REVERSE SURAL FLAP AS AN EFFECTIVE ALTERNATIVE TO FREE FLAPS IN LOWER-LIMB SOFT-TISSUE RECONSTRUCTION – A CASE REPORT

Odwrócony płat łydkowy jako skuteczna alternatywa dla wolnych płatów w rekonstrukcji ubytków tkanek miękkich kończyny dolnej – opis przypadku

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Abstract

Fasciocutaneous flaps offer a wide range of options for the reconstruction of lower-limb soft-tissue defects. This article presents the case of a 39-year-old patient who underwent sarcoma resection in the knee region, followed by reconstruction using a reverse sural flap. This regional flap is characterised by favourable retrograde perfusion, structural stability, and minimal donor-site morbidity, enabling single-stage defect coverage and protection of the deep structures of the knee joint. Free flaps are frequently considered the method of choice for the reconstruction of larger lower limb defects; however, their use may be limited in the presence of peripheral vascular disease, diabetes mellitus, post-traumatic wounds, or in patients with an increased risk of perioperative complications. In contrast, the reverse sural flap provides effective defect coverage, reduced operative time, and a lower risk of complications while preserving limb function. The presented case confirms that the reverse sural flap is a safe, effective, and practical option for lower-limb soft-tissue reconstruction, offering advantages over free microsurgical flaps in selected clinical scenarios.

Streszczenie

Płaty skórno-powięziowe dostarczają szerokich możliwości rekonstrukcji ubytków tkanek miękkich kończyny dolnej. W niniejszym artykule przedstawiono przypadek 39-letniego pacjenta po resekcji mięsaka w okolicy kolana, u którego zastosowano rekonstrukcję z użyciem odwróconego płata łydkowego. Ten regionalny płat charakteryzuje się korzystnym ukrwieniem wstecznym, stabilnością oraz minimalnym obciążeniem miejsca dawczego, co pozwala na jednoczasowe pokrycie ubytku i ochronę struktur głębokich stawu kolanowego. Wolne płaty niejednokrotnie są metodą z wyboru w rekonstrukcji większych defektów kończyny dolnej, jednak ich zastosowanie bywa ograniczone w przypadku współwystępowania chorób naczyń obwodowych, cukrzycy, ran pourazowych lub u pacjentów obciążonych zwiększonym ryzykiem powikłań okołooperacyjnych. Odwrócony płat łydkowy pozwala natomiast na skuteczne pokrycie ubytku, skrócenie czasu operacji oraz ograniczenie ryzyka powikłań przy zachowaniu funkcji kończyny. Opisany przypadek potwierdza, że odwrócony płat łydkowy jest bezpieczną, efektywną i praktyczną metodą rekonstrukcji ubytków tkanek miękkich kończyny dolnej, oferującą w wybranych sytuacjach przewagę nad wolnymi płatami mikrochirurgicznymi.

Keywords: reverse sural flap; lower limb reconstruction; soft tissue defect; knee; alternative to free flaps

Słowa kluczowe: odwrócony płat łydkowy; rekonstrukcja kończyny dolnej; ubytek tkanek miękkich; kolano; alternatywa dla wolnych płatów

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Introduction

Sarcoma is a tumour of mesenchymal origin that develops in soft tissues such as muscles, adipose tissue, blood vessels, and fasciae. Surgical management of sarcomas typically requires radical resection, which results in substantial soft-tissue defects. Effective reconstruction of these defects is essential for protecting the deep structures of the limb, preserving functionality, and enabling the patient's subsequent rehabilitation [1].

A fasciocutaneous flap is a segment of skin and its underlying fascia, transferred to cover a soft-tissue defect. Unlike free microsurgical flaps, regional flaps retain their intrinsic blood supply, allowing them to be transposed or reversed within adjacent anatomical structures. The reverse sural flap is a fasciocutaneous flap in which perfusion occurs retrogradely via perforators of the peroneal artery. This technique provides stable and reliable coverage of lower-limb defects, reducing operative time and lowering the risk of complications compared with free microsurgical flaps [2].

Case report

A 39-year-old man was admitted on an expedited elective basis to the Clinical Department of Plastic, Reconstructive and Burn Surgery at the Military Institute of Medicine – National Research Institute in Warsaw for reconstruction of a knee-region soft-tissue defect following sarcoma resection using a fasciocutaneous flap.

The patient is professionally active and rides motocross recreationally. He had initially undergone soft-tissue sarcoma resection at another centre, after which the procedure was found to be non-radical (positive margins). He subsequently received radiotherapy, followed by re-excision of residual tumour tissue within the scar left by the initial sarcoma. The patient was admitted electively for the reconstruction of the soft-tissue defect in the knee region using a fasciocutaneous flap retrogradely vascularised by perforators of the peroneal artery. Clinical examination revealed a 6 cm × 3 cm soft-tissue defect on the anterior aspect of the knee.

