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Reconstructive

Saphenous Artery-based Posteromedial Leg Fasciocutaneous Flap for Knee Reconstruction

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Background: Soft tissue knee defects are frequently seen in surgical practice. The saphenous artery (SA)-based flap is a management option with variable suggested donor sites. The present study describes the use of an SA-based flap harvested from the posteromedial aspect of the leg in management of soft tissue knee defects.
Methods: The present study recruited 30 patients with soft tissue knee defects due to miscellaneous causes. All patients were treated with an SA-based flap harvested from the posteromedial aspect of the leg. All patients were followed up for 6 months. Outcome parameters included flap survival, flap complications, and restoration of knee function.
Results: After 6 months of follow-up, all flaps survived; the reported complications were distal flap necrosis (6.7%), wound dehiscence (6.7%), seroma (3.3%), and small contracture band (3.3%). All patients restored normal range of motion around the knee.
Conclusion: An SA-based flap harvested from the posteromedial aspect of the leg is a feasible, safe, and effective option for management of soft tissue knee defects.
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INTRODUCTION

Soft tissue defects around the knee region are not uncommon. They may be caused by posttraumatic defects, multiple surgical operations, significant tumor excisions, massive tissue necrosis due to radiation or infection, or after surgical release of post-burn contractures.[1]

These defects are usually complex and constitute a significant clinical challenge from the reconstructive, functional, and aesthetic aspects. The mainstays of management entail reconstruction of normal anatomy, restoration of knee function, and wound repair. Although there are multiple reconstructive options, use of flaps is almost always recommended.[2,3]

Available flaps include muscle flaps, perforator flaps, and free flaps. Musculocutaneous flaps like these (including the gastrocnemius muscle) are commonly used as local flap for coverage of soft tissue defects around the knee and superior third of the tibia. Disadvantages of this approach include partial loss of one major muscle and relatively limited postoperative range of motion. Moreover, many locoregional fasciocutaneous flaps may not be the best choice due to their small size, hard reach, or the secondary defects that may expose the subcutaneous prominences of the knee joint.[4] Whatever the type of flap, appropriate choice of the source vessel is the key determinant of flap survival. Vessels around the knee include popliteal artery and its branches, sural arteries, and genicular arteries.[5]

A scarcity of reports discuss the utility of the saphenous artery (SA) of the descending genicular artery for transferred flaps. Experimentally, animal and cadaveric studies suggested that SA-based periosto-fasciocutaneous flaps can provide an appropriate alternative for knee reconstruction.[6,7]

In a small human study, Karamürsel and Celebioğlu[8] used an SA-based flap from the medial side of the knee. They highlighted the advantages of this flap—mainly its long and wide arterial pedicle. Notably, the donor sites for SA-based flaps vary from the medial side of the knee[8,9] and upper medial leg.[10]

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In this study, we report our experience with SA-based fasciocutaneous flaps in management of soft tissue knee defects due to variable causes.

PATIENTS AND METHODS

The present prospective was conducted from July, 2020 through December, 2021. The study included 30 consecutive patients with knee defects requiring reconstructive intervention. Patients (n = 2) were excluded due to immunocompromised state (patients under chemotherapy or immunotherapy). Preoperatively, patient data collected included age, gender, associated comorbidities, cause of defect, defect site, and defect size.

ANATOMY AND SURGICAL TECHNIQUE

The saphenous artery arises from the descending genicular artery. It runs distally in the medial side of the thigh behind the sartorius muscle until it reaches the back of the medial condyle of the tibia and then enters the subcutaneous tissue. After it becomes subcutaneous, it is referred to as the distal saphenous artery and runs distally to reach the upper medial aspect of the lower leg. The distal saphenous artery supplies a large area of skin 20 cm below the knee on the posteromedial aspect of the leg. The skin of the posterior aspect of the leg is supplied by the septocutaneous vessels of the posterior tibia1 artery, which also supply the medial aspect of the leg.

