatest tension (from the pivot point to the distal tip) can be sufficiently relaxed to allow medial advancement. The flap was raised in the sub-fascial plane. This plane is anatomically distinct and ensures the inclusion of the deep fascia (fascia lata and gluteal fascia) with the skin paddle. This technique preserves the subdermal plexus and the random-pattern perforators derived from the inferior gluteal artery (IGA) and the superior gluteal artery (SGA), which are essential for flap viability. Once elevated, the flap was rotated 90 degrees medially into the defect. To facilitate this rotation and reduce tension at the pivot point, a back-cut of 3 cm was performed at the base of the flap into the fascia lata. This maneuver released the restraint of the pivot point, allowing the flap to advance without compromising its vascularity. The rotation of such a large tissue paddle created a standing cutaneous cone, or dog-ear, at the pivot point. This was managed by excising a Burow's triangle to flatten the contour and improve the aesthetic result.

Prior to final closure, two closed-suction drains were placed deep into the wound bed to prevent hematoma and seroma accumulation. The superficial fascia of the flap was securely anchored to the fascia of the defect bed using 0-Vicryl interrupted sutures. This step was vital to obliterate the dead space and distribute tension to the fascial layer rather than the skin. The skin was closed with 3-0 Prolene vertical mattress sutures to ensure wound edge eversion and maximal strength.

The final histopathological analysis of the resected specimen described a tumor composed of spindle-shaped and wavy cells arranged in fascicles with a marble-like appearance, featuring both hypercellular and hypocellular areas. The nuclei were polymorphic and hyperchromatic with high mitotic activity. Extensive areas of intratumoral necrosis and hemorrhage were confirmed. The diagnosis remained Grade III MPNST. However, the microscopic assessment of the margins revealed a critical finding: tumor cells were present at the deep surgical margin (R1 resection). Despite the inclusion of muscle in the resection, the aggressive infiltrative nature of the tumor had extended beyond the grossly visible pseudocapsule. This R1 status fundamentally altered the postoperative prognosis and necessitated aggressive adjuvant therapy.

The patient's immediate postoperative recovery was remarkably rapid. The flap demonstrated robust perfusion with no evidence of venous congestion, ischemia, or tip necrosis. The drains were removed on postoperative day four after the output decreased to less than 30 milliliters per 24 hours. The patient was discharged home on postoperative day five, a significant achievement given the magnitude of the excision. At the 3-month follow-up, the surgical site was fully healed with excellent tensile strength. The patient had regained full mobility and was able to sit comfortably. Due to the positive deep margin (R1) and the high-grade nature of the tumor, the patient was referred for adjuvant radiotherapy. She underwent a course of 60 Gy delivered in 30 fractions. A notable

advantage of the fasciocutaneous flap was observed during this period: the robust, vascularized tissue withstood the radiation well, with no signs of dehiscence or radiation-induced necrosis. Although no macroscopic local recurrence was palpable at the 3-month interval, the patient remains under strict long-term surveillance due to the high risk of recurrence associated with R1 resections in MPNSTs.

Table 2. Diagnosis, Treatment, Follow-up, and Outcome

PHASE OF CARE	CLINICAL DETAILS
Final Diagnosis	**Histopathology:** Malignant Peripheral Nerve Sheath Tumor (MPNST), Grade III **Tumor Characteristics:** High mitotic activity, extensive necrosis, spindle cell morphology **Genetic Context:** Sporadic (Non-NF1 associated)
Surgical Treatment (Ablative Phase)	• **Procedure:** Wide Local Excision (WLE) • **Position:** Prone • **Resection Extent:** Skin, subcutaneous tissue, deep fascia, and portion of gluteus maximus muscle • **Specimen Weight:** 1.5 kg • **Defect Size:** **18 cm (H) x 16 cm (W) x 10 cm (D)**
Surgical Treatment (Reconstructive Phase)	**Technique:** Gluteal Fasciocutaneous Rotational Flap **Flap Dimensions:** Arc length 52 cm (Ratio 1:3.25) **Vascular Basis:** Random pattern (Inferior Gluteal Artery perforators preserved) **Modifications:** Sub-fascial elevation; 3 cm back-cut into fascia lata **Closure:** Layered closure over suction drains
Pathological Outcome	**Margin Status:** **Positive microscopic deep margins (R1 Resection)** **Implication:** Confirmed aggressive infiltration beyond gross pseudocapsule
Post-operative Recovery	**Hospital Stay:** Discharged on **Post-op Day 5** **Drain Management:** Removed on Day 4 (less than 30 mL/24h) **Complications:** None (No necrosis, dehiscence, or infection)
Adjuvant Therapy	**Indication:** R1 resection status and High-grade histology **Modality:** External Beam Radiotherapy (EBRT) **Dose:** 60 Gy in 30 fractions **Tolerance:** Flap withstood radiation well; no skin breakdown
Follow-up Outcome (3 Months)	**Wound Status:** **Fully healed**; excellent tensile strength **Functional Status:** Full ambulation regained; ability to sit restored **Oncological Status:** No palpable macroscopic recurrence (surveillance ongoing)

