

# A Rare Anatomical Vascular Variant of Lower Limb Arterial System – Duplicated Superficial Femoral Artery

Arunprakash Pitchaimuthu<sup>1</sup>, Manik<sup>2</sup>, Monish G K<sup>3</sup>, Shailendra Singh Naik<sup>4</sup>, Mayur Bedadala<sup>5</sup>

<sup>1</sup>Consultant Radiologist, Nidan Diagnostics Scan Centre, Bhubaneswar, Odisha, <sup>2</sup>Fellow in Fetal Medicine, ADI Advanced Centre for Fetal Care, Bengaluru, Karnataka, <sup>3</sup>Department of Interventional Radiology Tata Memorial Hospital, Mumbai, Maharashtra, <sup>4</sup>Assistant Professor, Department of Radiodiagnosis, MGMCRI, Pondicherry, India, <sup>5</sup>Department of Radiology University of Miami, Florida, United States 33124.

**Corresponding author:** Shailendra Singh Naik MD,DNB, MNAMS, FNVIR, Assistant Professor, Department of Radiodiagnosis, MGMCRI, Pondicherry, India,

**How to cite this article:** Arunprakash Pitchaimuthu, Manik, Monish G K, Shailendra Singh Naik, Mayur Bedadala. A rare anatomical vascular variant of lower limb arterial system – duplicated superficial femoral artery. *International Journal of Contemporary Medicine Surgery and Radiology*. 2023;8(3):C1-C3.

## A B S T R A C T

Understanding the anatomy and normal anatomical variations of lower limb arterial system is undeniably important not only to understand the pathology involving the vessels of lower limb but also as a part of endovascular intervention and surgical planning in cases which demand them as a part of treatment. There have been very few cases of duplication of SFA cited in the literature, close to six worldwide and this being the seventh case in the world and first to be reported in Indian population. We incidentally came across this normal variant during US lower limb (US-LL) duplex scan in a patient with claudicating pain in bilateral lower limbs hence suspected of having peripheral vascular disease. It was confirmed on CT-Peripheral Angiography (CT-PA) which was done successively.

**Keywords:** Peripheral Vascular disease, Claudicating Pain, Normal Anatomical Variants, Endovascular Intervention, Duplication, CT-Peripheral Angiography, Duplex Scan, Iohexol

## INTRODUCTION

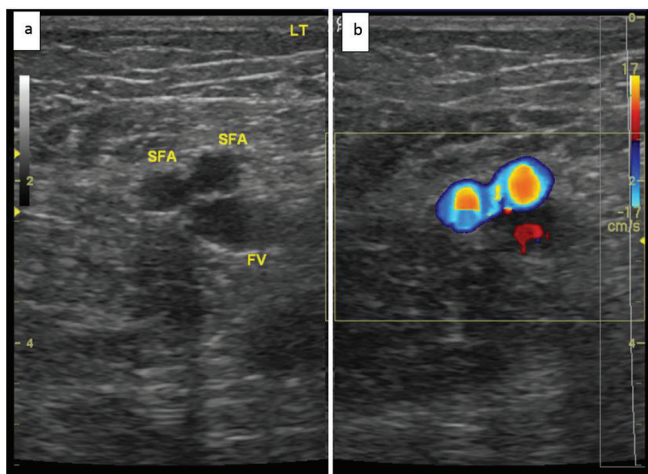
The lower limbs undeniably the fundamental part responsible for mobility of body, it comes to utmost importance knowing the blood supply to the muscles and bones composing them.<sup>1</sup> For clinching the right diagnosis of the pathologies involving the arteries of lower limb It comes to thorough knowledge of not only the normal vascular anatomy, the disease presentation and findings on different imaging that are to be taken into consideration but also knowing the normal anatomical variants and the normal physiological changes are equally important. As we encountered an extremely rare variant of SFA, hence for this report the course of SFA along with its known anatomical variations will be the topic of interest.

