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Lateral Calcaneal Artery Flaps in Atherosclerosis: Cadaveric Study, Vascular Assessment and Clinical Applications

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Background: Soft tissue defects of the lateral malleolus (LM) and Achilles tendon pose difficult reconstructive problems due to the bony prominence and limited local tissue available. The objectives were to study the anatomical landmarks of the lateral calcaneal artery (LCA) and patency of LCA in atherosclerotic patients.
Methods: Part I: Thirty-four cadaveric feet were dissected to identify the LCA. The distance between the LCA and the most prominent point of the LM was measured horizontally (LCAa-LM), obliquely (LCAb-LM), and vertically (LCAc-LM). Part II: Thirty-two patients were divided in 2 groups as nonatherosclerotic and atherosclerotic groups. The LCA was assessed by both Doppler ultrasonography and computed tomographic angiography (CTA). Part III: Clinical applications were demonstrated.
Results: Part I: Mean distances of LCAa-LM, LCAb-LM, and LCAc-LM were 24.76, 33.68, and 35.03 mm, respectively. The LCA originated 94.12% from the peroneal artery. Part II: Doppler ultrasonography detected the LCA at 90.62% and 87.50% in nonatherosclerotic and atherosclerotic groups, respectively, whereas 100.00% and 93.75%, respectively, were detected by CTA. No statistically significant difference was found in the patency of the LCA between nonatherosclerotic and atherosclerotic patients. Part III: Clinical applications were performed in atherosclerotic patients.
Conclusions: The LM is a reliable point to identify the LCA, and the LCA flap can be raised safely in atherosclerotic patients. Preoperative CTA should be performed in severely atherosclerotic patients or cases of major lower extremity vascular injuries. *(Plast Reconstr Surg Glob Open 2015;3:e517; doi: 10.1097/GOX.0000000000000502; Published online 22 September 2015.)*

Soft tissue defects of the lateral malleolus (LM) and Achilles tendon pose difficult reconstructive problems due to the underlying bony prominence, movement of the ankle joint, and limited local tissue available. ‘‘Moreover, some soft tissue defects of LM occur in atherosclerotic patients. A lateral calcaneal artery (LCA) flap was first described in 1981.[1] It was an axial pattern flap that included LCA, lesser saphenous vein, and sural nerve and proved to provide both effective and reliable posterior heel coverage. Its modifications include island flap,[2–4] subfascial flap,[5] distally based flaps,[6] and free flap.[7] However, the LCA flap for LM defects has been reported in a few studies.[2,8] The anatomical landmarks of LCA are variations in previous

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studies.[1,9,10] Moreover, the patency of the LCA in atherosclerotic patients is inconclusive.

The objectives were to study the anatomical landmarks of LCA associated with LM, patency of the LCA in atherosclerotic patients by comparison between Doppler ultrasonography and computed tomographic angiography (CTA), and clinical application use.

MATERIALS AND METHODS

Approval of this study was obtained from the ethics committee of Phramongkutklao Hospital and College of Medicine.

Part I: Anatomical Cadaveric Study

Thirty-four cadaveric feet from 17 cadavers (10 males and 7 females) with an average age of 60.29 years (range, 52–78 years) were dissected to study the course of LCA. None of the specimens had previous lower extremity surgery. The dissections of the posterolateral aspect of hind feet were photographed in sequence and measurements of the positions of relevant structures were made. The skin incisions were begun by a vertical straight line at midpoint between the Achilles tendon and LM and a horizontal line at midpoint between LM and heel. The structures superficial to deep fascia were identified and dissections were conducted through the deep fascia. The deep fascia was removed to expose the peroneal and flexor compartments including the lateral side of the calcaneus, the flexor hallucis, and the peroneal muscles and arteries within this area. Deep dissection was performed past anterior to the calcaneal tendon. The horizontal part of the incision was dissected and deepened to the bone. In the distal part, the fascia over the abductor digiti minimi was opened longitudinally and the muscle incised in the line of its fiber. Any arteries and veins were preserved and identified. After dissection, the vessels were marked. Then the distances between LCA and the most prominent point of LM were measured horizontally (LCAa-LM), at 45 degrees (LCAb-LM), and vertically (LCAc-LM) (Fig. 1). LCA was dissected proximally to the origin of the vessel and distally to its branches in the subcutaneous vessel. The LCA was transected horizontally (LCAa) and microscopically measured.