3. Discussion

The successful reconstruction of the massive gluteal defect presented in this case underscores the critical importance of understanding the vascular architecture of the pelvic region. The gluteal fasciocutaneous rotational flap is not merely a random rearrangement of tissue; it is a physiological procedure rooted in the angiosome concept described by Taylor and Palmer.[11] Unlike axial pattern flaps, which depend on the meticulous dissection of a single, named vessel (such as the inferior gluteal artery propeller flap), the large rotational flap employed here relies on a robust random pattern network. This network is supplied by a rich arborization of perforating vessels arising from both the superior and inferior gluteal arteries. These perforators traverse the substance of the gluteus maximus muscle, piercing the deep fascia to supply the overlying subcutaneous fat and skin.[12]

The key technical maneuver in raising this flap is the preservation of the fasciocutaneous plexus. By elevating the flap strictly at the sub-fascial level—including the deep fascia of the thigh (fascia lata) and buttock (gluteal fascia) with the skin paddle—the surgeon protects the delicate subdermal and suprafascial vascular networks. This preservation is paramount because it allows for the mobilization of exceptionally large tissue paddles, in this case, an arc length of 52 cm, without the risk of distal tip necrosis.[13] This vascular robustness is particularly advantageous in older or cachectic patients, such as the one in this report, where atherosclerotic changes might compromise specific axial vessels but generally spare the diffuse perforator network. Furthermore, by avoiding the intramuscular dissection required for myocutaneous flaps, this technique spares the remaining functional muscle units, preserving the patient's ambulatory capacity.[14]

The reconstruction of giant defects, defined here as those exceeding 15 cm in diameter, presents a unique biomechanical challenge: the management of tension. The gluteal region is a zone of high physiological stress, subjected to multidirectional shearing forces during locomotion and significant compression during sitting.[15] Attempting to close a defect of this magnitude (18 cm width) primarily is physically impossible; attempting to force closure would result in extreme tension at the suture line. This tension causes capillary collapse, leading to marginal ischemia, wound dehiscence, and eventual failure.

The rotational flap offers a sophisticated solution to this problem through the principle of tension redistribution (Figure 1). In a standard elliptical closure, tension is concentrated perpendicular to the incision line. The rotational design, however, fundamentally alters the vector of these forces. By designing a large, curvilinear incision that extends from the defect into the area of greatest skin laxity (the lateral hip and thigh), the surgeon recruits tissue that is not under immediate stress. As the flap rotates into the defect, the closing tension is not focused on a single point but is dissipated along the entire length of the long arc incision.[16]

The geometry of this design is critical. As demonstrated in this case, a defect-to-arc ratio of approximately 1:3 to 1:4 is essential to facilitate adequate rotation. A shorter arc would result in a tethered flap that cannot reach the medial edge of the defect without undue strain on the pivot point. The pivot point represents the line of greatest tension in any rotational flap. To further mitigate this, we employed a back-cut into the fascia lata at the base of the flap. This maneuver mechanically releases the restraint at the pivot point, allowing the thick, non-pliable gluteal skin to advance medially with greater freedom. This geometric precision effectively converts a defect that is impossible to close into a primary healing wound. While the surgical execution of the flap was successful, the management of this case highlights a profound oncological dilemma common in resource-stratified settings: the inability to confirm clear margins intraoperatively. The gold standard for sarcoma surgery is an R0 resection (microscopically negative margins).[17]

