

## Original Article

# Reconstruction of Complex Soft-Tissue Defects Around the Knee using the Proximally Based Sural Island Fasciocutaneous Flap

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ABSTRACT

**Background:** Complex soft tissue defects around the knee are not common. They pose significant reconstructive challenges; hence, several methods have been tried. In this study, the use of proximally based sural island fasciocutaneous flap is evaluated. **Aim:** The aim of this study is to report our experience with the use of proximally based sural island fasciocutaneous flap in the reconstruction of complex soft tissue defects around the knee. **Patients and Methods:** This was a prospective study. All patients that presented to the unit with complex soft tissue defects around the knee between December 2012 and November 2014 were included in this study. Data on age, sex, etiology, anatomical location of the defect, and flap size were noted and analyzed using descriptive statistics. Follow-up was for a minimum of 6 months. **Results:** There were 15 cases: 11 males and 4 females. Their ages ranged from 6 years to 47 years with an average age of 29 years. Ten of the defects resulted from road traffic accidents, while five were missile injuries. The anterior and lateral surfaces of the knee were more often involved, while the posterior surface was least involved. The flap sizes ranged from 8 cm × 6 cm to 16 cm × 12 cm, and the pedicle length ranged from 6 cm to 12 cm. All 15 flaps had full survival. A total of 13 patients had their donor sites skin grafted primarily with 96%–100% graft take. The other two patients had their donor sites closed directly. **Conclusion:** The proximally based sural island fasciocutaneous flap is a simple and reliable method of reconstruction for soft tissue defects around the knee.

**KEYWORDS:** *Complex soft tissue defects, island flap, knee, reconstruction, sural artery*

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## INTRODUCTION

The soft tissue defects around the knee are commonly due to trauma<sup>[1]</sup> and postoncological excision.<sup>[2]</sup> They may also result from chronic infections, postsurgical irradiation, and surgical release of postburn flexure contractures.<sup>[3]</sup> These defects may also result from surgical wound breakdown following total knee arthroplasty.<sup>[4-6]</sup>

These defects pose a serious challenge to the patient, as well as the surgeon. They put the knee at risk if not promptly and properly covered with well-vascularized tissue. Such risks include infection, desiccation of the joint surfaces, and even loss of implant and limb in patients who have had joint replacement surgery.<sup>[7]</sup>

The knee is largely a subcutaneous joint; hence, the applicability of local flaps in the management of defects of significant size is quite limited. Thus, a flap providing sizeable tissue, remote from the zone of injury, is quite desirable. This, however, can be technically challenging.


Various options have been utilized in providing soft tissue reconstruction for these defects. These include local muscle flaps, fasciocutaneous flaps, free flaps, and cross-leg flaps.<sup>[8-10]</sup>

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The local muscle flaps often give a bulky appearance with some compromise in muscle function.<sup>[11]</sup> The free flaps, on the other hand, require excellent microvascular surgical technique and equipment<sup>[12]</sup> which are grossly lacking in our environment, thus limiting its clinical application. The cross-leg flap is associated with a lot of discomfort since the contralateral leg must be fixed together with the injured knee for approximately 2 weeks.<sup>[13]</sup> It also carries an increased risk for the development of deep vein thrombosis and pressure sores.

The proximally based sural island fasciocutaneous flap provides thin sensate tissue, ideal for reconstruction of soft tissue defects around the knee.<sup>[4]</sup> However, there are limited reports regarding its clinical application in reconstruction of knee defects in Sub-Saharan Africa.

In this study, we report our experience with the use of the proximally based sural island fasciocutaneous flap in the management of soft tissue defects around the knee.

### PATIENTS AND METHODS

This was a prospective study. All patients that presented to the unit with complex soft tissue defects around the knee (defects with exposure of bone and/or joint) between December 2012 and November 2014 were included in this study. At first presentation, the following information were obtained: the sex, age, etiology, and anatomical location of the defect.

The patients were then worked up for surgery. At surgery, the flap size was noted and clinical photographs taken. The data were analyzed using descriptive statistics.

These patients were followed up for a minimum of 6 months.

The ethical clearance was obtained from the Ethical Committee of the hospital.