Statistical Analyses

All measurements of the data were tabulated and separated according to side and group. The Statistical Package for Social Science (SPSS version 11.5) was used for the analyses. The mean, standard error of mean (SEM) and range for each of the measurements were assessed.

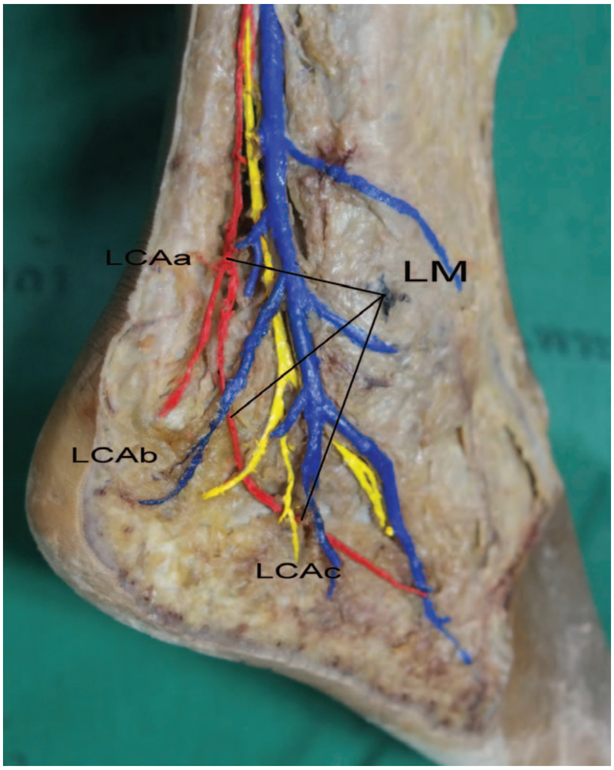

Fig. 1. The lateral side of the right cadaveric foot is shown. The distance between the LCA and the most prominent point of the LM was measured horizontally (LCAa-LM), at 45 degrees (LCAb-LM), and vertically (LCAc-LM). The red, blue, and yellow lines represent the LCA, lesser saphenous vein, and sural nerve, respectively.

Part II: Patency of Vascular Assessment

After written informed consent was obtained from all patients, Doppler ultrasonography and CTA were performed. Thirty-two patients, who underwent CTA of the lower extremity, were enrolled. The patients were divided in 2 groups with 16 patients each. Group 1 comprised patients with nonatherosclerotic risk factors and indications for CTA included preoperative vascular assessment for the anterolateral thigh or fibular free flap for head and neck cancer. The patients in group 2 had atherosclerotic risk factors and indications for CTA included peripheral vascular disease with symptoms or chronic ulcer of legs or feet. The atherosclerotic risk factors, based on Framingham risk score,[11] included total and high-density lipoprotein cholesterol, hypertension, smoking, and diabetes status. Exclusion criteria included previous fracture or vascular injury or surgery of lower extremities.

Data were recorded including age, sex, underlying disease, and atherosclerotic risk factor. LCA was assessed by both Doppler ultrasonography and CTA on the same day. The LCA were examined with a Huntleigh Mini Dopplex D-900 unit with an 8-MHz probe (Huntleigh Diagnostics, Cardiff, UK). All Doppler ultrasonography examinations were performed or verified by the first author to avoid interpersonal variations. To ensure the efficacy of Doppler ultrasonography, positive Doppler ultrasonography of the digital artery in each patient was performed before assessing the LCA. For each Doppler ultrasonography examination, the patient was placed in the supine position with the leg straight in neutral position. The presence of a triphasic waveform was an excellent indication of blood flow in this vessel.