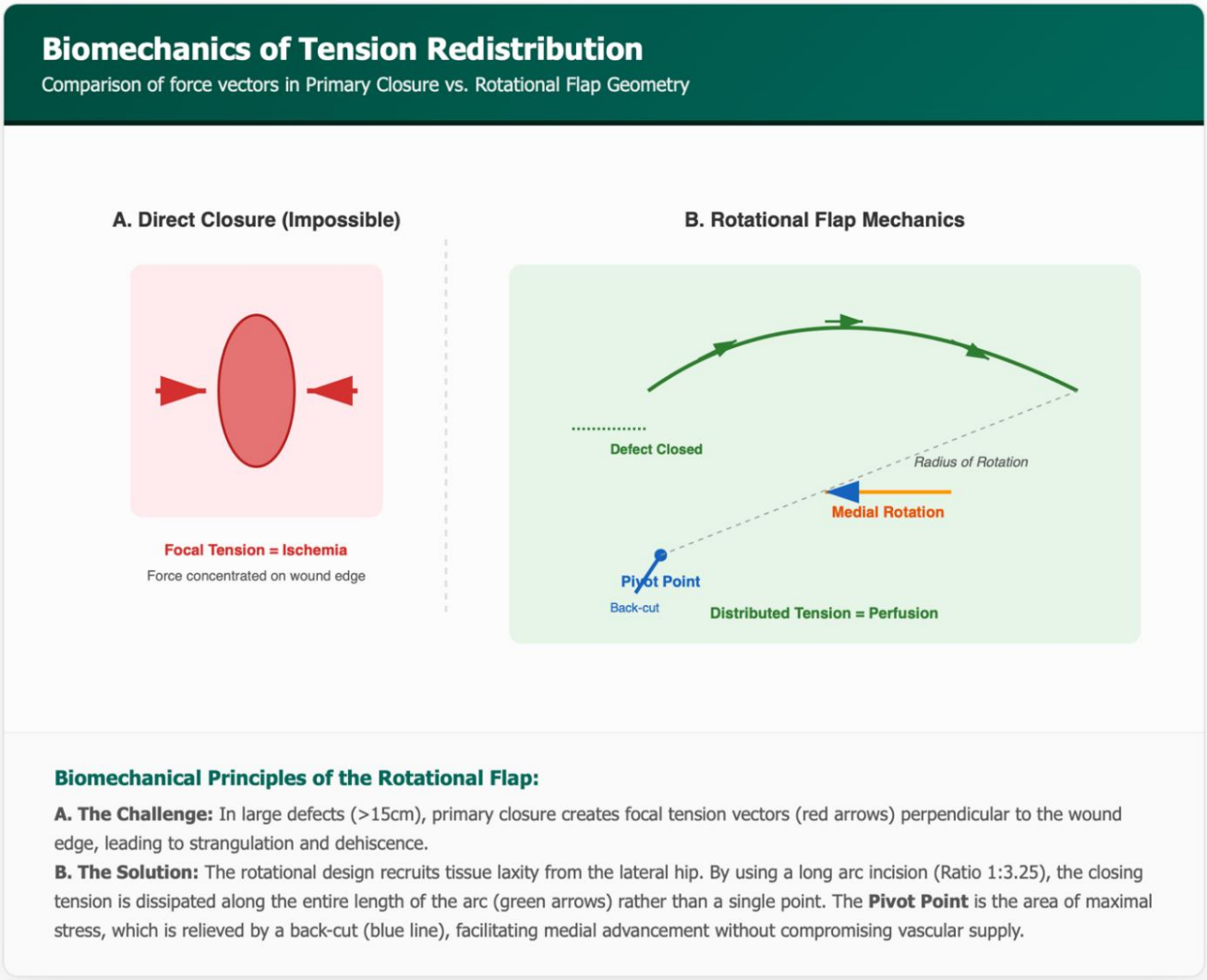

Figure 1. Biomechanics of tension redistribution.

In high-resource centers, this is achieved through real-time frozen section analysis, which guides the surgeon to re-excise positive areas before reconstruction begins. In the absence of this technology, the surgeon must rely on gross anatomical cues, which are notoriously unreliable for infiltrative tumors like Grade III MPNSTs. This creates a critical decision point: Immediate Reconstruction versus Staged Reconstruction. In this case, we opted for immediate flap coverage. The primary drivers for this decision were patient safety and logistical feasibility. The resection left a massive 18 cm x 16 cm defect with exposed muscle and bone. Leaving such a large wound open invites desiccation of vital structures, massive fluid loss, and a high risk of nosocomial infection. Furthermore, immediate closure allowed for early drain removal and rapid discharge (Day 5), which is crucial for patients who live far from tertiary care centers and cannot afford prolonged hospitalization.

