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Original Article

Outcome of Knee Reconstruction using Saphenous Artery-Based Fasciocutaneous Flap: A retrospective study

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ABSTRACT

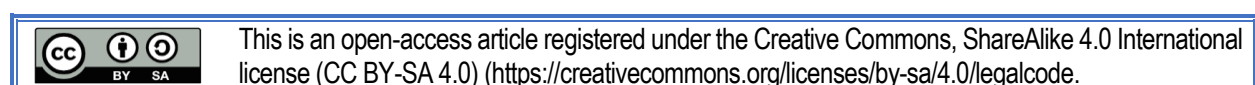
Background and Aim: The soft tissue defects around the knee are common and represents a challenge for surgeons due to its complexity and desired outcome. Many reconstructive treatment options are available and flaps are recommended. The current study aimed to evaluate the outcome of using saphenous artery (SA)-based flaps for the management of soft tissue defects around the knee.

Methodology: Files of 34 patients treated by SA-based flaps were reviewed for outcome and complications. Collected data included patient demographics, etiology, size, site and side of the defect and outcome (flap survival and complications) at the end of the 6th postoperative month.

Results: There were 26 males and 8 females. Their age ranged from 18 to 45 years; the mean age was 33.18±6.58 years. The commonest etiology was posttraumatic (64.7%) then post-burn contracture (20.6%). The majority of defects were on the right side (82.4%). The maximum length of the defect ranged between 14 and 20 cm (mean ± SD were 16.56±1.62) while the maximum width ranged between 6 and 10 cm (mean ±SD were 8.59±1.05). The flap survival rate was 97.1%. The overall complications rate was 14.7%, distal flap necrosis reported for 5.9%, wound dehiscence for 2.9% and seroma for 5.9%. All treated conservatively, except that of distal flap necrosis which need reintervention.

Conclusion: The saphenous artery-based fasciocutaneous flap is an effective, feasible and safe option for the management of soft tissue defects around the knee.

Keywords: Reconstructive Surgery; Flaps; Saphenous Artery; Perforators; Posteromedial.



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INTRODUCTION

The soft tissue defects around the knee joint are relatively common. Possible causes include posttraumatic defects, tumor excisions, radiation induced massive tissue necrosis, multiple surgeries and release of post-burn contractures⁽¹⁾.

These defects are challenging due to its complexity and needed functional and aesthetic outcomes. The aim of treatment is to reconstruct normal anatomy and knee function with accepted aesthetic wound repair. The use of flaps is recommended irrespective of available different reconstruction options⁽²⁻⁴⁾.

The available flap options include perforators, muscle and free flaps. The musculocutaneous flaps are widely used to cover the soft tissue defects around the knee. However, it had disadvantages of the partial loss of a major muscle (e.g., gastrocnemius) and relative limitation of postoperative range of motion (ROM). In addition, locoregional fasciocutaneous flaps are small in size, hardly reached, and subcutaneous prominences of the knee may be exposed in secondary defects⁽⁵⁻⁷⁾.

In flap reconstruction, the appropriate blood supply, is the key for determination of flap survival. Around the knee, the arterial supply includes popliteal, sural and genicular arteries⁽⁸⁻¹⁰⁾. There are few reports about the use of the saphenous artery (SA) for around knee flap reconstruction. Experimental studies proposed that; SA-based flaps may provide a suitable and feasible alternative for knee-defects reconstruction⁽¹¹⁻¹³⁾.

Previously, **Altramsy et al.**⁽¹⁴⁾ and **Karamursel and Celebioglu**⁽¹⁵⁾ reported on SA-based flap from the posteromedial and medial sides of the knee. They advocated the flap due to its advantages, as it had a long and wide arterial pedicle.

Here, we retrospectively evaluate the outcome of the management of soft tissue knee defects by SA-based fasciocutaneous flaps.