Imaging of the vascular supply to lower leg and foot was performed using CTA. The CT scanner used was a Siemens Somatom Sensation 64 multidetector-row CT scanner (Siemens Medical Solutions, Malver, Pa.). A standard bolus of 100 mL of intravenous ultravist 370 (Berlex Laboratories, Montuille, N.J.) or Omnipaque 350 (GE Healthcare, Princeton, N.J.) was used for contrast. The LCA was evaluated by a single radiologist. The volumetric data acquired were then used to reconstruct images with a slice width of 1.3 mm and reconstruction interval of 0.6 mm. A three-dimensional reconstruction of the foot was performed.

Statistical Analyses

Sensitivity, specificity, and positive and negative predictive values were calculated. For comparative study statistics, the chi-square or Mann-Whitney *U*-test for categorical data and Student *t* test for continuous data were used. A *P* value <0.05 was considered to indicate statistical significance.

Part III: Clinical Application

After written informed consent was obtained, atherosclerotic patients, based on Framingham risk score,[11] who had the defect at the LM or posterior heel, underwent LCA flap surgery.

RESULTS

Part I: Anatomical Cadaveric Study

Of the 34 cadaveric feet, the LCA could be identified in all feet. The mean distances of LCAa- LM, LCAb- LM, and LCAc- LM were 24.76, 33.68, and 35.03 mm, respectively (Table 1). The LCA originating from peroneal artery was 94.12%, whereas 5.88% originated from posterior tibial artery. The external and internal diameters of the LCA from the peroneal artery were 1.2 + 0.3 mm and 0.8 + 0.1 mm, respectively. The mean external diameter of the LCA that originated from posterior tibial artery was 0.8 mm and the internal diameter was 0.5 mm (Table 2).

Part II: Vascular Assessment

All patients were Asian and 71.87% were male. The mean ages in nonatherosclerotic and atherosclerotic groups were 48 and 61 years, respectively. The mean age was statistically significant between groups (Table 3).

Among the nonatherosclerotic patients, all the posterior tibial and dorsalis pedis arteries were detected by Doppler ultrasonography. Among the atherosclerotic patients, 18 (56.25%) and 22 extremities (68.75%) of posterior tibial and dorsalis pedis arteries could not be detected by Doppler ultrasonography, respectively (Table 4). Statistical significance was found between groups to detect the posterior tibial and dorsalis pedis arteries by Doppler ultrasonography. In nonatherosclerotic group, Doppler ultrasonography could detect the LCA at points A, B, and C in 29 (90.63%), 29 (90.63%), and 27 extremities (84.37%), respectively. In the atherosclerotic group, Doppler ultrasonography could detect the LCA at points A, B, and C among 28 (87.50%), 27 (84.37%), and 25 extremities (78.13%), respectively. No statistical significance was found between groups for detecting the LCA at points A, B, and C (Table 4).

The posterior tibial and dorsalis pedis arteries could not be detected by CTA in 8 (25.00%) and 12 extremities (37.50%), respectively, in the atherosclerotic group. Statistical significance was found between groups for detecting the posterior tibial and dorsalis pedis arteries by CTA. In all nonatherosclerotic patients, LCA could be detected by CTA. In atherosclerotic group, 93.75% of the LCAs could be detected at points A, B, and C by CTA (Fig. 2). The

Table 1. The Origin of the LCA and Distance from the LM to the LCA in Different Directions

Gender	Site	LCAa-LM Mean (Minimum–Maximum) (mm)	LCAb-LM Mean (Minimum–Maximum) (mm)	LCAc-LM Mean (Minimum–Maximum) (mm)	Arterial Origin
Male (*n* = 18)	Right (*n* = 9)	24.44 (24–25)	33.89 (33–35)	34.78 (33–36)	Peroneal
	Left (*n* = 9)	25.22 (24–26)	33.55 (33–35)	35.00 (34–37).	Peroneal
Male (*n* = 2)	Right (*n* = 1)	25	34	35	Posterior tibial
	Left (*n* = 1)	24	33	34	Posterior tibial
Female (*n* = 14)	Right (*n* = 7)	24.71 (24–25)	33.71 (33–34)	35.28 (33–36)	Peroneal
	Left (*n* = 7)	24.71 (24–26)	33.57 (33–34)	35.28 (34–36)	Peroneal
Total (*n* = 34)		24.76	33.68	35.03	