## CASE REPORT

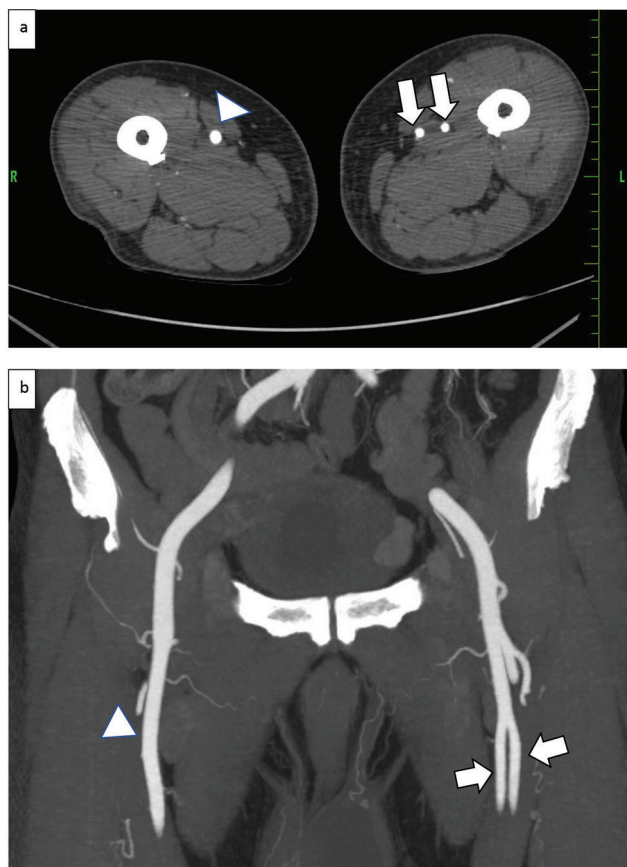
A 69-year-old male presented in the medicine OPD with complaint of severe claudicating pain over bilateral calf regions along with swelling, discoloration and scaling of involved region since past 1 month. History of loss of sensation over dorsal aspect of bilateral feet was also given. The patient is a smoker and known diabetic for 20 years on OHA, hypertensive for 2 years on medications and CKD patient managed on medications and dialysis. Considering in account the history provided, a provisional diagnosis of Peripheral vascular disease (PVD) was made and the patient was sent for bilateral LL US duplex scan for further evaluation. The scan was done using GE Expert P5 USG machine

which revealed normal venous system with no evidence of any DVT, but the arterial scan revealed two SFAs bifurcating at the level of proximal thigh continuing in close proximity till the distal third of thigh before reuniting however, they were comparatively narrow in diameter in comparison to that of the opposite limb where only one SFA was seen. Other findings included atherosclerotic wall calcifications involving distal LL arterial system bilaterally (Rt side > Lt side) with significant stenotic plaques.

The patient was further advised for CT-PA which the patient underwent post nephrology clearance in view of pre-existing Medical Renal Disease. CT-PA was done using GE 128 Slice CT machine using standard CT-PA protocol i.e., 120cc of Iohexol Contrast followed by a 30cc normal saline (NS) push under 10 second monitor delay with ROI at the level of descending aorta and enhancement threshold of 100HU. Reformatted images in all three planes i.e., axial, coronal and sagittal section were taken and carefully studied and the resultant being consistent with USG findings but more precise. AT ~3cm distal to the origin of the SFA, it was seen duplicating into two marginally smaller diameter vessels in comparison to the contralateral limb where only one normal diameter SFA was noted. The duplicated vessels were seen taking the normal SFA course in close proximity throughout the length of thigh in the adductor canal before they were seen reuniting to form back the SFA ~ 14.2 cm proximal to knee joint with normal opacification and no evidence of any filling defect or atherosclerotic wall calcifications noted within. Atherosclerotic wall calcifications with narrow caliber



**Figure-1:** Axial grey scale ultrasound(a) and corresponding colour Doppler (b) images at the level of left upper thigh showing duplicated SFAs and single FV lying posterior to it.

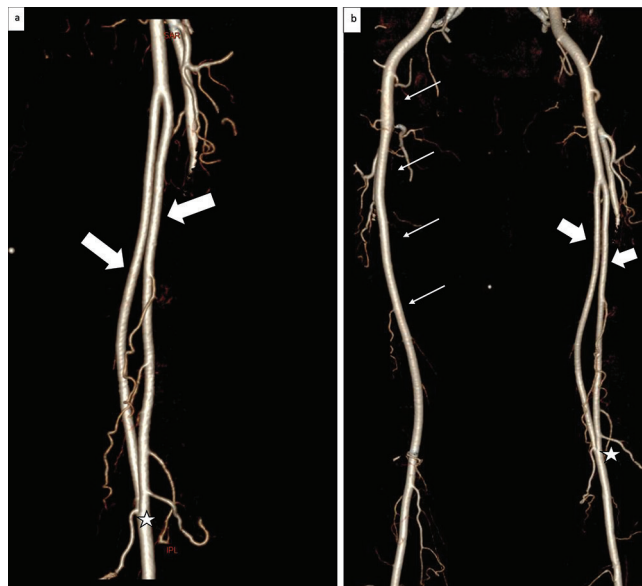


**Figure-2:** Axial CTA(a) and coronal maximum intensity projection images (b) showing duplicated SFAs on the left side(arrows) and normal single SFA on the right (arrowhead)

and faint opacification were noted predominantly in the long segments of bilateral PTA and peroneal arteries and all these findings became clearer after post-processing rendered 3-D volume rendered images. Hence, the diagnosis of duplicated SFA with bilateral PVD changes was reported.

