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Anatomical Study of the Descending Branch of the Lateral Femoral Circumflex Artery and Veins in Vascular Grafting in Japanese Cadavers

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Background: In microsurgery development, autologous vein grafting is necessary when there are no suitable blood vessels for anastomosis around the flap recipient site or when the vascular pedicle of the flap is short. The descending branches of the lateral femoral circumflex artery (LFCA) and vein have been used as a vascular bundle instead of vein grafts, but to our knowledge, there have been no reports on the relationship between thigh length and vessel length. In this study, we performed a macroscopic examination of the LFCA descending branch length required for grafting.
Methods: The length of the LFCA descending branches and veins as well as thigh length were measured in 16 preserved cadaveric legs.
Results: The average length of the thigh was 42.6 cm. It was possible to harvest a mean length of 14.2 cm of the descending branches of the lateral femoral circumflex vessels. Descending branches of the LFCA and veins were identified in all cases. It was estimated that the length of the LFCA descending branch and veins could be collected in 20% of the thigh length in 98% of cases.
Conclusion: When preparing a preoperative plan, it is important to thoroughly consider the required length of blood vessels for grafting and whether it is possible to harvest vessels with sufficient length. *(Plast Reconstr Surg Glob Open 2020;8:e3288; doi: 10.1097/GOX.0000000000003288; Published online 23 December 2020.)*

INTRODUCTION

With recent developments in microsurgery, free tissue transplantation has become a routine procedure. However, when suitable blood vessels are unavailable for anastomosis around the recipient site or when the vascular pedicle of the flap is short,[1] autologous vein grafting is often required.[2] While the saphenous vein is frequently used in these cases,[3,4] long vascular grafts reportedly have an increased frequency of developing flap necrosis due to vascular torsion.[5] Several reports have described the use of the descending branches of the lateral femoral circumflex artery (LFCA) and veins as a vascular bundle in place of vein grafting.[6–9] This method has mostly been applied in coronary artery bypass grafting. Reports have examined the descending branches of the LFCA and veins by computed tomography angiography,[9,10] although few studies have macroscopically examined the length of the descending branches of the LFCA and veins. To the best of our knowledge, all prior studies were conducted in Western populations,[8,9,11] and no published literature has conducted a macroscopic investigation in Japanese subjects. Furthermore, no reports have compared the relationship between thigh length and the length of the descending branches of the LFCA and veins. Therefore, this study aimed to address this gap in knowledge by examining the harvestable length of the descending branches of the LFCA and veins and revealing the relationship between thigh length and vessel length.

MATERIAL AND METHODS

We examined 16 preserved cadavers legs (6 men and 10 women) managed by the Department of Anatomy at Kawasaki Medical School. The mean age of the cadavers was 80.1 years (SD 13.6). Within 48 hours after death, an arterial embalming technique was used to prepare the materials. This technique consisted of the following steps: pre-embalming treatment with a blood clot disperser (pH-A solution and a cell conditioner, Champion Co., Ltd., USA), removal of blood clots, drainage of blood, and

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arterial embalming with an embalming apparatus through both the femoral and axillary arteries. The embalming fluid consisted of 95% ethyl alcohol (7.6 L), 35% formalin (1.3 L, as a fixative), diethylene glycol (2.7 L, as a preservative), liquified phenol (1.3 L, to prevent mold), and water (8.0 L).[12–16]

Macroscopic examinations were performed as follows: an initial midline incision was made in the thigh, the fascia lata was incised, and the rectus femoris was detached. The descending branches of the LFCA and veins were located under the rectus femoris. The descending branches that ran on the vastus lateralis were detached as far as could be confirmed with the unaided eye.

The following factors were examined:

1) The distance from the anterior superior iliac spine to the lateral epicondyle of the knee joint.
2) The length and number of descending branches of the LFCA and veins, and the distance from the pedicle of the rectus femoris to the periphery of the descending branches. The periphery was stretched until the sites of the descending branches could no longer be observed with the unaided eye.
3) The relationship between thigh length and the length of the descending branches of the LFCA and veins.

This study was conducted with the approval of the Kawasaki Medical School Ethics Committee (1391-4; April 26, 2019).

RESULTS

The mean distance from the anterior superior iliac spine to the lateral epicondyle of the knee joint was 42.6 cm (SD 3.5, range 38.0–48.0) and the descending branches of the LFCA and veins were observed in every cadaver leg. The mean number and length of the descending branches in each specimen were 1.5 (SD 0.5) and 14.2 cm (SD 2.8, range 10–19), respectively (Fig. 1, Table 1). The relationship between thigh length and the length of the descending branch of the LFCA and veins was illustrated. The mean ratio and median of the descending branch length to thigh length were 30.9% (SD 6.5, range 22.9–47.5) and 32.9%, respectively. We created a normal distribution based on collected data (mean, median, SD ratio of the descending branch of the LFCA, and veins' length to thigh length; Fig. 2). On the basis of normally distributed data, the length of the descending branch of the LFCA and veins was estimated to be 20% of the thigh length in 98% of cases.

