

Anatomic Basis of the Latero-Distal Cutaneous Flap of the Thigh

Ndiaye Ai^{1*}, Lengelé B², Gaye M¹, Manyacka Ma Nyemb P³, Wade R¹, Ndiaye Ab¹, Dia A¹

¹Anatomy and Organogenesis Laboratory Faculty of Medicine Cheikh Anta Diop University of Dakar, Sénégal

²Anatomy Laboratory Faculty of Medicine Catholic University of Leuven, Belgium

³Faculty of Medicine Gaston Berger University of Saint-Louis, Sénégal

Original Research Article

*Corresponding author

Ndiaye Ai

Article History

Received: 08.12.2017

Accepted: 08.01.2018

Published: 30.01.2018

DOI:

10.36347/sajb.2018.v06i02.001



Abstract: The latero-distal cutaneous flap of the thigh is one of the few local flaps that can be used for loss of substance of the anterior aspect of the knee, a delicate area to be covered by exposure of the patella and knee joint. Our study aimed to study the anatomical bases of this flap, in particular its arterial vascularization based on perforators. Our study took place in the anatomy laboratory of the Catholic University of Louvain in Brussels. We dissected 43 knees by performing an internal paramedian incision of the posterior face of the knee, supplemented by 2 transverse counter-incisions to detach the skin from the latero-distal part of the thigh. Fasciocutaneous perforators were studied as well as the superior lateral genicular artery (SLGA). On 9 other knees, we first injected a dye into the SLGA to observe the impregnated cutaneous territory before proceeding to the dissection. Of the 52 knees, the cutaneous perforator from the SLGA was present in 75% of cases. This perforator emerged from the fascia lata between the ilio-tibial tract in front and the lateral intermuscular septum back on average at 40.2 ± 7.5 mm slightly forward and above the epicondyle. In the absence of a perforator from the SLGA, substitution was provided by other cutaneous perforators from vascular branches of the biceps femoris or vastus lateralis muscles. Of the 9 knees injected, 2 knees did not have dermal impregnation of the dye. For impregnated cases, the colored territory covered at least the lateral pre-patellar area, the lateral face of the knee ranging from 1.5 to 4 cm below the lateral epicondyle to 5.3 to 11 cm above the epicondyle. The SLGA very often gives a cutaneous perforator irrigating the skin of the latero-distal part of the thigh. This septo-cutaneous perforator is supplied by perforators from the vascular branches of neighboring muscles. The cutaneous territory irrigated by the SLGA extends to the distal third - two-thirds proximal union of the thigh.

Keywords: Superior lateral genicular artery, cutaneous perforator, latero-distal thigh flap.

INTRODUCTION

The latero-distal skin flap of the thigh is mainly vascularized by the cutaneous perforator from the superior lateral pedicle of the knee. The first descriptions of this flap indicated in the dermal loss of the anterior face of the knee were made in the 1990s by Hayashi and Maruyama [1]; then few anatomical studies were done on the flaps of this region supplanted by the medio-distal side of the thigh which presented more vascular guarantee because irrigated by the superior medial genicular artery (SMGA) but also by the branch of the descending artery of the knee. Currently this region is experiencing a renewed interest with the ability to collect composite flaps including skin, fascial tape from the ilio-tibial tract and condylar bone. The aim of our work was to study the proportions in which the cutaneous perforator of the superior lateral genicular artery (SLGA) was present, its point of emergence, its substitution in case of absence and the

cutaneous territory under the dependence of the superior lateral genicular artery.

MATERIALS AND METHODS

The study was conducted at the anatomy laboratory of the Catholic University of Leuven in Brussels. It covered 52 knees from 31 cadaveric subjects. Twenty-one subjects were dissected bilaterally. 27 knees belonged to fresh bodies and 25 knees to embalmed bodies.

The pure dissection technique involved 43 knees while 9 knees were injected before their dissection. Regarding pure dissection, an internal Paramedian skin incision was made on the posterior face of the knee joining 2 against transverse incisions in the distal third of the thigh and distal quarter of the leg. The skin and the subcutaneous cellular tissue on the lateral side were carefully separated flush with the fascia lata, by scissors to dissect, sparing the septo-cutaneous

perforators of the distal third of the thigh. The detachment was made up to the lateral part of the patella. The fascia lata was incised longitudinally at the level of the lateral muscular septum. The distal portion of the biceps femoris muscle was disinserted and reclined upward to exhibit the lateral portion of the popliteal fossa and the lateral femoral condyle. The superior-lateral genicular vessels were retrograde dissected from their point of division into terminal branches until they originated in the popliteal vessels.

For the injected cases, before proceeding with the subcutaneous detachment, the popliteal artery was approached by the paramedian incision. It was incised along its posterior surface to highlight the ostium of the SLGA. The latter was catheterized before injecting 50% diluted latex dye. After skin impregnation, the area concerned was assessed in relation to bone markers such as the tip and base of the patella and the lateral epicondyle.