### Surgical technique

Patients were positioned prone under spinal anesthesia. A tourniquet was applied in the proximal thigh and pressurized with limited exsanguinations to achieve limited vascular congestion. This limited vascular congestion aided in the identification of vascular structures during dissection. Debridement of the recipient areas was performed before flap elevation. The flaps were elevated from distal to proximal up to the pivot point and tunneled unto the defect without torsion and tension on the pedicle.

Anatomically, the flaps consisted of an islet of skin, subcutaneous tissue, deep fascia, sural nerve, median superficial sural artery, and lesser saphenous vein. In four of our patients, we modified the flap by incorporating a segment of the gastrocnemius muscle to

fill-up dead space and aid in the delivery of antibiotics to infected wounds. The flaps were perfused by the median superficial sural vessels and the lesser saphenous vein.

The donor sites were usually closed with split-thickness skin grafts or direct closure where possible.

### RESULTS

There were 15 cases: 11 males and 4 females. Their ages ranged from 6 years to 47 years with an average

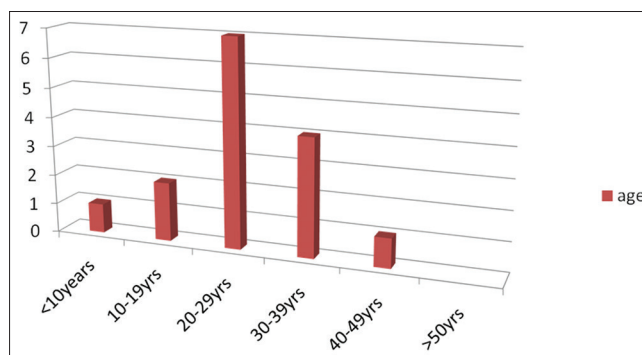


Figure 1: Age distribution

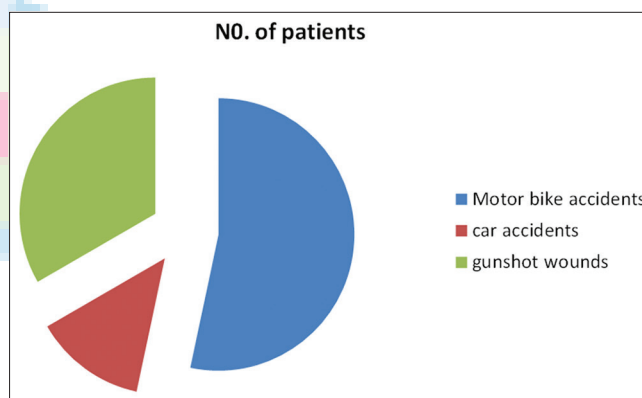
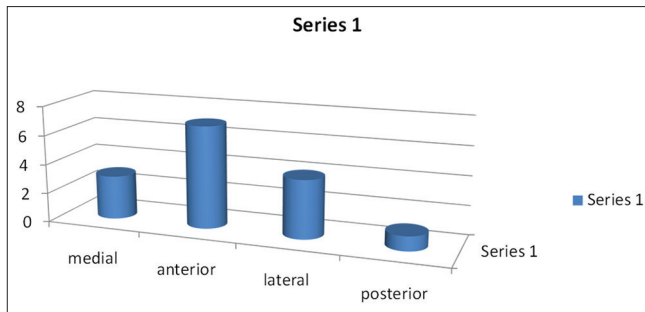