PATIENTS AND METHODS

The present work was a retrospective evaluation of the outcome of SA-based fasciocutaneous flaps in the management of soft tissue defects of the knee.

The data were collected from files of patients treated in the department of plastic surgery, Damietta Faculty of Medicine (DFM), Al-Azhar University, Damietta, Egypt. The data collected between January 2021 to December 2022.

The study included 34 patients with knee defects, who managed by reconstructive intervention.

Patients with immunosuppression (due to chemo-or – immunotherapy) or those with follow up < 6 months were excluded from the study. Data collected included patient's age, sex, associated comorbid conditions, cause of defect, its site, and size.

Surgical technique: The distal SA was marked on the skin, and the flap was outline around the marked line of the SA on the posteromedial aspect of the upper and middle thirds of the leg (Figure 1).



Figure (1): SA is drawn along its anatomical course. The flap is outlined according to the proposed defect keeping the artery at its center. Quoted from **Altramsy et al.**⁽¹⁴⁾.

The flap anterior edge was set along the medial border of the tibia. The pivot point was set below the medial condyle of the tibial head where the distal SA runs beneath the tendon of the Sartorius in the subcutaneous plane, which was confirmed by the portable Doppler.

The proximal base, with saphenous vessels in the middle of the flap, were designed as wide as 3–5 cm. In cases of contractures of the knee, the proposed defect was designed with guidance of the normal contralateral side. A tourniquet was applied to the limb before starting surgery. Flap dissection was aided by surgical loupes (×3.5).

The skin incision along the anterior line of the flap was dissected deep to the subcutaneous tissue to reach the superficial venous system. The long saphenous vein was ligated and divided to be included in the flap, to perform as a venous drainage system of SA.

The saphenous nerve was also included in the flap. The flap was wisely dissected from medial side towards the posterior side of the leg in the sub-fascial plane and then the posterior line of the flap up to the base had been cut. The SA was well exposed, and the skin around was cut to give a good arc of rotation (Figure 2).



Figure (2): The artery is identified and kept at the center of the flap. Quoted from **Altramsy et al.** (14).

During the sub-fascial dissection, perforators of the posterior tibial artery (PTA) or the medial gastrocnemius muscle were cautiously ligated and divided. Electric coagulation was avoided to prevent the damage of the fascial vascular network. The flap was well placed and sutured to the edges of the defect. A tube drain was applied, and the donor area was grafted.

Postoperative care: Postoperatively, patients were immobilized by a cast, keeping the knee in a semi-flexed 15° position for two weeks. Then, passive stretching exercises were started and sustained for the next two weeks before full mobilization was permitted. Patients were followed up for at least 6 months for flap survival, scars, functional recovery, and complications.

Analysis of data: The data collected were

anonymized and entered to the statistical package for social sciences (SPSS), version 18 (IBM®SPSS®, Armonk, USA) to carry out all statistical measures. Numerical data were presented by the mean, standard deviation (SD), minimum and maximum, while categorical variables were expressed by frequencies and percentages. Data compared by independent samples “t” test, Chi square or Fisher Exact tests according to the type of data and statistical situation. P value < 0.05 was considered significant.

RESULTS

The current work included 34 patients who submitted to flap reconstruction for skin defects around the knee. They were 26 males and 8 females. Their age ranged from 18 to 45 years. The commonest etiology was posttraumatic (64.7%) followed by post-burn contracture (20.6%) and the least was the deep burn. The majority were on the posterior aspect of knee (53.9%) and on the right side (82.4%). The maximum length of the defect ranged between 14 and 20 cm, while the maximum width ranged between 6 and 10 cm. Males and Females were comparable regarding patient's and defect's characteristics (Table 1).

At the end of the follow up period (6th month), the flap survival was reported for 33 out of 34 patients (97.1%). The overall complications rate was 14.7%, distal flap necrosis reported for 5.9%, wound dehiscence for 2.9% and seroma for 5.9%. All treated conservatively, except that of distal flap necrosis which need reintervention (Table 2).