### DISCUSSION

The arterial system in the lower limbs of an adult consist



**Figure-3:** 3D reconstructed CTA images of the left lower limb(a) and both lower limbs (b) demonstrating the duplicated SFAs on the left (thick arrows) with fusion at the level of the adductor hiatus (asterisk). Thin arrow points to the normal unduplicated SFA on the right side.

of two embryonic vessels - both of which take root from the dorsal root of the umbilical artery in the 6mm human embryo. One of them is the primitive or axial artery - the sciatic artery - and the other is of later development and joins the axial artery just above the knee. During the early embryonic stage, the sciatic artery supplies the lower limb. By the third month of development, the superficial femoral artery (SFA) takes over blood supply to the lower limb and the sciatic artery is completely interrupted.<sup>2</sup>

While anatomical variations of the SFA are rare, three of the variations have been described so far in literature - hypoplasia or aplasia associated with persistent sciatic artery (PSA)<sup>4</sup> - the most common one, duplicated SFA and absence or duplication of the deep femoral artery.<sup>5</sup> Duplication of the SFA is very rare and to the authors' knowledge has been documented only rarely in literature.<sup>4,6-9</sup> This is in contrast to duplication of the femoral vein which is very common at almost 41% in a study of 240 patients.<sup>10</sup> Diagnosis of the arterial variant is more difficult as the venous duplication is much more common and thus readily identified during routine ultrasound examinations and the second artery may actually be mislabeled as a large collateral during Duplex examination<sup>4</sup>.

The femoral arterial plexus has multiple vascular channels called 'rami femorales' which form wide 'femoral rete' and combine to form the SFA and deep femoral arteries<sup>3</sup>. The duplication of the SFA has been hypothesized to be due to failure of union of the femoral artery rete resulting in the formation of two arterial channels rather than one. A branch from the axial artery named as the 'ramus communicans' has been proposed to act as the fusion point of the SFA duplication.<sup>4</sup> If the two limbs of the SFA do not unite at some intermediate point, they must unite at a point just above the knee wherein the ramus communicans divides into



multiple branches.<sup>3</sup> Rarely, in some cases where the distal reunion does not occur at this level, the duplicated SFA can be associated with popliteal duplication as well.<sup>6</sup>

The significance of the duplicated SFA is that it is an anatomic variation which may be troublesome for the vascular surgeon or interventionist during a procedure. In a case report by Aksoy et al with a diagnosis of lower limb ischemia due to acute thromboembolism, both SFAs had to be catheterized with 4F and 5F Fogarty catheters followed by embolectomy.<sup>6</sup> Other pitfalls include a possible misinterpretation of the duplicated SFA as a large collateral vessel on Doppler examination<sup>4</sup>

A review of 12 cases of duplicated SFA was made by Senior in 1925<sup>3</sup>. Most of these cases however, were diagnosed in the 19<sup>th</sup> century based on autopsy findings. 2 other cases have been reported in the 1900s based on live patients<sup>11,12</sup>. 8 relatively recent cases have been reported so far according to the authors' best knowledge<sup>4,6-9,13-15</sup>, the most recent ones being published in 2020<sup>8,9</sup> While Hapugoda et al remark that the duplicated SFA is unlikely to cause foreseeable vascular compromise<sup>7</sup>, the paucity of literature on this subject due to its rarity precludes any conclusive decision on the topic unlike the aneurysmal complications associated with a persistent sciatic artery<sup>16</sup>. Thrombosis of one limb has been described in one case on Doppler and MRA<sup>13</sup> and another case had a stenosis at the confluence of the proximal duplication with multiple duplications of the SFA on angiography and CTA<sup>8</sup>. In the latter, due to narrow calibre and the unknown fragility component of the duplicated vessels, only one of the proximal duplicated vessels could be traversed with a guide wire and catheter and no intervention was performed for the same.<sup>8</sup> Kim et al further noted that the presence of multiple duplications likely contributed to diminished distal perfusion resulting in claudication symptoms.<sup>8</sup> Collaterals noted around the duplicated vessels in Hapugoda's case report favour this theory.<sup>7</sup>

It is also interesting to note that of the 8 total reported cases, 3 were diagnosed on USG itself and confirmed on MRA/CTA/Angiography<sup>9,13,15</sup> while others were diagnosed on CTA/angiography<sup>6-8,14</sup> save for one which was missed on USG and diagnosed on subsequent angiography due to the possible misinterpretation as a collateral vessel<sup>4</sup>. This report thus highlights the need for publishing such cases owing to the rarity of this variant and the lack of established literature and consensus regarding its pathological significance.