Table 2. The Diameter of LCA*

Origin of LCA	External Diameter (mm)	Internal Diameter (mm)
Peroneal artery (94.12%)	1.2+0.3	0.8+0.1
Posterior tibial artery (5.88%)	0.8	0.5

*Diameter of LCA at horizontally dimension from the LM.

Table 3. Demographic Data

	Group 1 (Nonatherosclerotic Risk) (N = 32)	Group 2 (Atherosclerotic Risk) (N = 32)	*P* Value*
Age	48	61	<0.001
Sex (M:F)	24:8	22:10	0.782

*Chi-square test for categorical data, Student *t* test for continuous data.
M, male; F, female.

LCA in 2 extremities (from 2 patients) in atherosclerotic group could not be detected by CTA. However, no statistical significance was found between groups to detect LCA at points A, B, and C (Table 5). Overall, the mean distances of LCAa-LM, LCAb-LM, and LCAc-LM measured by CTA were 29.67, 32.95, and 38.39 mm, respectively. No statistical significance of LCA-LM was found between groups when measured by CTA (Table 6).

No statistical significance was found in Doppler ultrasonography and CTA to detect the LCA (Table 7). The sensitivity and specificity of Doppler ultrasonography were 87.5 and 90.6, respectively. The sensitivity and specificity by CTA were 93.7 and 100.0, respectively. Positive predictive value of Doppler ultrasonography was 90 and that of CTA was 100. Negative predictive value of Doppler ultrasonography and CTA were 87 and 94, respectively.

Phase III: Clinical Applications

All 6 patients gave informed consent. Four patients were male and their mean age was 64.7 years. All patients had atherosclerosis risk factors and arterial insufficiency at different degrees (Table 8). All patients underwent only preoperative Doppler ultrasonography to confirm the presence of LCA. The LCA flaps were successfully raised to cover 3 defects of the LM and 3 defects of the Achilles tendon. All donor sites were covered with skin grafts. A minor complication occurred in 1 patient.

Case 1

A 63-year-old Thai man had a chronic ulcer on his right LM for 3 years. He was a mortician. Usually, he sat on his haunches at least 2 hours every day. His medical problems included diabetes mellitus, hypertension, and dyslipidemia, but they were under control by a general practitioner. The patient had a history of small ulcer 3 years previously and progressively in the first year without any history of trauma. The ulcer was under care by his general practitioner but the situation did not improve. Physical examination revealed a 4×2 cm ulcer at right LM with pale granulation (Fig. 3). The joint capsule was exposed. Pulse of the right common femoral artery was normal but the popliteal artery was decreased. The posterior tibial and dorsalis pedis arteries were absent by manual examination. Doppler ultrasonography could detect posterior tibial, dorsalis pedis, and lateral calcaneal arteries. Plain film of the right ankle showed normal bony structure. Incisional biopsy revealed chronic inflammation without malignancy. Sensation along the right foot had decreased.

The diagnosis was pressure ulcer at the right LM and the patient was recommended to avoid sitting on his haunches. LCA flap was raised and transposed to cover the LM (Fig. 4). The LCA showed no area of ischemia and the donor site healed without complication (Fig. 5). The patient had normal daily life activities but had to relieve pressure at the LM every 15 minutes when he had to sit on his haunches. One year after operation, no recurrence of ulcer was observed.

