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ORIGINAL PAPER

Terminology of the branches of the lateral circumflex femoral artery: Who is Who?

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Abstract

The anterolateral thigh flap and the tensor fasciae latae flap are supplied by the lateral circumflex femoral artery (LCFA). Different branching patterns of the LCFA have been described, leading to confusion, discrepancies and difficulties in clinical and cadaveric study comparisons. The aim of this study was to evaluate the branching patterns of the LCFA in dissected lower limbs and propose a simplified nomenclature. One hundred and two lower limbs fixed with Thiel's method were investigated. Meticulous dissection was performed, and the branching pattern of the arteries was documented by illustration and photography. These were analysed and allocated to the currently existing terminologies regarding the numbers of the branches (Part 1), and these subgroups were evaluated according to the variability of the trunk formations (Part 2). In Part 1, four subgroups could be classified (A, B, C and D). Group A included a total number of three branches (n = 50), Group B included four (n = 41), Group C included five (n = 5) and Group D included only two branches (n = 6). Part 2 showed in total 11 different trunk variations. Group A had four trunk variations: A1 (n = 38), A2 (n = 5), A3 (n = 2) and A4 (n = 6); Group B also had four variations: B1 (n = 16), B2 (n = 18), B3 (n = 3) and B4 (n = 4); Group C displayed two variations: C1 (n = 1) and C2 (n = 4); and in Group D, there was only one variation observed D1 (n = 6). Branching patterns were highly variable and inconsistent in terms of the number of branches and trunk variations, which resulted in different possible and justified interpretations and classifications. A new terminology should be defined cooperatively among anatomists and clinicians that will be useful for everybody. We propose a terminology oriented to the associated muscles.

KEYWORDS
ALT flap, anatomy, lateral circumflex femoral artery, nomenclature, TFL flap

1 | BACKGROUND

The branches of the lateral circumflex femoral artery (LCFA) are important in reconstructive microsurgery because the pedicles are used for making flaps. Anterolateral thigh (ALT) flap (Koshima et al., 1993, 2005; Wei et al., 2002) and the tensor fasciae latae (TFL) flap are popular (Hill et al., 1978; Hubmer et al., 2009; Nahai, 1980; Nahai et al., 1979). A solid understanding of the terminology of the vascular anatomy in this region is essential especially for plastic and reconstructive microsurgeons. However, the names of the branches are frequently

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changed (Lakhiani et al., 2012), which lead to confusion in anatomical and clinical studies as well as in their comparisons and interpretations.

Regarding the different vocabulary used, the problem becomes most obvious when discussing the branching patterns of the LCFA. There are different interpretations regarding the branching patterns arising from the LCFA with two, three, and four branches. Anatomists primarily list the following three branches: an ascending branch to the TFL muscle, a transverse branch to the proximal portion of the vastus lateralis muscle (pVL), and a descending branch to the distal portion of the vastus lateralis muscle (dVL) (Thiel, 1969; Tubbs, 2016). An additional fourth branch has been described by Lakhiani et al. (2012) in their systematic review. Other anatomists have also described a descending branch to the dVL as having two branches and one ascending branch to the TFL (Lanz, 2006; Tillmann & Leonhardt, 1988). In addition, some surgeons have mentioned a transverse branch (to the TFL), which is assumed as a new oblique branch to the pVL as well as a descending branch to the dVL, but no ascending branch, resulting in a total of three branches (Wong et al., 2009). This previously unnamed "oblique branch" was first described by Wong et al. (2009) who harvested 88 ALT flaps and analysed the vascular anatomy of the LCFA, as running between the transverse and descending branch. It is usually visible lateral to the descending branch in the proximal part of the thigh once the intermuscular septum is opened and runs a variable distance in (or underneath) the intermuscular septum before piercing the substance of the vastus lateralis muscle, usually in the proximal third of the muscle. The oblique branch may originate either from the descending branch, the transverse branch, the LCFA, the profunda femoris artery, or even directly from the femoral artery, and the authors postulated it as an alternative and additional pedicle for myocutaneous ALT flap or perforator-based fasciocutaneous ALT flap. This oblique branch was present in 31 cases (out of 88 investigated limbs), but the authors also further described trunk variabilities. Trunks are not recognized in any version of the anatomical nomenclature, issued by the International Federation of Associations of Anatomists (IFAA), which is the only international body representing all aspects of anatomy and anatomical associations (Whitmore, 1998). Hence, there is no precise definition by the IFAA regarding the trunks of the LCFA (Whitmore, 1998). The problem in assigning vessels using existing terminology has been previously discussed by Adachi (1928). He investigated the LCFA in 367 lower limbs and noted that performing statistics for the LCFA would be difficult due to the different terminologies used to describe it and different variations in terms of numbers of branches and take-offs. Therefore, he included only the thickest branches in his statistics, describing them as the ascending and descending branches (Adachi, 1928).