Figure 2: Aetiology of defects

Table 1: Flap dimensions

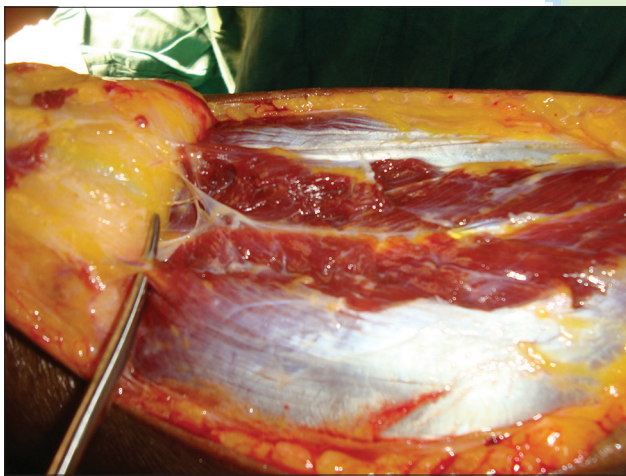
Patient	Pedicle length	Flap sizes
1	8 cm	9 × 6 cm
2	6 cm	14 × 12 cm
3	7 cm	6 × 10 cm
4	12 cm	10 × 7 cm
5	10 cm	12 × 8 cm
6	8 cm	8 × 6 cm
7	9 cm	12 × 10 cm
8	9 cm	8 × 8 cm
9	7 cm	16 × 12 cm
10	10 cm	8 × 6 cm
11	8 cm	10 × 7 cm
12	7 cm	9 × 5 cm
13	9 cm	12 × 10 cm
14	10 cm	8 × 7 cm
15	8 cm	10 × 6 cm



**Figure 3:** Location of defects



**Figure 4:** (a) Flap elevation showing markings. (b) Flap elevation with inclusion of a section of the gastrocnemius muscle. (c) Knee defect covered with a large flap



**Figure 5:** Perforator vessel

age of 29 years [Figure 1]. Ten of the defects were a result of road traffic accidents while five were missile injuries [Figure 2]. The anterior and lateral surfaces of the knee were more often involved whereas the posterior surface was least involved [Figure 3]. The flap sizes ranged from 8 cm × 6 cm to 16 cm × 12 cm, and the pedicle length ranged from 6 cm to 12 cm [Table 1]. All 15 flaps had full survival. A total of 13 patients have

their donor sites skin grafted primarily with 96%–100% graft take. The other two patients had their donor sites closed directly.

## DISCUSSION

Various options have been utilized in providing soft tissue reconstruction for defects around the knee. These include local muscle flaps, fasciocutaneous flaps, free flaps, and cross-leg flaps. The free flaps have the advantage that they can easily be tailored to meet the needs of the defect to be reconstructed. However, the need for microvascular surgical technique and facilities puts it relatively out of reach in a resource-poor environment like ours. Pedicled muscle and musculocutaneous flaps still represent the workhorse for coverage of knee defects, as these flaps are relatively straightforward and easy to dissect. They are thought to be more suitable for more complex soft tissue defects with joint and/or prosthesis exposure as they obliterate the three-dimensional defect and provide rich blood supply to the wound that facilitates the antibiotics delivery.<sup>[4]</sup> Various pedicled muscle flaps have been used for this purpose. These include the gastrocnemius muscle flap, the distally based gracilis muscle flap, Sartorius muscle, vastus medialis, and vastus lateralis muscle flaps.<sup>[14–17]</sup> The gastrocnemius flap, first introduced in 1978,<sup>[18]</sup> is still the most commonly used flap for knee coverage, due to its reliable axial blood supply and ease of dissection.<sup>[4]</sup> However, apart from being quite bulky, use of the pedicled gastrocnemius muscle flap carries some degree of functional impairment.<sup>[11]</sup> A patient who has had this procedure may not be able to fruitfully engage in activities requiring sprinting. The sural island flap is simple and does not require specialized surgical facilities for its utilization. It also does not affect muscle function and so obviates the functional challenges associated with the muscle flaps. In the more complex wounds with significant depth and bone and joint exposure, we elevated the proximally based sural island flap, incorporating a segment of the medial gastrocnemius muscle [Figure 4]. The muscle segment was usually contoured to fit the defect, and harvested incorporating a musculocutaneous perforator vessel commonly located at the junction of the proximal and middle thirds of the leg [Figure 5]. These gastrocnemius musculocutaneous perforators have been shown to anastomose freely with the vessels of the sural angiosome.<sup>[19]</sup> This form of segmental muscle harvest did not significantly affect the gastrocnemius muscle function as the origin–insertion anatomy was not usually disrupted.