Table 4. Comparative Study of Doppler Ultrasonography between Nonatherosclerotic and Atherosclerotic Patients

	Nonatherosclerotic Risk Factor (N = 32) (100%)	Atherosclerotic Risk Factor (N = 32) (100%)	*P* Value*
Posterial tibial artery			
Absent	0 (0.00)	18 (56.25)	<0.001
Present	32 (100.00)	14 (43.75)	
Dorsalis pedis artery			
Absent	0 (0.00)	22 (68.75)	<0.001
Present	32 (100.00)	10 (31.25)	
LCA			
Point A: Absent	3 (9.37)	4 (12.50)	1.000
Point A: Present	29 (90.63)	28 (87.50)	0.708
Point B: Absent	3 (9.37)	5 (15.62)	0.750
Point B: Present	29 (90.63)	27 (84.38)	
Point C: Absent	5 (15.62)	7 (21.87)	
Point C: Present	27 (84.38)	25 (78.13)	

*Chi-square test.

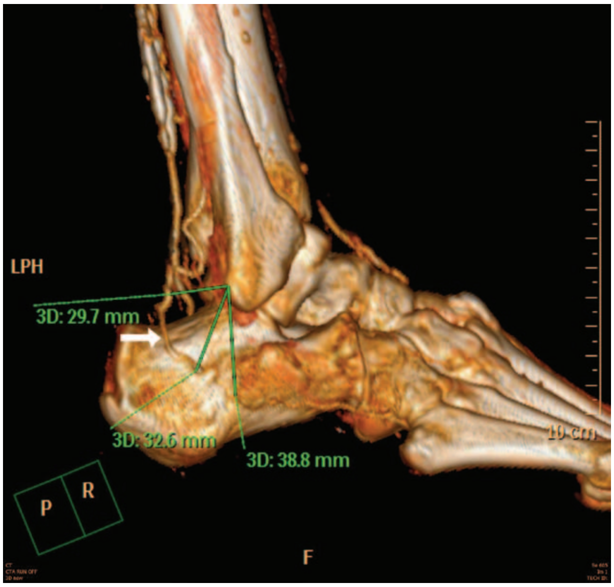

Fig. 2. CTA of the right lower extremity in an atherosclerotic patient demonstrating the LCA (white arrow). The distance between the LCA and the most prominent point of the LM was measured horizontally (LCAa-LM), at 45 degrees (LCAb-LM), and vertically (LCAc-LM).

Case 2

A 58-year-old Thai man presented with a chronic ulcer on his right heel for 1 year. His medical problems included diabetes mellitus and hypertension but they were under control by a general practitioner. The patient had a history of motorcycle accident 1 year previously and fracture of the calcaneus was found. Open reduction and internal fixation with screws was performed (Fig. 6). The ulcer with exposed Achilles tendon was identified and stabilized for 1 year after vacuum-assisted treatment failed. Physical examination revealed a 3×2 cm ulcer on the right Achilles tendon (Fig. 7). Incisional biopsy revealed chronic inflammation without malignancy. The right common femoral, poppliteal, posterior tibial, and dorsalis pedis arteries were decreased by manual examination (1+). Hyperpigmented skin of the right ankle was found. The venography of right leg showed anterior and posterior tibial veins occluded with some collateral veins. Doppler ultrasonography could detect the LCA.

The LCA flap was raised and transposed to cover the Achilles tendon (Fig. 8). LCA flap showed venous congestion on postoperative day 1 (Fig. 9). Bloodletting with heparin-soaked gauze was performed to alleviate congestion for 2 days. Superficial skin necrosis was found on postoperative day 4 and improved by conservative treatment. The donor site healed without any complication (Fig. 10). No recurrence of ulcer was observed 3 months after operation (Fig. 11).

DISCUSSION

Soft tissue defects of the LM present difficult reconstructive problems. The LCA flap, first described by Grabb and Argenta,[1] is another alternative for posterior heel reconstruction. Modification of this flap can cover most heel defects, such as island flap,[2–4] subfascial flap,[5] distally based flaps,[6] V-Y

Table 5. Comparative Study of CTA between Nonatherosclerotic and Atherosclerotic Patients