The fact that there are several interpretations and definitions for the vascular anatomy of the LCFA illustrate that there is still a discrepancy in the definition of the number of branches and trunks of the LCFA (Lanz, 2006; Lakhiani et al., 2012; Thiel, 1969; Tillmann & Leonhardt, 1988; Tubbs, 2016; Whitmore, 1998; Wong et al., 2009). Therefore, we conducted an anatomical study, based on cadaver dissections, to clarify the vascular anatomy of the LCFA and their branches and to allocate them to one of the three existing classifications or terminologies (two, three or four branches). Furthermore, we evaluated the different branch take-offs as it was described by Lakhiani et al. (2012), who included 44 relevant studies in his systematic review. The overall aim of this study is to determine and propose a universal terminology that is useful and logical for both surgeons and anatomists.

2 | MATERIALS AND METHODS

From October 2017 to January 2018, 102 lower limbs fixed with Thiel's method (Thiel, 1992a, 2002) were investigated. All bodies investigated were donated to the Division of Macroscopic and Clinical Anatomy of the Medical University of Graz according to the donation program of the division and under the strict rules of the Styrian burial law. All investigated limbs received an additional arterial injection with a mixture of dextrin, latex and lead tetroxide, called DGM 85 mass, which also reaches small subcutaneous vessels (Thiel, 1992b). With Thiel's embalming method, the colour, consistency and transparency of the tissues were very well preserved and useful for clinical anatomical investigations (Feigl et al., 2007, 2012).

Eighty-eight lower limbs were dissected during the regular anatomical dissection course for third-semester students. Additionally, six lower limbs taken from the dental medical dissection course were investigated in October by the authors (A.P. and C.S.). During the course, students dissected the area of the femoral triangle, whereas the authors completed the dissection by dissecting the vessels as deep as the insertion points of the muscles. The authors (A.P. and C.S.) dissected the remaining 18 lower limbs separately in January 2018.

2.1 | Dissection steps

Meticulous dissection started with the removal of the skin and the subcutaneous tissue. The fascia lata was exposed, incised and removed. The borders of the femoral triangle (inguinal ligament, sartorius muscle and gracilis muscle) were represented and the femoral artery identified. The deep fat around the structures, the fascia of the muscles, accompanying veins of the arteries and the nerves were removed and the arteries dissected to the entry point into the muscles (Figures 1, 2 and 5). Arteries could be identified easily due to the latex injection. Limbs were excluded when branches were cut by students prior to assessment.

2.2 | Documentation

In January 2018, the results were documented by sketching the left and right femoral triangle and additionally by photography (Figures 1, 2 and 5). The results and analyses were executed on the same cohort.

The analysis was divided into two parts: In Part 1, we screened the graphics focusing on the number of branches and assigned them to the corresponding terminologies (Whitmore, 1998; Wong et al., 2009). In Part 2, we screened the graphics again and analysed the documented trunk variations. These trunk variations were then allocated, if possible, to the same groups from Part 1.

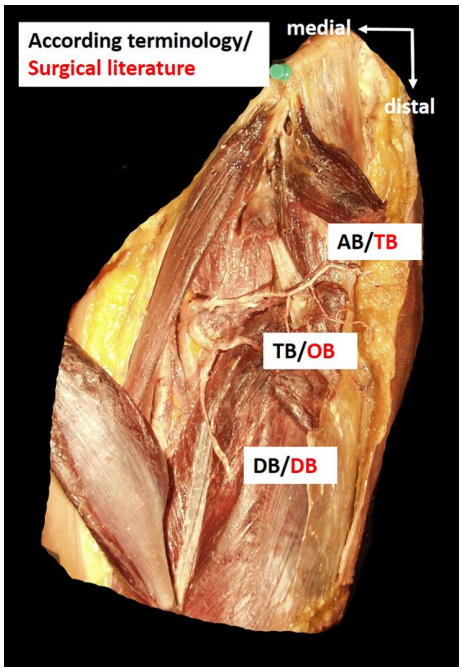

FIGURE 1 Anatomical dissection of a left thigh showing three branches. It shows the different interpretations of the branches. AB, ascending branch; TB, transverse branch; OB, oblique branch; DB, descending branch. ASIS, anterior superior iliac spine