Case

A 40-year-old man with a defect of the left nasal ala underwent reconstruction of the nasal ala using an auricular helix flap (Fig. 3). An 8.5 cm graft was interposed from the descending branch of the LFCA and veins (Fig. 4) and a vascular bypass on the superficial temporal and facial vessels of the flap was performed (Fig. 5). The flap was fully engrafted, and the nasal ala remained in a satisfactory shape 5 years after surgery (Fig. 6).

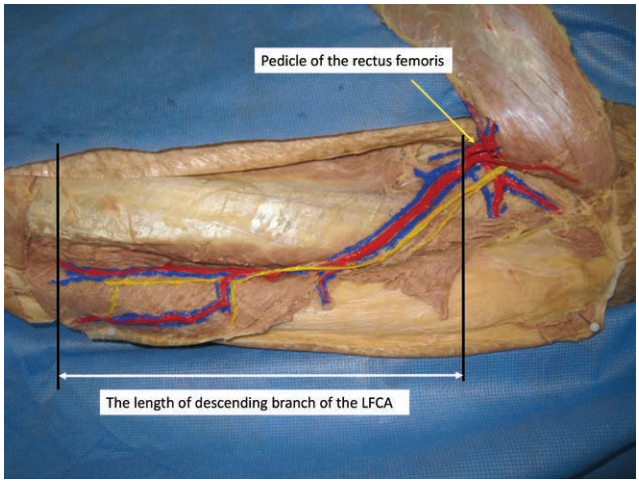

Fig. 1. Photograph of the macroscopic anatomy of the thigh. The distance from the pedicle of the rectus femoris to the periphery of the descending branch of the lateral femoral circumflex artery and veins is displayed.

Table 1. Cadaver Age, Distance from the Anterior Superior Iliac Spine to the Lateral Epicondyle of the Knee Joint, Number, and Length of Descending Branches of the Lateral Femoral Circumflex Artery and Veins

Specimen	Age (y)	Distance of the Anterior Superior Iliac Spine to to the Lateral Epicondyle of the Knee Joint (cm)	Nomber of LFCA	Length of LFCA (cm)
A	97	38	2	15
		38	2	12
B	86	40	1	16
		40	1	19
C	70	43	2	12
D	89	40	1	12
		39	1	11
E	87	43	1	16
F	64	45	1	13
		45	1	18
G	60	46	2	16
		47	1	16
H	95	41	2	10
		41	2	13
I	73	48	2	11
		48	2	17
Mean	80.1	42.6	1.5	14.2
Median	86	42	1.5	14

DISCUSSION

The saphenous vein is the most commonly used blood vessel for vascular bypass.[3–5] However, vascular bypass also requires arteriovenous reconstruction, and the harvested vascular grafts must be at least twice the length of the defect. Therefore, long blood vessels are required; yet they are often difficult to harvest. Tanaka et al. reported in 1995 that the descending branches of the LFCA and veins could be used as a bypass vessel in surgery for facial trauma.[17] Use of the descending branches as a vascular bundle offers several advantages, including the simultaneous harvesting of arterial and venous grafts with one incision. Additionally, the harvested blood vessels only need to be as long as the defect that requires vascular grafting when a vascular bundle is used. Therefore, the descending