However, the final pathology revealed a positive deep margin (R1). Retrospectively, a staged approach would have been oncologically safer. This would involve placing a negative pressure wound therapy (NPWT) device (VAC dressing) or a temporary biological dressing for 7 to 14 days while awaiting final

pathology. If the report confirmed positive margins, the patient could be returned to the operating room for a wider re-excision before the reconstructive flap was burned. By performing the flap immediately, we have buried the positive margin under a thick layer of healthy tissue. This complicates surveillance, as a local recurrence must grow to a substantial size before it becomes palpable through the flap, potentially delaying salvage surgery. Our decision was driven by the specific constraints of our setting—namely, the lack of long-term inpatient NPWT capabilities and the patient's inability to sustain a staged hospital stay. This highlights the difficult trade-offs surgeons must make in global surgery contexts, often balancing perfect oncological principles against the realities of wound morbidity and resource availability.[18]

Despite the R1 resection, the choice of a fasciocutaneous flap provided a distinct advantage regarding adjuvant therapy. Because of the positive margin and high-grade nature of the tumor, post-operative radiotherapy was mandatory.[19] Radiation functions by inducing DNA damage, but it also causes obligate tissue injury, leading to fibrosis and microvascular thrombosis. A simple skin graft or a wound closed under extreme tension is poorly vascularized and highly susceptible to radiation-induced necrosis, which can lead to chronic non-healing wounds that delay cancer treatment. In contrast, the rotational flap imports virgin, well-vascularized tissue from the lateral thigh—tissue that was outside the primary field of resection and radiation. This healthy tissue bed brings its own blood supply, allowing it to tolerate the oxidative stress of radiotherapy significantly better than scarred or grafted tissue. In this case, the flap remained stable throughout the 60 Gy radiation course, ensuring that the patient received her life-saving adjuvant treatment without interruption. This biological resilience is a key argument for using robust flaps in sarcoma reconstruction, where multimodal therapy is the norm.

It is important to acknowledge the limitations of this study. First, it is a single case report, which limits the generalizability of the findings. While it demonstrates the technical feasibility of the flap, it cannot prove oncological superiority over other methods. Second, the follow-up period of 3 months is short. While sufficient to document the success of the wound closure and the flap's survival, it is inadequate to assess the true oncological outcome. Local recurrence in high-grade MPNST typically occurs within the first 12 to 24 months. The R1 status places this patient at high risk, and the presence of the flap may obscure early clinical detection of recurrence.[20] Future research in this domain should focus on two areas. First, comparing the long-term outcomes of immediate vs. staged reconstruction in resource-limited settings to establish evidence-based guidelines. Second, investigating the integration of low-cost margin assessment tools, such as imprint cytology, to reduce the reliance on gross anatomical clearance when frozen sections are unavailable.

4. Conclusion

The management of giant malignant peripheral nerve sheath tumors (MPNSTs) in the gluteal region demands a surgical strategy that is as bold as it is precise. It requires a delicate balance between the aggressive resection needed for cancer control and the reconstructive ingenuity needed for functional restoration. The case presented here demonstrates that the gluteal fasciocutaneous rotational flap is a formidable weapon in the surgeon's armamentarium. This technique offers a highly effective solution for the immediate closure of massive defects (up to 18 cm) that are otherwise amenable only to complex free tissue transfer. Its advantages are manifold: (1) Versatility: It recruits tissue from the lateral thigh and hip, providing a perfect color and texture match; (2) Reliability: It relies on a robust, redundant vascular supply that does not require microsurgery, making it accessible in settings where resources are scarce; (3) Durability: It provides thick, vascularized cover that obliterates dead space and withstands the rigors of adjuvant radiotherapy.

However, this technical success must be tempered with oncological caution. The R1 dilemma encountered in this case serves as a sobering reminder of the risks inherent in immediate reconstruction without margin confirmation. While the flap saved the patient from a massive open wound and allowed for rapid discharge, it also covered a microscopic focus of disease. Therefore, we conclude that while the fasciocutaneous rotational flap should be considered a first-line reconstructive option for closing complex gluteal defects, its application in oncological surgery requires strict judgment. In resource-stratified settings, surgeons must weigh the benefits of immediate closure against the risks of burying positive margins. Wherever feasible, a staged approach using negative pressure wound therapy should be strongly considered to ensure margin clearance before the final flap is inset. Ultimately, the goal of sarcoma surgery is not just to close the hole, but to cure the patient, and reconstruction must always serve this primary oncological imperative.

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