RESULTS

Of the 52 cases dissected, the cutaneous perforator from the SLGA of the knee was present in 39 cases or in 75% of cases. Septo-cutaneous perforator from the SLGA emerged from the fascia lata between the ilio-tibial tract anteriorly and the lateral intermuscular septum back on average at 40.2 ± 7.5 mm slightly forward and above the epicondyle (Figures 1a and 1b). In 3 cases, the SLGA gave 2 cutaneous perforators (Figures 2 and 3). In 5 cases, near the septo-cutaneous perforator from the SLGA, one or multiple cutaneous perforators from the vascular branches of the biceps femoris, vastus lateralis or gastrocnemius muscles (Figures 4a and 4b). In the absence of the perforator, replacement was provided by other cutaneous perforators from vascular branches of the biceps femoris muscle or vastus lateralis muscle (Figures 5a and 5b). Of the 9 knees injected, 2 knees did not have dermal impregnation of the dye. For impregnated cases, the colored territory covered at least the lateral pre-patellar area, the lateral aspect of the knee ranging from 1.5 to 4 cm below the lateral epicondyle to 5.3 to 11 cm above the epicondyle. Back of the epicondyle, only a wide strip of 1.6 to 4.7 cm was colored (Figures 6a and 6b).

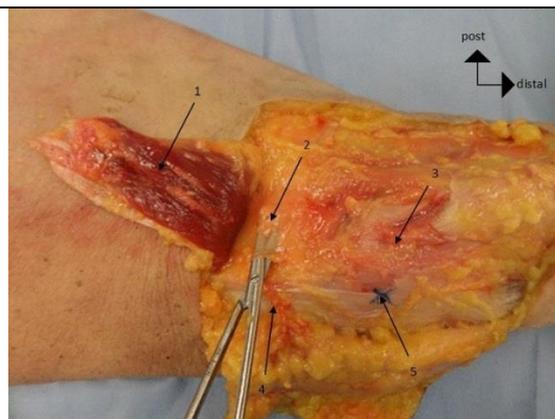


Fig-1a: lateral muscular septum of the thigh

1. Biceps femoris muscle reclined
2. Intermuscular septum
3. Lateral femoral condyle
4. Septo-cutaneous perforator from SLGA
5. Lateral epicondyle of the femur

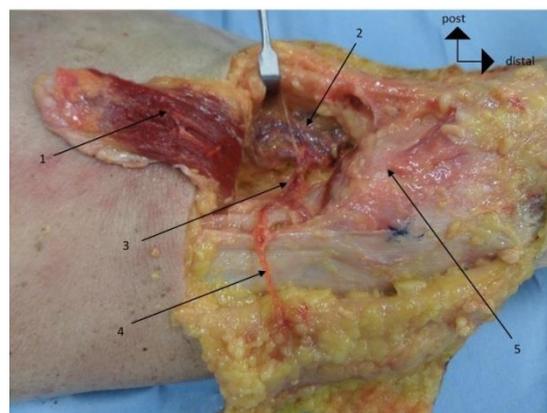


Fig-1b: lateral muscular septum of the thigh

1. Biceps femoris muscle reclined
2. Popliteal artery
3. SLGA
4. SLGA perforator
5. Lateral epicondyle of the femur

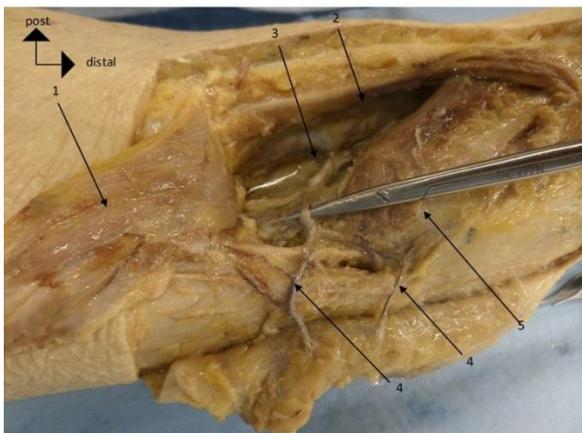


Fig-2: double perforator from the SLGA

1. Biceps femoris muscle reclined
2. Popliteal artery
3. SLGA
4. SLGA perforator
5. Lateral epicondyle of the femur

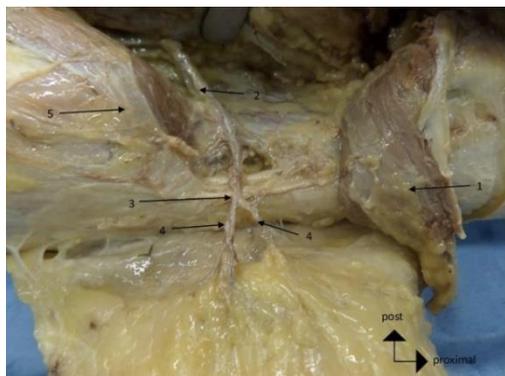


Fig-3: Bifurcation of SLGA perforator

1. Biceps femoris muscle reclined
2. Popliteal artery
3. Bifurcation of SLGA perforator
4. SLGA perforator
5. Lateral epicondyle of the femur