Table (1): Patient's and knee defect characteristics.

Variables		Males (n=26; 76.5%)	Females (n=8; 23.5%)	Total (n=34)	Test	p
Age (years)	Mean±SD	33.42±6.68;	32.37±6.63	33.18±6.58	0.38	0.70
	Min. – Max.	18-45	19-37	18-45		
Cause (n,%)	Contracture	6 (23.1%)	1 (12.5%)	7 (20.6%)	1.09	0.58
	Posttraumatic	17 (65.4%)	5 (62.5%)	22 (64.7%)		
	Deep burn	3 (11.5%)	2 (25.0%)	5 (14.7%)		
Site	Anterior aspect of the knee	12 (46.2%)	4 (50.0%)	16 (47.1%)	FE	0.58
	Posterior aspect of the knee	14 (53.8%)	4 (50.0%)	18 (53.9%)		
Side	Right	21 (80.8%)	7 (87.5%)	28 (82.4%)	FE	0.56
	Left	5 (19.2%)	1(12.5%)	6 (17.6%)		
Defect maximum Length (cm)	Mean±SD	16.38±1.75	17.13±0.99	16.56±1.62	1.14	0.26
	Min. – Max.	14-20	16-18	14-20		
Defect maximum width (cm)	Mean±SD	8.58±1.10	8.63±0.92	8.59±1.05	0.11	0.191
	Min. – Max.	6- 10	7 -10	6-10		

Table (2): Outcome at the end of the postoperative 6th month.

Variables		Males (n=26; 76.5%)	Females (n=8; 23.5%)	Total (n=34)	Test	p
Flap survival (n,%)	Yes	25 96.2%	8 (100.0%)	33 (97.1%)	FE	0.76
	No	1 (3.8%)	0 (0.0%)	1 (2.9%)		
Complications (n%)	Overall	5 (19.2%)	0 (0.0%)	5 (14.7%)	FE	0.23
	Distal flap necrosis	2 (7.7%)	0 (0.0%)	2 (5.9%)	FE	0.57
	Wound dehiscence	1 (3.8%)	0 (0.0%)	1 (2.9%)	FE	0.76
	Seroma	2 (7.7%)	0 (0.0%)	2 (5.9%)	FE	0.58

DISCUSSION

The current work retrospectively reported the outcome of SA-based skin flap of the posteromedial aspect of the leg for the management of soft tissue defects of the knee. Results showed flap survival for 33 out of 34 patients (97.1%), with a lower rate of overall complications (14.7%) (distal flap necrosis, wound dehiscence and seroma).

All complications were treated conservatively without any effects on the flap survival except one patient of distal flap necrosis which affected the flap survival and needs subsequent intervention. These results reflected the safety and efficacy of SA-based flaps in the management of soft tissue knee defects.

El-Shennawy *et al.* ⁽¹⁶⁾ studied the cutaneous perforators of the anteromedial thigh to explain their significance in the design of the flap. They divided anteromedial thigh skin into 6 squares (squares 1 and 4 for the upper medial thigh, squares 2 and 5 for the middle thigh and squares 3 and 6 for the lower thigh). The upper squares supplied by the superficial external pudendal artery, deep external pudendal artery and superficial circumflex femoral artery. The middle supplied by perforators of the superficial femoral artery, and the lower supplied by the saphenous artery and superficial femoral artery. They concluded that, the anteromedial skin is richly supplied by a mixture of perforators from multiple sources. This grants the anteromedial thigh flap. It explains the basis of the use of anteromedial flap in the current work.

This was previously confirmed in an animal study by **Zhan *et al.*** ⁽¹¹⁾ who studies the saphenous nerve and its perforators and concluded that, SA had a fixed position with side diameter and rich perforators, permitting its use as a reliable model of perforator flaps, including capillary perforator flaps.