	Nonatherosclerotic Risk Factor (N = 32) (100%)	Atherosclerotic Risk Factor (N = 32) (100%)	*P* Value*
Posterial tibial artery			
Absent	0 (0.00)	8 (25.00)	0.005
Present	32 (100.00)	28 (87.50)	
Dorsalis pedis artery			
Absent	0 (0.00)	12 (37.50)	<0.001
Present	32 (100.00)	20 (62.50)	
LCA			
Point A: Absent	0 (0.00)	2 (6.25)	0.492
Point A Present	32 (100.00)	30 (93.75)	0.492
Point B: Absent	0 (0.00)	2 (6.25)	0.492
Point B Present	32 (100.00)	30 (93.75)	
Point C: Absent	0 (0.00)	2 (6.25)	
Point C: Present	32 (100.00)	30 (93.75)	

*Chi-square test.

Table 6. Comparative Study of the LCA-LM by CTA between Nonatherosclerotic and Atherosclerotic Patients

LCA-LM (mm)	Nonatherosclerotic Risk Factor (N = 32) Mean (Minimum–Maximum) (mm)	Atherosclerotic Risk Factor (N = 30) Mean (Minimum–Maximum) (mm)	*P* Value*
LCAa-LM	29.59 (28.2–31.4)	29.75 (28.1–31.6)	0.312
LCAb-LM	33.01 (30.9–34.0)	32.89 (31.1–34.3)	0.575
LCAc-LM	38.33 (36.6–39.3)	38.45 (37.0–39.5)	0.589

*Mann-Whitney *U* test.

Table 7. Comparison of the LCA between Doppler Ultrasonography and CTA

	Doppler Ultrasonography (N = 32) (100%)	CTA (N = 32) (100%)	*P* Value*
Nonatherosclerotic risk factor			
Point A	29 (90.63)	32 (100.00)	0.076
Point B	29 (90.63)	32 (100.00)	0.076
Point C	27 (84.37)	32 (100.00)	0.019
Atherosclerotic risk factor			
Point A	28 (87.50)	30 (93.75)	0.391
Point B	27 (84.37)	30 (93.75)	0.229
Point C	25 (78.13)	30 (93.75)	0.072

*Chi-square test.

advancement,[3,12] combined with muscle,[13] and free flap.[7] However, few reports have demonstrated the LCA flap concerning LM defects.[2,8] It is well provided with sensate nonbulky flap with minimal donor-site morbidity.[1] The disadvantages of this flap are depression at the donor site and sensory disturbances at the lateral portion of the dorsum of foot. However, these disadvantages gradually disappear over time.[2]

Freeman et al[9] reported that the LCA originated 87% from peroneal artery and 13% from posterior tibial artery. In contrast, in our study, 94.12% of the LCA originated from the peroneal artery. Grabb and Argenta[1] used the Achilles tendon as an anatomical landmark of the LCA but the thickness varied, blending to the calcaneal bone. In addition, mobility frequently varied because the defect needed reconstruction. As a result, the relation between the LCA and the Achilles tendon was inconsistent.

The distance from the Achilles tendon to the LCA varied considerably, eg, reported as 5–8 mm,[1] 11.5 + 2 mm,[10] and 15 mm.[9] We suggested using the most prominent point of the LM as the anatomical reference to the LCA with the most consistent measurement similar in our study and some previous studies (33 + 3 mm[10] and 31 mm[9]).

Table 8. The LCA Flap Clinical Series

Case	Age (yr)	Sex	Cause	Site	Defect Size (cm)	Atherosclerotic Risk Factors	Flap Design	Complication
1	63	Male	Pressure ulcer	Lateral malleolus	4×2	DM, HT, DLD	Long version	None
2	65	Male	Trauma	Lateral malleolus	3×2.5	DM, HT	Long version	None
3	58	Male	Trauma	Achilles tendon	3×2	DM, HT	Vertical	Venous congestion
4	63	Male	Infection	Achilles tendon	4×2	DM, HT, DLD	Vertical	None
5	68	Female	Verrucous carcinoma	Achilles tendon	3×3	DM, HT	Vertical	None
6	71	Female	Trauma	Lateral malleolus	2.5×2	DM, HT, DLD	Long version	None

DM, diabetes mellitus; HT, hypertension; DLD, dyslipidemia.