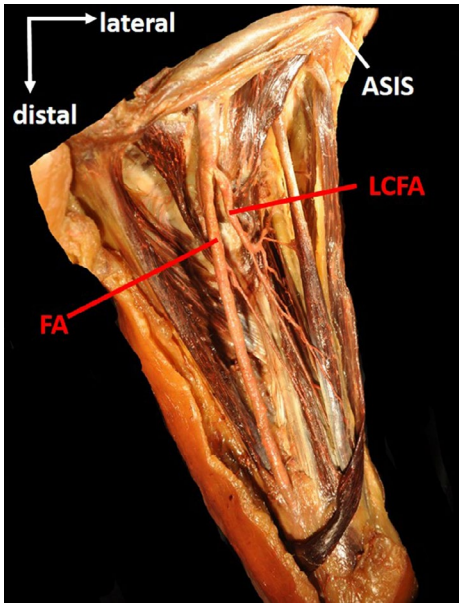

FIGURE 2 Anatomical dissection of a left thigh showing three branches. It shows the different interpretations of the branches. AB, ascending branch; TB, transverse branch; OB, oblique branch; DB, descending branch; ASIS, anterior superior iliac spine. FA, femoral artery; LCFA, lateral circumflex femoral artery

2.3 | Statistical analysis

IBM SPSS statistical software, version 25.0 (SPSS) was used for descriptive statistical analysis. Categorial variables are expressed as absolute numbers and percentages.

3 | RESULTS

Hundred and two lower limbs were assessed and included in our analysis. In all dissections, the proximal and distal branches were consistent, running to the TFL muscle and dVL muscle.

3.1 | Part 1 (Number of branches of the LCFA)

We defined four groups to describe the number of branches observed (Groups A, B, C and D) with their courses described from proximal to distal (Table 1 and Figure 3).

3.1.1 | Group A (International Terminology [Whitmore, 1998]; Hafferl and Thiel, 1969, Wong et al., 2009) Number of branches: 3

In Group A, totally, there were three branches observed (Figure 4) with different variations of trunks, which are described and evaluated in Part 2. The proximal branch of the LCFA passed proximally, beneath the TFL

TABLE 1 Different trunk variations and allocations to the author's morphological course descriptions

Table 1	Thiel et al. and International anatomy	Wong et al.	Lakhiani et al.	Lanz-Wachsmuth
A1 (*n* = 38)	✓	✓	✓	×
A2 (*n* = 5)	✓	✓	×	×
A3 (*n* = 2)	×	×	×	×
A4 (*n* = 1)	×	×	×	×
B1 (*n* = 16)	×	×	✓	×
B2 (*n* = 18)	×	×	✓	×
B3 (*n* = 3)	×	×	✓	×
B4 (*n* = 4)	×	×	×	×
C1 (*n* = 1)	×	×	×	×
C2 (*n* = 4)	×	×	×	×
D1 (*n* = 6)	×	×	×	✓

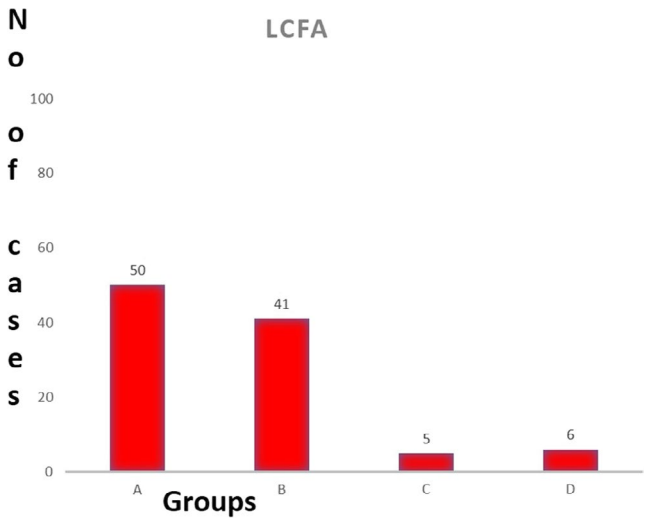

FIGURE 3 Figure shows our results in relation to the number of branches. Hundred and two lower limbs were included in this study. A = 3 branches (International Anatomy, Wong et al.) (*N* = 50), B = four branches (Lakhiani et al.) (*N* = 41), C = (No terminology) five branches (*N* = 5), D = two branches (*N* = 6)

muscle, to the lateral aspect of the hip (ascending branch/transverse branch). The middle branch ran laterally over the vastus intermedius muscle and pierced the vastus lateralis muscle (transverse branch/oblique branch). The distal branch ran distally, behind the rectus femoris muscle and on the vastus lateralis muscle (descending branch). In total, 50 lower limbs that we examined belonged to this type.

3.1.2 | Group B (Lakhiani et al., 2012), Number of branches: 4

Group B displayed four branches in total (Figure 4). Again, the most proximal one passed proximally, behind the rectus femoris muscle, and it coursed towards the TFL muscle and gluteus medius muscle. The second branch ran between the vastus intermedius muscle and rectus femoris muscle and pierced the proximal part of the vastus lateralis muscle. The third branch ran again between the intermedius and rectus muscle and pierced the vastus lateralis muscle in the middle part of the thigh. The distal branch ran distally, behind the rectus femoris muscle and upon the vastus lateralis muscle. In total 41 lower limbs belonged to this type.