This flap was firstly described in 1992 by **Bertelli**, who used superomedial SA-based cutaneous island leg flap for reconstruction of the soft tissue defects at or distal to the knee. He emphasized the flap rich blood supply. A modified "adipofascial" form of this flap was subsequently introduced by **Lin SD, *et al.*** in 1996 for the management of soft tissue defects around the knee and upper third of the tibia. All flaps were completely survived, with minimal donor site complications ⁽¹⁸⁾.

Previously, **Karamursel and Celebioglu** ⁽¹⁵⁾ reported on the treatment of 6 patients, using the SA-based flap for lower limb defects distal to the knee. All flaps were survived with adequate healing of wounds.

Balakrishnan *et al.* ⁽¹⁹⁾ reported on the SA-based flaps harvested from the thigh for 16 patients with soft tissue knee defects and followed up for more than a year. All flaps

were survived and the knee function were recovered with acceptable aesthetic results.

Altramsy *et al.* ⁽¹⁴⁾ reported on the SA-based flap harvested from the posteromedial aspect of the leg below the knee. They stated that, this flap has many advantages, being nourished by a large-caliber artery through a long vascular pedicle with a reliable nerve supply. Third, the harvested skin is relatively thin and more elastic in comparison with other donor sites. It facilitates the manipulation of the flap and eases joint movement. Fourth, the donor area can provide a large skin area, and cover wide defects. Fifth, the flap is technically feasible as it characterized by straightforward dissection.

To summarize, the saphenous artery-based fascio-cutaneous flap is an effective, feasible and safe option for the management of soft tissue defects around the knee. However, the results could not be generalized due to small number of patients and retrospective nature of the study. A prospective, wide scale studies with inclusion of comparative groups are recommended.

Conflict of interest: none

Financial disclosure: none.

REFERENCES

1. **Chandra AA, Romanelli F, Tang A, Menken L, Zhang M, Feintisch A, Liporace FA, Yoon RS.** A comparison of healing and complication rates between common flaps utilized in total knee arthroplasty: a review of the literature. *Knee Surg Relat Res.* **2022** Mar 26;34(1):15. doi: 10.1186/s43019-022-00145-3.
2. **Gkiatas I, Korompilia M, Kostas-Agnantis I, Tsirogkakis SE, Stavradi M, Korompilias A.** Gastrocnemius pedicled muscle flap for knee and upper tibia soft tissue reconstruction. A useful tool for the orthopaedic surgeon. *Injury.* **2021** Dec;52(12):3679-3684. doi: 10.1016/j.injury.2021.04.009.
3. **Li Z, Li P, Tan Q.** Reconstruction of Soft Tissue Defects Around the Knee with Pedicled Perforator Flaps. *Ann Plast Surg.* **2018** Oct; 81 (4): 462-467. doi: 10.1097/SAP.0000000000001544.
4. **Osei DA, Rebehn KA, Boyer MI.** Soft-tissue Defects After Total Knee Arthroplasty: Management and Reconstruction. *J Am Acad Orthop Surg.* **2016** Nov; 24 (11): 769-779. doi: 10.5435/JAAOS-D-15-00241.
5. **Russo A, Clemente A, Massè A, Burastero G.** Medial gastrocnemius rotational flap for the reconstruction of extensor mechanism disruption in periprosthetic knee infections: a retrospective series with minimum two-year follow-up. *Int Orthop.* **2023** Apr;47(4):983-993. doi: 10.1007/s00264-023-05716-x.