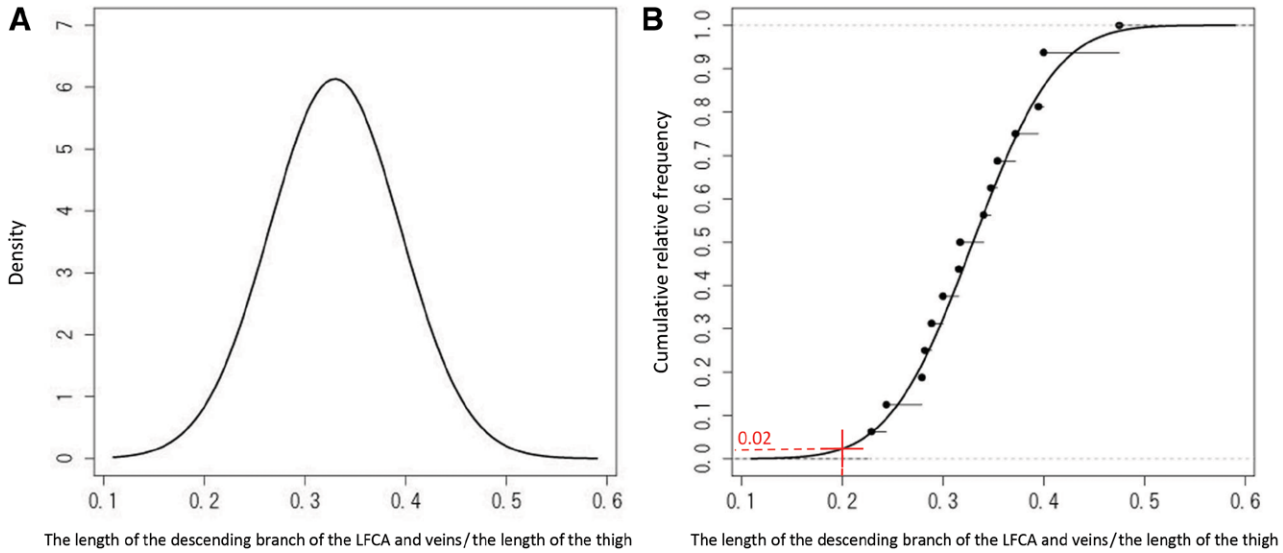

Fig. 2. A, Normal distribution of the descending branch of the lateral femoral circumflex artery and veins length/thigh length. B, Cumulative distribution of the descending branch of the lateral femoral circumflex artery and veins length/thigh length. It was estimated that the length of the descending branch of the lateral femoral circumflex artery and veins corresponded to approximately at least 20% of the thigh length in 98% of cases.

Fig. 3. A 40-year-old man who suffered a facial burn and had a defect of the left nasal ala.

Fig. 4. An 8.5-cm-long descending branch of the lateral femoral circumflex artery and veins was interposed from the auricular helix flap, and anastomosis was performed.

branches of the LFCA and veins are commonly used, easily harvested in plastic surgery, and associated with harvesting of anterolateral thigh (ALT) flaps.[18,19] Furthermore, the descending branch of the LFCA and veins has a large diameter in its proximal portion and a small diameter in its distal portion, permitting the harvest of a vascular bundle with the required diameter.

Another particular advantage of using the descending branches of the LFCA and veins as a vascular bundle for bypass is that vascular torsion is less likely to occur during grafting.[11] Germann and Steinau reported that reoperation is often performed due to venous twisting or torsion after vein grafting.[20] When arteries or veins are grafted in pieces, greater distances increase the likelihood of vascular torsion.[5] Using the descending branches as a vascular bundle is associated with a decreased risk of complications, although compromised blood flow in the lower limbs is a rarely observed complication.[21] Although such harvesting is a routine procedure for most plastic surgeons, it is necessary to be mindful of the blood flow in the lower limbs when performing the surgery, particularly in higher risk patients. Kimata et al. recommended that the pedicle of the rectus femoris should be preserved when harvesting the descending branches for ALT flap surgery.[21,22] Damage

Fig. 5. Vascular bypass of the left facial vessels.

Fig. 6. Five years postoperative photograph showing that the nasal ala remained in a satisfactory shape.

to the pedicle of the rectus femoris was indicated to cause necrosis of the rectus femoris. Therefore, in this study, when examining the length of the descending branches, we also measured the distance from the pedicle of the rectus femoris.

Zenn et al. previously reported that the mean length of harvestable descending branches of the LFCA and veins was 20.5 cm,[11] which significantly differs from our findings. We speculate that anthropometric characteristics of Japanese people play a role in this discrepancy. Japanese people tend to have a smaller build and shorter legs than the Western population. In our statistical analysis this study, we established that the harvestable length of the descending branches of the LFCA and veins corresponded to approximately at least 20% of the thigh length in Japanese.

For preoperative planning, it is important to thoroughly consider the length of blood vessels needed for grafting and whether harvesting vessels with a sufficient length is possible. We consider that using these vessels for reconstruction is an effective surgical method that can be applicable toward many fields and that this method will be used more frequently in the future.

CONCLUSIONS

We established that the harvestable length of the descending branches of the LFCA and veins corresponded to approximately at least 20% of the thigh length. Considering the length of blood vessels needed for grafting and whether harvesting vessels of the required length is possible is an important step for preoperative planning. In particular, because Japanese people have a smaller build and shorter legs, it is important to take the physique of individual patients into account.

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PATIENT CONSENT

The patient provided written consent for the use of his image.

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