3.1.3 | Group C (Not mentioned in literature yet) Number of branches: 5

Examples from Group C exhibited five branches in total (Figure 4). The proximal branch showed the same course as in Groups A and B. The next three branches ran between the vastus intermedius muscle and rectus femoris muscle, and they all pierced the vastus lateralis muscle at different heights along the thigh. The distal branch showed the same course as in Groups A and B. A total number of five thighs belonged to this type. Thus far, there has been no description of this kind of branch constellation for the LCFA.

3.1.4 | Group D (Lanz and Wachsmuth, 2006) Number of branches: 2

This unusual group exhibited only two branches (Figure 5). The proximal branch ran between the rectus femoris muscle and vastus intermedius muscle and beneath the TFL muscle. The distal branch ran as usual distally behind the rectus femoris muscle and upon the vastus lateralis muscle. We could not identify any other branch that pierced the VL muscle. A total number of six thighs belonged to this type.

3.2 | Part 2 (Trunk variations)

In total, we observed 11 different trunk variations and described their origins. For a better overview, the allocations are illustrated in Table 1. In Group A, we classified four trunk variations (A1, A2, A3 and A4) (Figure 4). In Group B, we observed again four variations (B1, B2, B3 and B4) (Figure 4). In Group C, we saw two variations (C1 and C2) (Figure 4), and in Group D, we could classify one variation (D1) (Figure 4).

3.3 | Description of the trunk variations (Table 1)

3.3.1 | Group A

Group A displayed four different trunk variations (Figure 4). In type 1 (A1), the TFL and pVL branches had a common trunk, and the branch to the dVL ran distally at the beginning of the LCFA. We could identify this type in 38 lower limbs. This description for type 1 corresponded well with the descriptions given by Hafferl and Thiel (1969), Wong et al. (2009) and Lakhiani et al. (2012). In type 2 (A2), the TFL branch started its course at the beginning of the LCFA. Distally, the pVl and the dVL had a common trunk. This type was found in five cases, and its course was similar to the description by Wong et al. (2009). In type 3 (A3), all three branches had a common trunk, which was found in two limbs. In addition, in type 4 (A4), the TFL and the pVL branch had a common trunk, and the dVL branch ran separately from the LCFA, originating from the profunda femoris artery. This type was found in five lower limbs. The trunk constellations observed for Groups A3 and A4 have not yet been described in the literature.

3.3.2 | Group B

Group B showed four different trunk variations (Figure 4). In type 1 (B1), the TFL and the pVL branches have a common trunk. The