6. Kaplan A, Allı İ, Ergani HM, Yaşar B, Duru Ç, Ünlü RE. New Technique for the Proximal Leg Reconstruction: Medial Sural Artery-Based Cross-leg Flap. *Indian J Orthop.* **2021** May 20;55(Suppl 2):481-485. doi: 10.1007/s43465-021-00411-8.
7. Walton Z, Armstrong M, Traven S, Leddy L. Pedicled Rotational Medial and Lateral Gastrocnemius Flaps: Surgical Technique. *J Am Acad Orthop Surg.* **2017** Nov; 25 (11): 744-751. doi: 10.5435/JAAOS-D-15-00722.
8. Panagatla P, Ravula P, Chandrashekar P, Srikanth R, Alekya N. Sural Artery as a Recipient Vessel for Free Flaps. *Indian J Plast Surg.* **2023** Feb 7;56(1):31-38. doi: 10.1055/s-0042-1760094.
- 9 Power HA, Cho J, Kwon JG, Abdelfattah U, Pak CJ, Suh H. Are Perforators Reliable as Recipient Arteries in Lower Extremity Reconstruction? Analysis of 423 Free Perforator Flaps. *Plast Reconstr Surg.* 2022; 149 (3): 750-760. doi: 10.1097/ PRS.00000000000008873.
10. Fang T, Zhang EW, Lineaweaver WC, Zhang F. Recipient vessels in the free flap reconstruction around the knee. *Ann Plast Surg.* **2013** Oct; 71 (4): 429-33. doi: 10.1097/ SAP.0b013e31824e5e6e.
11. Zhan Y, Zhu H, Li W, Su Q, Liu XL, Qi J. Saphenous Artery Perforator Flaps in Minipigs: Anatomical Study and a New Experimental Model. *J Invest Surg.* **2021** May; 34 (5): 486-494. doi: 10.1080/08941939.2019.1654570.
12. Hirtler L, Lübbers A, Rath C. Vascular coverage of the anterior knee region - an anatomical study. *J Anat.* **2019** Aug; 235(2):289-298. doi: 10.1111/joa.13004.
13. Gocmen-Mas N, Aksu F, Edizer M, Magden O, Tayfur V, Seyhan T. The arterial anatomy of the saphenous flap: a cadaveric study. *Folia Morphol (Warsz).* **2012**; 71 (1):10-4. PMID: 22532178.
14. Altramsy A, Dahy AA, Abu-Elsoud A, Khattab RF, Nafeh AM, Mohamed AH, Saleh AK, Mahmoud BA. Saphenous Artery-based Posteromedial Leg Fasciocutaneous Flap for Knee Reconstruction. *Plast Reconstr Surg Glob Open.* **2022** Oct 24;10 (10): e4575. doi: 10.1097/GOX.0000000000004575.
15. Karamursel S, Celebioglu S. Use of the medial side of the knee skin as a free flap: saphenous flap. *Plast Reconstr Surg.* **2006** Apr; 117 (4):1308-14. doi: 10.1097/01.prs.0000204800.19118.2e.
16. El-Shennawy HATM, Elzawawy EM, Atta-Allah ES, Omar SMMH. Perforators of the Anteromedial Thigh Skin and Possible Design of the Anteromedial Thigh Flap: A Cadaveric Study. *Ann Plast Surg.* **2022** ;89(3):312-325. doi: 10.1097/SAP.0000000000003244.
17. Bertelli JA. The saphenous postero-medial cutaneous island thigh flap and the saphenous supero-medial cutaneous island leg flap (25.10.91). *Surg Radiol Anat.* **1992**; 14(2):187-9. doi: 10.1007/BF01794899.
18. Lin SD, Lai CS, Chiu YT, Lin TM, Chou CK. Adipofascial flap of the lower leg based on the saphenous artery. *Br J Plast Surg.* **1996** Sep; 49 (6): 390-5. doi: 10.1016/s0007-1226(96)90008-9.
19. Balakrishnan TM, Narayanan AVL, Jaganmohan J. Saphenous Artery Perforator/Propeller Flap in the Reconstruction of Perigenual Soft Tissue Defects. *Indian J Plast Surg.* **2019** Sep;52(3):330-336. doi: 10.1055/s-0039-3400354.

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