Upon admission, a detailed clinical assessment was performed, and surgical treatment was planned. The operative technique was meticulously defined prior to the procedure. Vascular perforators were mapped on the skin under ultrasound guidance, and the course of the sural nerve was traced, enabling safe planning and dissection of the fasciocutaneous flap. A wound swab was obtained for microbiological analysis. Preoperative thromboprophylaxis and empirical antibiotic therapy with intravenous clindamycin (300 mg three times daily) were initiated. Analgesic management was also maintained. Following completion of the preoperative workup, the patient was cleared and prepared for surgery. In the present case, a fasciocutaneous flap retrogradely vascularised by perforators of the peroneal artery was selected, allowing effective defect coverage while preserving the integrity of the structures surrounding the knee joint.

Stage I of the operation – excision of the lesion and preparation of the reverse sural flap

During the first stage of surgery, the sural flap was harvested. A skin incision was made along the previously marked course of the sural bundle. After dissection through the subcutaneous tissue, the fascia of the gastrocnemius muscle was reached. The fasciocutaneous flap was subsequently dissected together with the neurovascular bundle to approximately 2 cm below the popliteal fossa. The sural nerve and the short saphenous vein were identified, ligated, and transected. Muscular perforators were likewise ligated and transected. Next, the fasciocutaneous flap was elevated along with the skin island, fascia, nerve, and vein up to the pivot point on the fascial pedicle. The flap relied on retrograde vascularisation originating from the perforators of the peroneal artery and the short saphenous vein. Following dissection, the flap was viable and well-perfused. It was left in its original position and secured to the donor-site margins with skin sutures for postoperative observation.

Stage II of the operation – surgical debridement of the medial knee wound with fixation of the reverse sural flap

The wound in the region of the right knee was cleansed and debrided until a bleeding wound bed was obtained. An incision connecting the flap pivot point to the wound was then made. Skin flaps were dissected, and meticulous haemostasis was achieved. The flap was rotated into the knee-region defect and secured with interrupted sutures. A drain was placed beneath the flap at the distal pole. Subsequently, the margins of the donor-site wound were approximated to the muscle using sutures. The donor site for the split-thickness skin graft (STSG) was cleansed and lubricated. A 0.2 mm STSG was harvested from the right thigh using a dermatome. The harvested graft was carefully unfurled over the defect site, achieving complete coverage (100%). Skin staplers and sutures were applied, and dressings were placed over the donor sites. The intra- and post-operative course was uneventful. The surgical count was correct.

Immediately after surgery, the flap demonstrated normal viability. Pharmacological therapy was initiated, consisting of oral acetylsalicylic acid 75 mg once daily and intravenous pentoxifylline 200 mg twice daily. Analgesic management and thromboprophylaxis were continued.

The first dressing change was performed on the second postoperative day. The upper drain was removed, the flap was massaged to evacuate accumulated sanguineous fluid, and patient mobilisation was initiated. On postoperative day 4, the drain was changed, and subsequent dressing changes were performed every two days. From the third day onwards, targeted antibiotic therapy was introduced based on the results of the pre-operative wound swab. Subsequent dressing changes demonstrated a normal healing process. On postoperative day 10, marginal epidermal maceration of the flap was observed; however, healing of the fasciocutaneous flap itself progressed normally. The patient was discharged with recommendations for regular outpatient dressing changes and follow-up.

During further outpatient follow-up, post-operative healing was monitored. The healing process proceeded normally. Approximately one month later, the patient presented with suspected infection of the residual wounds and was readmitted to the department. The patient was afebrile (body temperature 37°C). Secondary intention healing was noted at the donor site within the upper and lower poles of the flap. A wound swab for microbiological culture was obtained, wound toilet was performed, isolated skin staplers were removed, and an iodoform dressing was applied for local antisepsis. The patient remained in good general condition, with improvement in the local wound status. Hospitalisation lasted two days, after which the patient was discharged home with outpatient recommendations. Follow-up visits confirmed complete flap take and normal limb function.

Discussion

Sarcomas are rare malignant neoplasms originating from mesenchymal tissue. They encompass more than 70 histopathological subtypes. Approximately four-fifths arise from soft tissues, with the remainder originating from bone. In Europe, their incidence is estimated at 4–5 cases per 100,000 population annually [3]. Limb-sparing resection is currently considered the gold standard in the treatment of soft tissue sarcomas [4]. Studies have demonstrated that combining surgery with radiotherapy yields better outcomes than surgery alone. However, radiotherapy adversely affects tissue viability and graft take during subsequent reconstruction. The choice between preoperative and postoperative radiotherapy is made individually, as the baseline condition of the tissues plays a crucial role in determining reconstructive options [5].

Plastic surgery procedures are therefore essential for restoring both the appearance and function of the limb following sarcoma treatment [6]. In 1981, Pontén described the fasciocutaneous flap as a reconstructive option for soft-tissue defects of the lower limb, particularly in the knee region. This flap is now widely used across the lower leg – from the heel and ankle to the knee – though it is most frequently applied in the distal third of the leg [7]. The sural flap is typically located between the popliteal fossa and the mid-calf, overlying the heads of the gastrocnemius muscle. It is one of the longest fasciocutaneous flaps in the lower limb [7]. The reverse sural flap is an island flap innervated by the sural nerve, with retrograde perfusion supplied by perforators of the peroneal artery. Dissection of this flap requires caution, primarily with regard to the peroneal artery [8]. Doppler ultrasonography is highly valuable in preoperative planning, as precise assessment of the vascular supply is essential [7]. Because the flap is pedicled, its harvest does not require microsurgical infrastructure. Consequently, this method is more accessible than other modalities and can be performed by centres with varying resources [9].