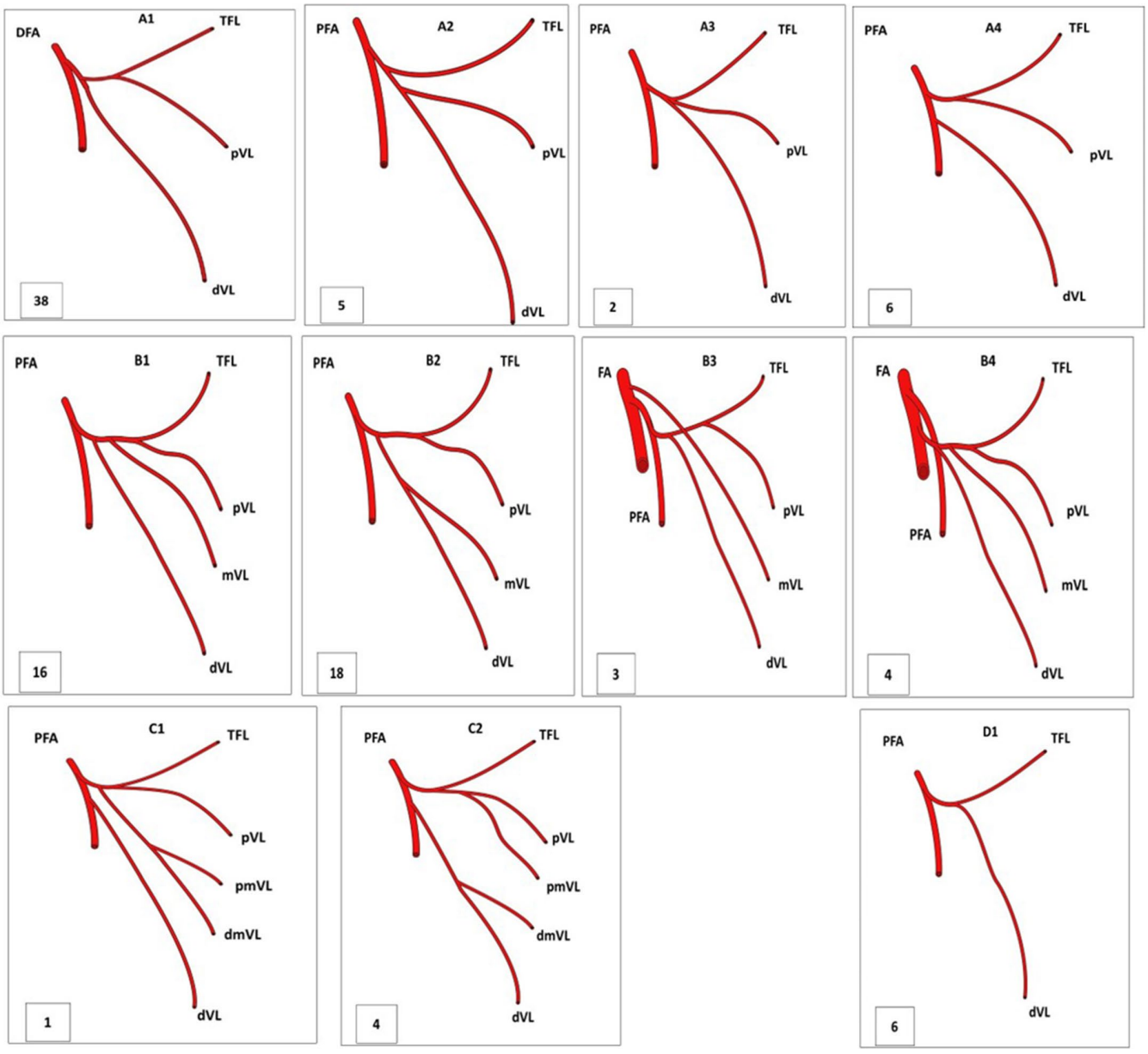

FIGURE 4 Figure presents the results and number of cases of Groups A, B and C. Group A (a total number of three branches) have four trunk variations (A1, A2, A3 and A4). PFA, profunda femoris artery; TFL, tensor fasciae latae muscle; pvl, proximal portion of the vastus lateralis muscle; dVL, distal portion of the vastus lateralis muscle. Group B (a total number of four branches) have four trunk variations (B1, B2, B3 and B4). FA, femoral artery; PFA, profunda femoris artery; TFL, tensor fasciae latae muscle; pVL, proximal portion of the vastus lateralis muscle; mVL, middle-portion of the vastus lateralis muscle; dVL, distal portion of the vastus lateralis muscle. Group C (a total number of five branches) and Group D (with a total number of two branches) show also some trunk variations (C1, C2 and D1). PFA, profunda femoris artery; TFL, tensor fasciae latae muscle; pVL, proximal portion of the vastus lateralis muscle; pmVL, proximal-middle portion of the vastus lateralis; dmVL, distal-middle portion of the vastus lateralis; dVL, distal portion of the vastus lateralis muscle

branch to the middle part of the vastus lateralis muscle (mVL) had its take-off from the middle point of the trunk, whereas the dVL branch had its origin at the beginning of the LCFA. We could identify 16 lower limbs with this kind of variation. In type 2 (B2), we observed two common trunks; one for the TFL and pVL branches and one for the mVl and dVl branches. In total, 18 lower limbs represented this group. Lakhiani et al. (2012) similarly described the constellations for B1 and B2 in the systematic review. In type 3 (B3), we observed a separate mVL branch, which had its take-off from the common femoral artery. Again, the TFL and pVL branches had a common trunk, whereas the dVL branch arose from the very beginning of the LCFA. Three lower limbs belonged to this type. Type 4 (B4) had the same trunk variations as type 1, except that the LCFA had its take-off from the femoral artery. Four lower limbs belonged to this type. The B3 and B4 trunk constellations have also not been described in the literature to the best of our knowledge.

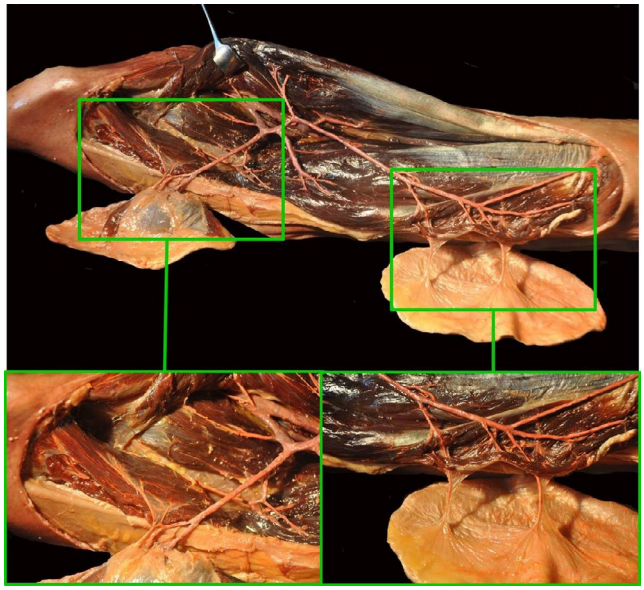

FIGURE 5 Figure shows the branches after harvesting the ALT and TFL flap and removing the fat tissue, nerves and veins