Fig. 3. Chronic ulcer on the right lateral malleolus with pale granulation. A, lateral view. B, closed up view.

Fig. 4. The LCA flap was raised and transposed to cover the lateral malleolus; donor site covered with skin graft (immediately postoperation).

Our study revealed the vertical distance from the LM to the LCA to be 35 mm, while previous studies reported 10 mm[1] and 41 + 4 mm[10]. The study of Grabb and Argenta[1] was conducted in 18 preserved cadaveric legs, while, Borrelli et al[10] studied 24 fresh cadaveric legs. The different results may have resulted from cadaveric freshness, point of reference (tip of the fibula or the most prominent point of the LM), or ethnic differences. Further studies of fresh cadavers and greater sample size will provide more information and help to determine the constant anatomic landmarks.

The LCA flap in atherosclerotic patients remains inconclusive and challenging for surgeons and preoperative vascular assessment is controversial. Previous report have recommended Doppler ultrasonography in patients for whom the long version of the flap was planned and angiography in patients with significant lower extremity trauma.[1] Gang RK[2] described the long version of the flap as an island without any preoperative Doppler ultrasonography assessment or arteriography. He recommended performing a complete vascular evaluation in diabetic patients. Our study showed that the long version is safe. Grabb and Argenta[1] showed that 100% Doppler ultrasonography could be detected in normal patients and 92% in atherosclerotic patients. In our study, Doppler ultrasonography could detect the LCAa-LM as 90.63% among nonatherosclerotic and 87.50% among atherosclerotic patients. Nevertheless, no statistical significance was found between groups in detecting the LCA by Doppler ultrasonography.

Fig. 6. Fracture of the calcaneus was found. Open reduction and internal fixation with screws was performed.

CTA is the gold standard for vascular evaluation. In our study, 100% and 93.75% of nonatherosclerotic and atherosclerotic patients demonstrated LCA

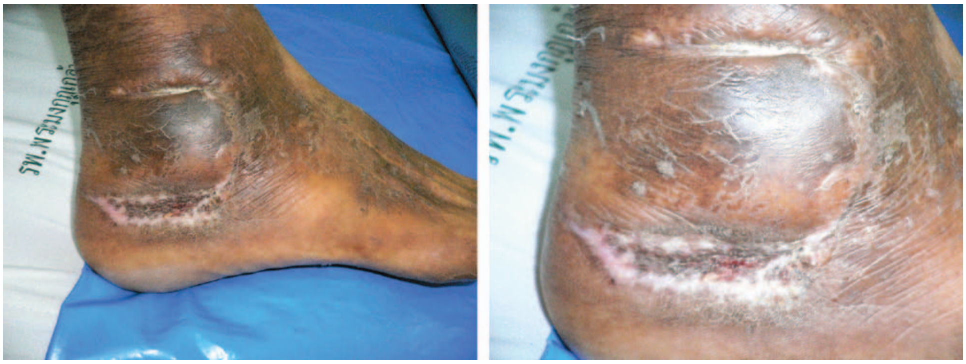

Fig. 5. The LCA flap showing no area of ischemia and donor site healed without any complications (1 month postoperation). A, lateral view. B, closed up view.

Fig. 7. The ulcer with exposed Achilles tendon was identified.

by CTA, respectively. No statistical significance was found using Doppler ultrasonography and CTA to detect the LCA. Duplex ultrasound could be used to evaluate the direction of blood flow in the LCA. Herein, the authors recommend at least using Doppler ultrasound to assess the LCA, posterior tibial and dorsalis pedis arteries, and if any questionable assessment occurred, CTA should be performed.