Fig-4a: multiple cutaneous perforators

1. Iliotibial Tract
2. Cutaneous perforator

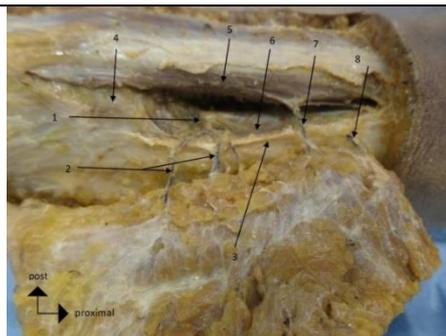


Fig-4b: cutaneous perforators of the latero-distal thigh flap

1. SLGA
2. SLGA perforators
3. Ilio-tibial tract
4. Lateral femoral condyle
5. Biceps femoris Muscle
6. Vastus lateralis muscle
7. Cutaneous perforator of the biceps femoris muscle
8. Cutaneous perforator of the vastus lateralis muscle



Fig-5: terminal bifurcation SLGA without cutaneous perforator

1. Popliteal artery
2. SLGA
3. Biceps femoris muscle dissected
4. Cutaneous perforator of the biceps femoris artery
5. Biceps femoris artery

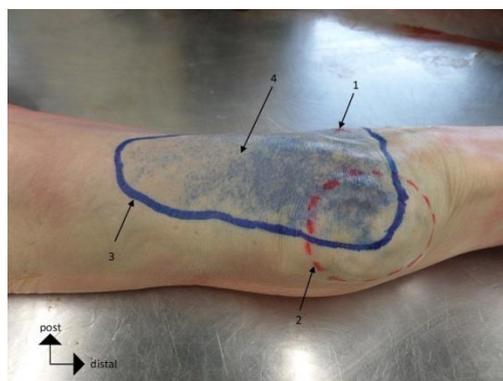


Fig-6a: Skin impregnation after injection of SLGA (previous view)

1. Lateral epicondyle of the femur
2. Contours of the patella
3. Contours of the impregnation zone
4. Impregnation zone



Fig-6b: Skin impregnation after injection of SLGA (side view)

1. Lateral epicondyle
2. Contours of the patella
3. Contours of the impregnation zone
4. Impregnation zone

DISCUSSION

The SLGA, a collateral branch of the popliteal artery, is consistently found in the various studies. This artery does not always give a cutaneous perforator branch. In our study, this perforating branch is absent in about 1 out of 4 cases (25% of cases). These data are superior to those of Parvizi [2], which mentions the absence of cutaneous perforator from the superior lateral artery of the knee in 14% of the cases of his series of dissection involving 28 knees. The absence of the perforator from the SLGA is not uncommon. The area of emergence of the SLGA cutaneous perforator was constant: forward of the lateral intermuscular septum separating the vastus lateralis and biceps femoris muscles just above the condyle; to use the words of Hayashi [3] who dissected the SLGA on 10 cadavers, this is a small triangular area bounded by the femoral condyle below and the vastus lateralis and short head of biceps femoris. The point of emergence has been specified by choosing the lateral epicondyle which is an anatomical palpatory landmark accessible to clinical examination; other authors have chosen femoro-tibial joint space which is lower than the epicondyle and clinically more difficult to locate than the lateral epicondyle of the femur but more reliable when using medical imaging. Parvizi [2] found an average distance of 56mm and Zumiotti [4] 74mm between perforating and joint space against 42mm between perforator and epicondyle for our series and 40mm for Liu [5] always between epicondyle and perforator. In 25% of the cases, we did not find cutaneous perforator resulting from the SLGA however we still know of cutaneous perforators coming from the vascular branches of the neighboring muscles. It should be noted that Masquelet [6] reported in 1989 cases of cutaneous perforators of the lateral distal third of the thigh which were terminal branches of the Bourgerie artery; this artery, the first collateral branch of the popliteal artery, gave muscular branches for the vastus lateralis and biceps femoris. The point of

emergence of the cutaneous perforator, which is on average 10cm above the joint line after Masquelet [6], is higher than that of the cutaneous perforator from the SLGA but they are located on the same vertical alignment between fascia lata and biceps femoris.