3.3.3 | Group C

In Group C, we could identify two different types of trunk variation (C1 and C2) (Figure 4). In C1, the TFL and pVL shared a common trunk. From the shared trunk, the pVL and dVL had their take-off. The dVL arose separately from the DFA distally. Only one lower limb belonged to this type. In type C2, the TFL, the pVL and the pVL had a common trunk, and the dVL arose from the dVL branch. In total, four thighs belonged to type C2. As mentioned in Part 1, there are currently no published descriptions of five branches of the LCFA.

3.3.4 | Group D

We observed one type representing this Group for which there was no branch running either to the proximal or middle part of the vastus lateralis. Overall, six lower limbs belonged to this type (Figure 5).

4 | DISCUSSION

The current study clearly demonstrates that the vascular branching pattern of the LFCA cannot be entirely described by any of the existing 'classifications', neither anatomical nor clinical. Furthermore, we observed trunk variations that have never been described before. All previous studies about the branching of the LFCA have some commonalities, and all made important classification proposals based on the results of their rigorous analyses. We can strongly support the statement of Adachi that use of existing terminologies to describe LCFA branching is impossible in most cases.

In terms of the morphology of the LCFA, there is always described an ascending and descending branch, which morphologically is a constant observed in all cases. The problem in categorizing differences may rest in-between these branches. When can a branch be described as transverse or oblique? On the other hand, is it even worthwhile to consider these terms if there are so many possible variations?

Figure 4 demonstrates the four branches described for Group B, which was present in 41 lower limbs. This constellation confirmed findings by Lakhiani (2012) in his systematic review, which referenced Wong et al. (2009) regarding an oblique branch. However, Lakhiani added the ascending branch and thus reported four branches. In other studies, Lakhiani's oblique branch was considered as the medial or lateral division of the descending branch (Koshima et al., 1989; Valdatta et al., 2002; Xu et al., 1988). The confusion surrounding the branching of this group has even gone so far as for authors to suggest carrying out new dissection studies to compare Caucasian and Asian vascular anatomy (Valdatta et al., 2002). Nevertheless, Group B's constellation did not correspond to descriptions by anatomists either, who mention three or two branches (Hafferl and Thiel, 1969; Lanz, 2006; Tillmann & Leonhardt, 1988; Tubbs, 2016; Whitmore, 1998). In Group C (Figure 3), we could identify five branches, for which similar descriptions could not be found. In this constellation, there were too many branches to give each a corresponding name, which may contribute to the discrepancy in terminology. It is possible to designate some vessels as divisions of the branches. However, this would lead us back to the original question as to which branch is ascending, transverse, descending or even oblique and would not address whether the oblique branch was a division of the descending branch or whether the transverse branch was a division of the ascending branch.

As our study shows, performing statistics on studies of the LCFA turn out to be very difficult, due to the different numbers of branches (two to five) and different trunk variations (11) described. This makes it even more difficult to allocate LCFA analyses precisely to any existing classification or morphological descriptions and to state accurate and meaningful interpretations.

Different flaps of the thigh, such as the TFL or the ALT flap, which have great significance and many indications for reconstructive interventions (Bulstrode et al., 2006; Dabernig et al., 2006; Santanelli & Scuderi, 2000), are based on the integrity and availability of the LCFA. However, the different terminology of the branching patterns makes clinical or cadaveric study comparisons difficult.

Song et al. (1984) was the first to describe the ALT flap. The ALT flap is based on the three branches listed by "Terminologia anatomica" (1998, 2021). Wong et al. (2009) was the first author to mention an oblique branch from an investigation of the branching patterns of the LCFA by harvesting ALT flaps in 88 cases. The oblique branch was documented in 31 patients (35%),

however, only three branches were described in this study (transverse, oblique, descending branch, but no ascending branch). In the systematic review by Lakhiani et al. (2012), four branches were described. As some readers would condemn this description as not correct, we can state that Lakhiani´s interpretation to be justified. Our analysis found 41 lower limbs with four branches (Figure 4), further validating the previous analyses.