The proximally based sural island flap was able to provide ample tissues for coverage. Flap dimensions as large as 16 cm × 12 cm were raised to cover extensive



defects. Such large defects would in the past have required either a free flap or a cross-leg flap.<sup>[20]</sup> The free flap as earlier stated requires microsurgical skills, and there is a challenge with proper selection of recipient vessels around the knee.<sup>[4,21]</sup> The cross-leg flap, on the other hand, is associated with severe discomfort from immobilization. There is also an increased risk of deep vein thrombosis and pressure sores.<sup>[11]</sup> More recently, local perforator flaps have been used with significant advantages due to their low donor morbidity and good esthetic outcome.<sup>[20]</sup> The inferomedial thigh flap based on perforators arising from the descending genicular artery can provide flaps large enough to resurface the entire knee.<sup>[22]</sup> It, however, requires preoperative evaluation of the perforator vessels<sup>[23]</sup> as this flap also occasionally suffers from venous congestion sometimes requiring an additional venous microanastomosis with a local vein. Such vascular incidents are uncommon with the proximally based sural island flap. All 15 flaps in our series survived fully, with no vascular incidents. This is a reflection of the reliability of its blood supply. All grafted donor sites healed satisfactorily.

In this series, more than two-thirds of our patients<sup>[24]</sup> were males. This is typical of trauma-related events, where males are more commonly affected.<sup>[25]</sup> In the females, we noted that the flaps had more subcutaneous fat than in the males, thus appearing bulkier. The esthetic results, therefore, appeared better in the male patients. Indeed, one of the female patients expressed dissatisfaction with the bulky appearance of the flap. This was, however, easily addressed by liposuction.

Although majority of the defects resulted from road traffic accidents as was the case in similar studies,<sup>[1,25,26]</sup> a significant proportion (33%) resulted from gunshot injuries: in a region not at war, this reflects a high level of violence in our environment where in recent times, the illegal proliferation of light arms and weapons has been an issue of concern. Virtually, all surfaces of the knee (medial, anterior, lateral, and posterior) were involved in these injuries [Figure 3]. The proximally based sural island flap showed good reach, as it was able to address defects involving all surfaces of the knee.

## CONCLUSION

Reconstruction of soft-tissue defects around the knee is quite a challenge. Several methods have been advocated. However, from our study, we found the proximally based sural island fasciocutaneous flap a simple, reliable, and cost-effective method.

## Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the

patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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## Conflicts of interest

There are no conflicts of interest.

## REFERENCES

1. Babu NV, Chittaranjan S, Abraham G, Bhattacharjee S, Prem H, Korula RJ. Reconstruction of the quadriceps apparatus following open injuries to the knee joint using pedicled gastrocnemius musculotendinous unitas bridge graft. *Br J Plast Surg* 1994;47:190-3.
2. Wang TY, Dormans JP, Chang B. Soft-tissue optimization of limb salvage with knee endoprosthesis: The 10-year experience at the children's hospital of Philadelphia. *Ann Plast Surg* 2012;69:560-4.
3. Yildirim S, Avci G, Akan M, Misirlioğlu A, Aköz T. Anterolateral thigh flap in the treatment of postburn flexion contractures of the knee. *Plast Reconstr Surg* 2003;111:1630-7.
4. Gravvanis A, Kyriakopoulos A, Kateros K, Tsoutsos D. Flap reconstruction of the knee: A review of current concepts and a proposed algorithm. *World J Orthop* 2014;5:603-13.
5. Satoh K, Fukuya F, Matsui A, Onizuka T. Lower leg reconstruction using a sural fasciocutaneous flap. *Ann Plast Surg* 1989;23:97-103.
6. Cariou JL, Lambert F, Arcila M, Tripon P, Bellavoir A. Posterolateral sural fasciocutaneous island flap with proximal aponeurotic pedicle. Anatomical study and use for cutaneous cover of the knee. Apropos of 9 clinical cases. *Ann Chir Plast Esthet* 1995;40:148-61.
7. Menderes A, Demirdover C, Yilmaz M, Vayvada H, Barutcu A. Reconstruction of soft tissue defects following total knee arthroplasty. *Knee* 2002;9:215-9.
8. Zheng HP, Lin J, Zhuang YH, Zhang FH. Convenient coverage of soft-tissue defects around the knee by the pedicled vastus medialis perforator flap. *J Plast Reconstr Aesthet Surg* 2012;65:1151-7.
9. Cheon SJ, Kim IB, Park WR, Kim HT. The proximally-based sural artery flap for coverage of soft tissue defects around the knee and on the proximal third and middle third of the lower leg: 10 patients followed for 1-2.5 years. *Acta Orthop* 2008;79:370-5.
10. Leclère FM, Egli S, Mathys L, Vögelin E. Anatomic study of the superficial sural artery and its implication in the neurocutaneous vascularized sural nerve free flap. *Clin Anat* 2013;26:903-10.
11. Pan H, Zheng Q, Yang S. Utility of proximally based sural fasciocutaneous flap for knee and proximal lower leg defects. *Wounds* 2014;26:132-8.
12. Shim JS, Kim HH. A novel reconstruction technique for the knee and upper one third of lower leg. *J Plast Reconstr Aesthet Surg* 2006;59:919-26.
13. Necmioglu S, Askar I, Lök V, Subasi M. Use of the vastus lateralis muscle flap with a grooving procedure in the surgical treatment of chronic osteomyelitis of the femur. *Ann Plast Surg* 2004;53:570-6.