In a systematic review, Tripathee et al. reported that complications occurred in approximately one-quarter of patients undergoing reconstruction using a reverse sural flap. The most common complications included partial flap necrosis and venous congestion [9]. Mild venous congestion typically resolves spontaneously within a few days [7]. Total flap necrosis – the most severe complication – occurred in approximately 2.5% of cases. Early detection of signs of impaired flap adaptation can help prevent total necrosis; hence, training medical staff in recognizing early abnormalities is essential [9]. Other reported complications include haematoma and infection of the surrounding tissues. Risk factors for complications include diabetes mellitus, age over 40 years, and vascular diseases [8].

Nevertheless, the reverse sural flap is used to treat defects in patients with diabetic foot ulcers, achieving an excellent healing rate despite the baseline presence of these risk factors [8]. However, although this method can be successfully used in patients with diabetes and peripheral vascular disease, caution is advised in smokers, whose risk of partial necrosis is approximately threefold higher [10]. Venous insufficiency is another significant risk factor, increasing the risk of complications up to ninefold [11]. Because the flap is harvested with its innervation, patients experience temporary sensory loss and paraesthesias on the lateral aspect of the foot, which typically resolve over time [7]. Methods used to manage the most serious complication – partial or total flap necrosis – include leg elevation, catheterisation of the proximal stump of the lesser saphenous vein, and venous 'supercharging'. Some authors also recommend the flap delay technique, which involves transecting a vessel or incising the lateral borders of the skin island to redirect blood flow. A disadvantage of the flap, limited to aesthetic concerns, is the visible donor-site scar; however, it does not result in any functional impairment of the limb [7].

Despite this, the sural flap is widely used in reconstructive surgery and is characterized by a safety profile comparable to other methods of covering tissue defects. Due to the high efficacy of this method in both adult and paediatric populations, the sural flap should be considered a valuable option in reconstructive therapy across all age groups [12]. Its main advantages include relatively simple dissection, preservation of the major arteries supplying the lower limb, and a low incidence of donor-site complications [8]. Importantly, its greatest strength is the ability to perform successful reconstruction without microsurgical expertise, which significantly increases its availability [9].

The lower limb is a surgically demanding region and often presents greater reconstructive challenges than other anatomical areas [13]. Historically, free muscle flaps were considered optimal for defects with exposed bone due to the rich vascularity of muscle tissue. However, subsequent evidence has demonstrated that fasciocutaneous flaps possess higher vascular density and should be regarded as the method of choice for reconstructing defects with exposed bone surfaces [14]. There is no single universal technique for the management and reconstruction of soft-tissue defects that can meet the needs of all patients. Nevertheless, the sural flap remains one of the most commonly used reconstructive methods and is associated with good functional outcomes [15].

The choice between using a reversed sural flap and a free flap remains a topic of debate among reconstruc-

tive surgeons. According to the principle of the "reconstructive ladder", the sural flap occupies an earlier stage than free flaps because of its characteristics. Studies have demonstrated more favourable outcomes of flap adaptation with the sural flap than with free flaps [9]. It is a particularly useful method when contraindications to microsurgical reconstruction using a free tissue flap are present [7]. A study involving 221 paediatric patients compared the use of a pedicled sural flap with that of a free microsurgical flap. The mean surface area of tissue used to cover the defect was significantly larger in the free-flap group. Significantly more patients required a skin graft at the donor site after using the pedicled sural flap, whereas a significantly greater number of patients undergoing reconstruction with a free flap required secondary thinning. Differences in the frequency of postoperative complications were not statistically significant, and both methods demonstrated comparable safety profiles. However, the sural flap is less demanding because it does not require microsurgical skills from the operator, and the operative time is shorter. The surface area of the harvested tissues is smaller, and consequently, the sural flap is intended for the reconstruction of defects of a specific location and size, due to its pedicle and limited dimensions [14].

In cases where the skin and soft tissues of the posterior aspect of the lower leg are intact, the reversed sural flap represents a good and accessible method for the surgical reconstruction of defects of various aetiologies [16]. Another advantage is that any necessary revision and tissue elevation are considerably easier than in the case of a free flap [14].

Conclusions

Following a two-stage sarcoma resection and complementary scar excision, the patient underwent reconstruction of the tissue defect using a reverse sural flap. This treatment enabled him to return to physical activity without any functional limitation of the tumour-affected limb. Although reconstruction using a reverse sural flap – like any surgical procedure – may be associated with complications, it typically does not lead to long-term sequelae. Most complications can be managed conservatively with appropriate wound care and rehabilitation. The reverse sural flap, characterised by retrograde vascularisation, remains one of the primary methods for soft-tissue reconstruction of the lower leg, ankle, and foot. It is a readily accessible option for covering tissue defects and does not require microsurgical expertise.

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