The descending branch is widely considered to be the most constant of all branches. It is always described as a provider for the ALT flap. The oblique branch, which was previously unknown by "Terminologia anatomica" (1998, 2021), was interpreted as an alternative vessel for the ALT flap. This interpretation caused some irritation and confusion.

Even anatomists argue among themselves in an ongoing discussion that remains unsolved. Lanz (2006) described only two branches: a proximal, which runs to the TFL and gluteus medius muscle (ascending branch) and a distal one (descending branch), which runs to the dVL. On the other hand, anatomists such as Thiel (1969) or Tubbs (2016) described three branches, listing an ascending branch, a transverse and descending branch.

Another confusion in terminology is concerning the different trunk variations, as well as the separate branches that take off from them. This variability in branching patterns make it nearly impossible to have a clear designation to any existing "terminology" (Figure 4). Is a transverse branch real if it arises from a trunk? How do we classify a common trunk, which sends branches corresponding to a transverse or ascending branch? As you can see in Figure 4 (A4 and B3), branches also sometimes take off separately, and theoretically, they can no longer be allocated to the actual trunk. Furthermore, it changes the nomenclature of the whole femoral artery system.

In several TFL flap descriptions (Hill et al., 1978; Koshima et al., 1993; Lakhiani et al., 2012), the transverse branch serves as the main provider, but there are other authors describing the ascending branch as the main provider for the TFL flap (Bulstrode et al., 2006; Dabernig et al., 2006; Hubmer et al., 2009; Siddharth et al., 1985). According to the definition of several authors, the most proximal branch would be the transverse branch, which should be the supplier of the TFL flap, or the ascending branch, as described by Hubmer et al. (2009). In their cadaveric study, they investigated the branching patterns of the TFL flap in 45 thighs, and in 44 cases, the ascending (most proximal one) was described as the TFL flap supplier. The discrepancy in terms of the TFL flap supplier is therefore obvious.

5 | CONCLUSION

Because of the confusion and discrepancy in the past decades concerning the naming of the branching patterns of the LCFA, the existing terminology is questionable. This study clearly shows that while previous descriptions were valid, none completely described all possible constellations. Therefore, we suggest that clinicians and anatomists communicate more effectively when creating new terminologies to avoid confusion and the adverse consequences this could lead to.

Based on our results, which showed a high level of variability and inconsistency in terms of the number of branches and trunk variations, we suggest a change in the terminology and to associate the muscles with the branches (e.g. TFL branch, pVL branch, dVL branch), to simplify the branching patterns of the LCFA. There are currently too many different interpretations and classifications for this, which leads to one question: Who is Who?

DATA AVAILABILITY STATEMENT

There are new data, which we want to share. On behalf of the co-authors, sincerely from Witten Georg Feigl.

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REFERENCES

Adachi, B. (1928) Das Arteriensystem der Japaner. In: Adachi, B. (Ed.) *Anatomie Der Japaner*. Kyoto: Verlag der Kaiserlichen-Japanischen Universität zu Kyoto, pp. 150–151.

Bulstrode, N.W., Kotronakis, I. & Baldwin, M.A.R. (2006) Free tensor fasciae latae musculofasciocutaneous flap in reconstructive surgery: a series of 85 cases. *Journal of Plastic, Reconstructive & Aesthetic Surgery*, 59(2), 130–136.

Dabernig, J., Shilov, B., Schumacher, O., Lenz, C., Dabernig, W. & Schaff, J. (2006) Functional reconstruction of Achilles tendon defects combined with overlaying skin defects using a free tensor fasciae latae flap. *Journal of Plastic, Reconstructive & Aesthetic Surgery*, 59(2), 142–147.

Da-Chuan, X.U., Shi-Zhen, Z., Ji-Ming, K., Guo-Ying, W., Muzhi, L., Li-sheng, L. et al. (1988) Applied anatomy of the anterolateral femoral flap. *Plastic and Reconstructive Surgery*, 82, 305–310.

Feigl, G., Anderhuber, F., Schwarz, G., Dorn, C., Fasel, J.H.D. & Likar, R. (2007) Training methods for regional anaesthesia: evaluation and comparison. *Anaesthesist*, 56(5), 437–443.

Feigl, G.C., Petrac, M., Pixner, T., Ulz, H., Mörth, C. & Dreu, M. (2012) The superficial palmar arch and median artery as an example of misleading results due to a small number of investigated specimens or the use of different classifications. *Annals of Anatomy - Anatomischer Anzeiger*, 194(4), 389–395.

Hill, H.L., Nahai, F. & Vasconez, L.O. (1978) The tensor fascia lata myocutaneous free flap. *Plastic and Reconstructive Surgery*, 61(4), 517–522.