Firstly, the distal saphenous artery is marked on the skin. The proposed flap is outlined around the marked line of the artery on the posteromedial aspect of the upper and middle third of the leg. The anterior edge of the flap is along the medial border of the tibia. The pivot point is just below the medial condyle of the head of the tibia where the distal saphenous artery runs from beneath the tendon of the sartorius muscle in a subcutaneous plane, which is confirmed using hand Doppler. The proximal base, including the saphenous vessels in the middle of the flap, can be designed as wide as 3–5 cm. In cases of knee contracture, the proposed defect could be designed according to the normal side. A tourniquet is applied to the affected limb before starting surgery. Flap dissection is aided using surgical loupes (×3.5). The skin incision along the anterior line of the flap is deepened to the subcutaneous tissue where the superficial venous system is found.

The long saphenous vein is ligated and divided to be included in the flap because it is one of the two venous drainage systems of the vascular territory supplied by the saphenous artery. The saphenous nerve is included in the flap. The flap is carefully dissected from medial side going to the posterior side of the leg in the subfascial plane and then cutting the posterior line of the flap up to the base. The artery is well exposed, and then the skin around it can be cut as you go to give a good arc of rotation. During the subfascial dissection, perforators from the posterior tibia1 artery or the medial gastrocnemius muscle are carefully ligated and divided. Electric coagulation is not used, to avoid damage to the fascial vascular network. The flap is well placed and sutured to the edges of the defect. A tube drain is applied, and the donor area is grafted (Figs. 1–5).

Takeaways

Question: Is the saphenous artery (SA)-based flap an option with variable suggested donor sites?

Findings: Use of an SA-based flap harvested from posteromedial aspect of the leg with variable dimensions in management of soft tissue knee defects.

Meaning: An SA-based flap harvested from the posteromedial aspect of the leg is a feasible, safe and effective option for management of soft tissue knee defects.

Fig. 1. Posttraumatic knee contracture about 80 degrees.

Fig. 2. SA is drawn along its anatomical course. The flap is outlined according to the proposed defect keeping the artery at its center.

POSTOPERATIVE IMMOBILIZATION AND FOLLOW-UP

Postoperatively, patients were immobilized using a cast with the knee in a semi-flexed 15-degree position for 2 weeks. Then, passive stretching exercises were initiated and continued for another 2 weeks before full mobilization is allowed. Patients were followed up for 6 months for flap survival, scars, functional recovery, and complications.

RESULTS

The present study included 30 patients with soft tissue knee defects. They comprised 26 men and four women with

Fig. 3. The contracture is released, showing the huge defect. The flap is elevated in a subfascial plane.

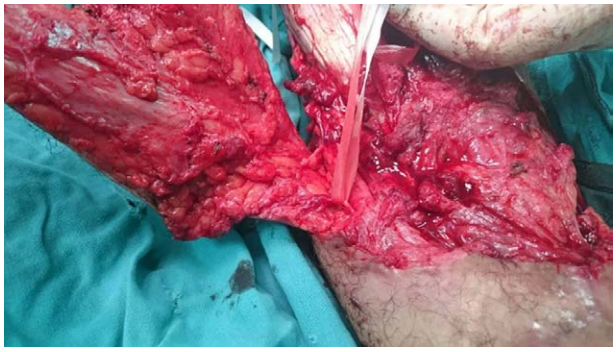

Fig. 4. The artery is identified and kept at the center of the flap.

Fig. 5. The flap is placed with excellent color match.

a median age of 33.5 years (range: 10–48.0). Causes of knee defect include postburn contracture (30.0%), posttraumatic degloved injury (26.7%), explosive injury (23.3%), deep burn (10.0%), posttraumatic skin loss (6.7%), and gun round bullet (3.3%). Knee defects were located anteriorly in 13 patients (43.3%) and posteriorly in 17 patients (56.7%). The reported defects had a median length of 16 cm (range: 12.0–20.0) and a median width of 9.5 cm (range: 7.0–14.0). After 6 months of follow-up, all flaps survived, and the reported complications were distal flap necrosis about 1 cm (6.7%), wound dehiscence (6.7%), seroma (3.3%), and small contracture band (3.3%) (Table 1). Patients with distal flap necrosis underwent regular dressing until healing. Patients with wound dehiscence were treated by secondary sutures, whereas patients with small contracture band were treated by small Z-plasty.