## CONCLUSION

The finding of a duplicated SFA is very rare as evidenced by the sparse literature on the subject. Such a variant should not be missed however, as the reduced caliber of the duplicate vessel may compromise femoral access during interventional procedures such as angiography<sup>8</sup>. As the hemodynamic implications of a duplicated SFA are as of yet incompletely understood, further reports will likely be necessary to expand the literature on the subject.

## REFERENCES

1. Yadav MK, Mohammed AKM, Puramadathil V, Geetha D, Unni M. Lower extremity arteries. *Cardiovasc Diagn*

*Ther.* 2019 Aug;9(Suppl 1):S174–82.

2. Senior HD. The development of the arteries of the human lower extremity. *Am J Anat.* 1919 Jan;25(1):54–95.
3. Senior HD. An interpretation of the recorded arterial anomalies of the human pelvis and thigh. *Am J Anat.* 1925;36(1):1–46.
4. Javerliat I, Rouanet A, Bourguignon T, Long A, Lermusiaux P. Duplication of Superficial Femoral Artery: An Uncommon Variation of the Lower Limb Arterial System. *Ann Vasc Surg.* 2010 Apr;24(3):415. e1-415.e3.
5. Anger P, Seidel K, Kauffmann G, Urbanyi B. Seltene Variationen der großen Oberschenkelarterien. *RöFo - Fortschritte Auf Dem Geb Röntgenstrahlen Bildgeb Verfahr.* 1984 Sep;141(9):318–26.
6. Aksoy M, Barbaros U, Genc FA, Kurtoglu M. Duplication of Superficial Femoral and Popliteal Artery (A Previously Undescribed Variant). *EJVES Extra.* 2002 Aug;4(2):37–8.
7. Hapugoda S, Hsu CC-T, Kwan GNC, Watkins TW, Rophael JA. Duplication of the superficial femoral artery: comprehensive review of imaging literature and insight into embryology. *Acta Radiol Open [Internet].* 2016 Jul 26 [cited 2021 Feb 18];5(7). Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4963987/>
8. Kim TI, Chaar CIO, Guzman RJ, Fischer UM. Multiple duplications of the superficial femoral artery – Case report and review of the literature. *Vascular.* 2020 Jul 23;170853812094331.
9. Yu SH, Hwang JH, Kim JH, Park S, Lee KH, Choi ST. Duplication of superficial femoral artery: imaging findings and literature review. *BMC Med Imaging.* 2020 Dec;20(1):99.
10. Paraskevas P. Femoral vein duplication: incidence and potential significance. *Phlebol J Venous Dis.* 2011 Mar;26(2):52–5.
11. Müller JH. [Duplication of the femoral artery]. *Fortschr Geb Rontgenstr Nuklearmed.* 1967 Jan;106(1):152–3.
12. Krasemann PH. [Double femoral artery]. *Fortschr Geb Rontgenstr Nuklearmed.* 1972 Aug;117(2):220–2.
13. Kantarci F, Mihmanli I, Aksoy H, Barutca H, Gurses B, Kaynak K. Duplication of the Superficial Femoral Artery Diagnosed Primarily on the Basis of Color Doppler Ultrasonography. *J Ultrasound Med.* 2003 Jun;22(6):641–3.
14. Huynh KD, Alfaqawi M, Paaske WP. Duplication of the superficial femoral artery. *Vascular.* 2010 Oct;18(5):292–3.
15. Rajadurai VA, Sieunarine K. Superficial Femoral Artery Duplication. *J Vasc Interv Radiol.* 2015 Sep 1;26(9):1323.
16. van Hooft IM, Zeebregts CJ, van Sterkenburg SMM, de Vries WR, Reijnen MMPJ. The Persistent Sciatic Artery. *Eur J Vasc Endovasc Surg.* 2009 May;37(5):585–91.

**Source of Support:** Nil; **Conflict of Interest:** None

**Submitted:** 25-07-2023; **Accepted:** 29-08-2023; **Published online:** 30-09-2023