Hubmer, M.G., Schwaiger, N., Windisch, G., Feigl, G., Koch, H., Haas, F.M. et al. (2009) The vascular anatomy of the tensor fasciae latae perforator flap. *Plastic and Reconstructive Surgery*, 124(1), 181–189.

Koshima, I., Fukuda, H., Utunomiya, R. & Soeda, S. (1989) The anterolateral thigh flap; variations in its vascular pedicle. *British Journal of Plastic Surgery*, 42, 260–262.

Koshima, I., Ogata, E., Motegi, S., Nagase, T., Gonda, K., Asado, H. et al. (2005) History of the development of the anterolateral thigh flap. *Japanese Journal of Plastic Reconstructive Surgery*, 48(10), 1077–1081.

Koshima, I., Yamamoto, H., Hosoda, M., Moriguchi, T., Orita, Y. & Nagayama, H. (1993) Free combined composite flaps using the lateral circumflex femoral system for repair of massive defects of the head and neck regions: an introduction to the chimeric flap principle. *Plastic and Reconstructive Surgery*, 92(3), 411–420.

Lakhiani, C., Lee, M.R. & Saint-Cyr, M. (2012) Vascular anatomy of the anterolateral thigh flap: a systematic review. *Plastic and Reconstructive Surgery*, 130(6), 1254–1268.

Lanz, T. (2006) Bein und Statik. In: Lang, J. & Wachsmuth, W. (Eds.) *Praktische Anatomie*, 2nd edition. Berlin, Heidelberg, New York: Springer-Verlag, pp. 118–119.

Nahai, F. (1980) The tensor fascia lata flap. *Clinics in Plastic Surgery*, 7(1), 51–56.

Nahai, F., Hill, L.H. & Hester, R.T. (1979) Experiences with the tensor fascia lata flap. *Plastic and Reconstructive Surgery*, 63(6), 788–799.

Santanelli, F. & Scuderi, N. (2000) Neophalloplasty in female-to-male transsexuals with the island tensor fasciae latae flap. *Plastic and Reconstructive Surgery*, 105(6), 1990–1996.

Siddharth, P., Smith, N.L., Mason, R.A. & Giron, F. (1985) (1985) Variational anatomy of the deep femoral artery. *Anatomical Record*, 212(2), 206–209.

Song, Y.G., Chen, G.Z. & Song, Y.L. (1984) The free thigh flap: a new free flap concept based on the septocutaneous artery. *British Journal of Plastic Surgery*, 37(2), 149–159.

Thiel, W. (1969) Untere Extremität. In: Haffer, A. & Thiel, W. (Eds.) *Lehrbuch Der Topographischen Anatomie*, 3rd edition. Heidelberg: Springer Verlag, p. 840.

Thiel, W. (1992a) Die Konservierung ganzer Leichen in natürlichen Farben. *Annals of Anatomy - Anatomischer Anzeiger*, 174(3), 185–195.

Thiel, W. (1992b) Eine Arterienmasse zur Nachinjektion bei der Konservierung ganzer Leichen. *Annals of Anatomy - Anatomischer Anzeiger*, 174(3), 197–200.

Thiel, W. (2002) Ergänzung für die Konservierung ganzer Leichen nach W. Thiel. *Annals of Anatomy*, 184(3), 267–269.

Tillmann, B. & Leonhardt, H. (1988) Untere Extremität. In: Leonhardt, H., Tillmann, B. & Zilles, K. (Eds.) *Rauber, Kopsch: 4th Volume: Anatomie Des Menschen*. Stuttgart: Georg Thieme Verlag, pp. 444–447.

Tubbs, S. (2016) Thigh. In: Standring, S. (Ed.) *Gray´s anatomy*, 41st edition. Amsterdam: Elsevier Verlag, p. 1369.

Valdatta, L., Tuinder, S., Buoro, M., Thione, A., Faga, A. & Putz, R. (2002) Lateral circumflex femoral arterial system and perforators of the anterolateral thigh flap: an anatomic study. *Annals of Plastic Surgery*, 49, 145–150.

Wei, F.C., Jain, V., Celik, N., Chen, H.C., Chuang, D.C.C. & Lin, C.H. (2002) Have we found an ideal soft-tissue flap? An experience with 672 anterolateral thigh flaps. *Plastic and Reconstructive Surgery*, 109(7), 2219–2226.

Whitmore, I. (1998) Terminologia anatomica. In: FCAT (Federative Committee on Anatomical Terminology) (Ed.) *International anatomical terminology*, 1st edition. Stuttgart, New York: Thieme Verlag, p. 90.

Wong, C.H., Wei, F.C., Fu, B., Chen, Y.A. & Lin, J.Y. (2009) Alternative vascular pedicle of the anterolateral thigh flap: the oblique branch of the lateral circumflex femoral artery. *Plastic and Reconstructive Surgery*, 123(2), 571–577.

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