Table 1. Clinical Characteristics of the Studied Patients (n = 30)

Age (y) median (range)	33.5 (10.0–48.0)
Gender (men/women), n	26/4
Comorbidities, n (%)	
Diabetes mellitus	1 (3.3)
Hypertension	1 (3.3)
Cause of defect, n (%)	
Postburn contracture	9 (30.0)
Posttraumatic degloved injury	8 (26.7)
Explosive injury	7 (23.3)
Deep burn	3 (10.0)
Posttraumatic skin loss	2 (6.7)
Gun bullet	1 (3.3)
Defect site, n (%)	
Anterior knee	13 (43.3)
Posterior knee	17 (56.7)
Defect side, n (%)	
Right	22 (73.3)
Left	8 (26.7)
Defect length (cm) median (range)	16.0 (12.0–20.0)
Defect width (cm) median (range)	9.5 (7.0–14.0)
Flap survival at 6 mo, n (%)	30 (100.0)
Flap complications at 6 mo, n (%)	
Distal flap necrosis	2 (6.7)
Wound dehiscence	2 (6.7)
Seroma	1 (3.3)
Small contracture band	1 (3.3)

Data obtained are presented as number and percent, or median and range as appropriate.

DISCUSSION

In the present study, we reported our experience with use of an SA-based skin flap harvested from the posteromedial aspect of the leg in management of soft tissue knee defects. After 6 months of follow-up, all flaps survived with low rate of complications, including distal flap necrosis, wound dehiscence, seroma, and small contracture band. All complications were appropriately managed without affecting flap survival. Utilization of SA-based flaps proved to be a feasible, safe, and effective option in management of soft tissue knee defects. In comparison with previous studies using SA-based flaps, we harvested our flap from the posteromedial aspect of the leg well below the knee level. For example, the harvesting site in the study of Acland et al[9] was notably higher than ours.

Karamürsel and Celebioğlu[8] used the medial side of the thigh as a donor site for SA-based flap for management of lower limb defects distal to the knee in six patients. All flaps survived, and all wounds were adequately healed. In another study, 16 patients with knee defects were treated with SA-based flaps harvested from the thigh. After an average follow-up of 12.5 months, flaps were well settled with good recovery of knee function and acceptable aesthetic appearance.[11]

In 1992, Bertelli[10] described the SA-based "supero-medial saphenous cutaneous island leg flap" indicated for reconstruction of tissue defects at or distal to the knee level. He highlighted the rich blood supply of the flap and the ability of harvesting it as an osteo-peri-osteo-cutaneous island flap. A modified "adipofascial" form of this flap was subsequently suggested by Lin et al,[12] for management of soft tissue defects around the knee and upper third of the tibia. In five patients, all flaps completely survived. The modified flap had minimal donor site complications due to preservation of the overlying skin.

To our knowledge, the present study describes the first series of patients with soft tissue knee defects treated by SA-based flaps exclusively harvested from the posteromedial aspect of the leg below the knee level. The SA-based flap has multiple advantages. First, the flap is nourished with a large-caliber artery through a long vascular pedicle. Second, it has a reliable nerve supply. Third, the harvested skin is thin and more elastic in comparison with other donor site areas, which facilitates manipulation of the flap and eases joint movement. Fourth, the donor area can provide a large skin area, which may be needed for wide defects. Fifth, the flap is technically characterized by straightforward dissection.

The study findings are limited by a relatively small sample size. Moreover, adding a comparative patient group that uses another surgical intervention would make our conclusions more meaningful. In addition, following patients for a longer period may be more useful. In conclusion, SA-based flaps harvested from the posteromedial aspect of the leg provide an adequate option for management of soft tissue knee defects that is capable of coverage of large defects with minimal postoperative complications.

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All authors equally shared in formulating the idea, conception, and data collection statistics, and in writing and drafting of this article.

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