14. Tiengo C, Macchi V, Vigato E, Porzionato A, Stecco C, Azzena B, *et al*. Reversed gracilis pedicle flap for coverage of a total knee prosthesis. *J Bone Joint Surg Am* 2010;92:1640-6.
15. Shen YM, Yu DN, Hu XH, Qin FJ, Li M, Ning FG, *et al*. Repairing proximal and middle lower-leg wounds with retrograde sartorius myocutaneous flap pedicled by perforating branches of medial inferior genicular artery or posterior tibial artery. *J Plast Reconstr Aesthet Surg* 2012;65:1158-64.
16. Mathes SJ, Nahai F. Classification of the vascular anatomy of muscles: Experimental and clinical correlation. *Plast Reconstr Surg* 1981;67:177-87.
17. Swartz WM, Ramasastry SS, McGill JR, Noonan JD. Distally based vastus lateralis muscle flap for coverage of wounds about the knee. *Plast Reconstr Surg* 1987;80:255-65.
18. Feldman JJ, Cohen BE, May JW Jr. The medial gastrocnemius myocutaneous flap. *Plast Reconstr Surg* 1978;61:531-9.
19. Follmar KE, Baccarani A, Baumeister SP, Levin LS, Erdmann D. The distally based sural flap. *Plast Reconstr Surg* 2007;119:138e-48e.
20. Adreas LA, Casey WJ, Clarke HD. Technique in soft tissue coverage around the knee. *Tech Knee Surg* 2009;8:119-25.
21. Fang T, Zhang EW, Lineaweaver WC, Zhang F. Recipient vessels in the free flap reconstruction around the knee. *Ann Plast Surg* 2013;71:429-33.
22. Moscatiello F, Masià J, Carrera A, Clavero JA, Larrañaga JR, Pons G. The 'propeller' distal anteromedial thigh perforator flap. Anatomic study and clinical applications. *J Plast Reconstr Aesthet Surg* 2007;60:1323-30.
23. Gravvanis A, Karakitsos D, Dimitriou V, Zogogiannis I, Katsikeris N, Karabinis A, *et al*. Portable duplex ultrasonography: A diagnostic and decision-making tool in reconstructive microsurgery. *Microsurgery* 2010;30:348-53.
24. Saeed RM, Mohammed HN, Leila OZ, Mohammad HF, Reza SK. Descriptive epidemiology of traumatic injuries in 18890 adults: A 5 year study in a tertiary trauma center in Iran. *Asian J Sports Med* 2015;6:e23129.
25. Suri MP, Friji MT, Ahmad QG, Yadav PS. Utility of proximally based sural artery flap for lower thigh and knee defects. *Ann Plast Surg* 2010;64:462-5.
26. Manfrini M, Capanna R, Caldora P, Gaiani L. Gastrocnemius flaps in the surgical treatment of sarcomas of the knee. *Chir Organi Mov* 1993;78:95-104.