In theory, the latero-distal skin flap of the thigh taken from the islet can be pediculated on the SLGA perforator or on the Bourgerie artery, knowing that the advantage of being able to raise the upper edge of the this last flap at the level of the thigh is annihilated by a point of pivot of the flap which will also be higher located. SLGA mainly irrigates the latero-distal part of the thigh after dye injection. Gosain [7] by radiopaque injection demonstrates that the latero-distal third of the thigh is SLGA-dependent while the upper part is dependent on the branches of the deep femoral artery and the circumflex lateral femoral artery.

The upper limit of the territory irrigated by SLGA cutaneous perforator is variable according to individuals ranging from 5.3 cm to 11 cm above the lateral epicondyle. Wong [8] found that the ilio-tibial tract was perfused by SLGA at an average height of 11.5 cm from the lateral femoral epicondyle over a series of 16 injected lower extremities. This shows that for a pedicled skin flap on the SLGA perforator, exceeding the lower third of the thigh greatly increases the risk of necrosis of the tip of the flap. This limit at the distal third of the thigh makes this pedicled flap find its best indications of the loss of substance of the anterosuperior part of the knee (Taniguchi [9], Zbuchéa [10] and Wiedner [11]) but also for skin loss from the popliteal fossa (Zheng [12]). For the injected knees, we also noticed that the medial prepatellar part was not impregnated. This calls into question the existence of functional anastomosis in front of the patella, between branches from the SLGA and SMGA branches.

CONCLUSION

The SLGA very often gives a cutaneous perforator irrigating the skin of the latero-distal part of the thigh. In case of absence, an additional network of perforators from the vascular branches of the neighboring muscles provides the skin. The vascular risk of the latero-distal thigh flap based on the SLGA perforator is subject to its height, it is increasing as one approaches the distal third and upper two thirds union of the thigh.

REFERENCES

1. Hayashi A, Maruyama Y. The lateral genicular artery flap. *Ann Plast Surg.* 1990 Apr; 24(4):310-7.
2. Parvizi D, Vasilyeva A, Wurzer P, Tuca A, Lebo P, Winter R, Clayton RP, Rappl T, Schintler MV, Kamolz LP, Buerger HK. Anatomy of the vascularized lateral femoral condyle flap. *Plastic and reconstructive surgery.* 2016 Jun 1;137(6):1024e-32e.

3. Hayashi A, Maruyama Y. Lateral intermuscular septum of the thigh and short head of the biceps femoris muscle: an anatomic investigation with new clinical applications. *Plast Reconstr Surg.* 2001 Nov; 108(6):1646-54.
4. Zumiotti AV, Teng HW, Queipo Briceño NC, Lotierzo PH, Ishida LH, Montag E, Ferreira MC. Lateral flap of the thigh based upon the lateral superior genicular artery: an anatomic and histomorphometric study and clinical applications *Acta Ortop Bras* 2005; 13(1):24-7.
5. Liu Y, Zhang C, Fu X, Wang J, Sui Z, Zhang X, Wang L. Clinical application of lateral superior genicular composite tissue flap. *Zhonghua Zheng Xing Wai Ke Za Zhi.* 2015 Mar; 31(2):111-4.
6. Masquelet AC, Bessa J, Romana MC. Bourgerly's artery: anatomic basis for a new cutaneous skin flap (21.06.88). *Surg Radiol Anat.* 1989; 11(3):249-50.
7. Gosain AK, Yan JG, Aydin MA, Das DK, Sanger JR. The vascular supply of the extended tensor fasciae latae flap: how far can the skin paddle extend? *Plast Reconstr Surg.* 2002 Dec; 110(7):1655-61.
8. Wong VW, Higgins JP. Distally Based Iliotibial Band Flap: Anatomic Study with Surgical Considerations. *Reconstr Microsurg.* 2016 Sep; 32(7):551-5.
9. Taniguchi Y, Kitano T, Shimoe T, Asai Y, Yoshida M. Superior lateral genicular artery flap for coverage of a soft tissue defect after total knee arthroplasty. *J Reconstr Microsurg.* 2009 Nov; 25(8):479-82.
10. Zbucnea A. Lateral Genicular Artery Flap for Reconstruction of a Large Knee Defect, Following Oncological Resection - Case Report. *Chirurgia (Bucur).* 2016 Jul-Aug; 111(4):353-7.
11. Wiedner M, Koch H, Scharnagl E. The superior lateral genicular artery flap for soft-tissue reconstruction around the knee: clinical experience and review of the literature. *Ann Plast Surg.* 2011 Apr; 66(4):388-92.
12. Zheng X, An HB, Chen T, Wang HB. The lateral superior genicular artery perforator iliotibial band flap for the treatment of scar contraction of popliteal fossa. *Zhongguo gu shang= China journal of orthopaedics and traumatology.* 2013 Feb; 26(2):128-30.