Previous studies have demonstrated that the peroneal artery is the least involved with atherosclerosis.[14,15] The LCA is an anatomical constant terminal branch of peroneal artery; so, it is the last vessel to be occluded in atherosclerotic patients. Occasionally, it can present as the terminal branch of the posterior tibial artery. One previous report[1] showed that 1 patient had the LCA as the main blood supply of the foot, so the LCA flap was contraindicated because it would disrupt the blood supply for the entire foot. Nevertheless, in our study, for 2 patients in the atherosclerotic group, the LCA could not be detected by CTA. Therefore, CTA is recommended to be performed in severely atherosclerotic patients where the dorsalis pedis and posterior tibial arteries cannot be palpated and detected by Doppler ultrasonography. When only LCA or other small vessels are shown

Fig. 9. The LCA flap showing venous congestion on postoperative day 1.

to supply the entire foot, the LCA flap is contraindicated and another flap should be used.

The disadvantages of this flap are depression at the donor site and sensory disturbances at the lateral portion of the dorsum of the foot. The sensory ability of the lateral aspect of the foot will be preserved by opening the fascia and preserving the sural nerve. The operative procedures for patients involved less surgical procedures than in the cadaveric study to preserve the soft tissue of lateral aspect of foot. However, these disadvantages gradually disappear over time.[2] One of our patients had venous insufficiency. In patients with combined arterial and venous insufficiency, the LCA flap can be performed with careful surgical procedures and close monitoring after surgery.

The sural flap is another choice for defects of the LM and Achilles tendon. The advantage is suitable for large defects, but the disadvantage is that it reveals a bulky and visible donor-site defect. The perforating branch of peroneal artery flaps such as the lateral supramalleolar flap[16] and the lateral retromalleolar perforator-based flap[17] can be used to cover

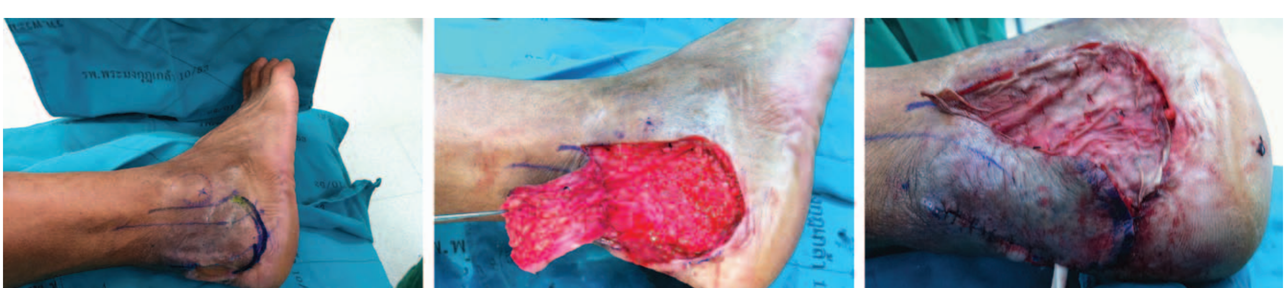

Fig. 8. A, The LCA flap was designed. B, The LCA flap was raised. C, The LCA flap was transposed to cover the Achilles tendon. Donor site was covered by skin graft (immediately postoperation).

Fig. 10. The LCA flap showing partial skin loss (A) and improved by conservative treatment (B).

Fig. 11. Three months after operation, the LCA flap was intact. The patient had normal daily life activities (posterior and oblique views).

the defect of Achilles tendon. The disadvantages are scarring from skin graft and division of superficial peroneal nerve in lateral supramalleolar flap. Moreover, the reliability of this flap in atherosclerotic patients is inconclusive.

Authors have recommended the LCA flap to be the first choice for small to medium defects of LM and Achilles tendon. The advantage of this flap is mainly that it does not require the sacrifice of the major artery to the foot. Its relative thinness with minimal donor-site morbidity can be an alternative.

CONCLUSIONS

With the increasing knowledge of anatomy, the LCA flap can be harvested confidently to ensure the axial flap, minimize the possibility of injury to the vessel, save operative time, and safely reconstruct complicated soft tissue defects of LM and Achilles tendon. The LCA flap can be raised safely among atherosclerotic patients using the LM as a reliable anatomic landmark. Preoperative CTA should be performed in severely atherosclerotic patients or in major lower extremity vascular injuries.

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