

The persistence of the sciatic artery

George Paraskevas¹, Basilios Papaziogas², John Gigis¹, Argirios Mylonas³, Panagiotis Gigis¹

¹Department of Anatomy, Faculty of Medicine, Aristotle University of Thessaloniki, Greece

²2nd Surgical Clinic, Faculty of Medicine, Aristotle University of Thessaloniki, Greece

³Laboratory of Anatomy, Faculty of Sports Science, Aristotle University of Thessaloniki, Greece

[Received 6 April 2004; Revised 18 June 2004; Accepted 18 June 2004]

The persistent sciatic artery (PSA) is a rare anatomical variant where the internal iliac artery and the axial artery of the embryo provide the major supply of the lower limb, the superficial femoral artery being usually poorly developed or absent. We describe an extremely large right PSA in a 79-year-old male cadaver during a medical gross anatomy course, with simultaneous existence of a hypoplastic superficial and deep femoral artery. The PSA, which was a continuation of the anterior division of the right internal iliac artery, entered the buttock through the greater sciatic foramen situated in the gluteal region laterally to the sciatic nerve and in the mid thigh medially to the same nerve, becoming in the popliteal fossa the popliteal artery. Neither the superficial nor the deep femoral artery had communication with the popliteal artery. Because the PSA in our study was the only blood supply to the lower limb, we present the embryologic origins and the clinical anatomy of this artery.

Key words: persistence, sciatic artery, anatomy

INTRODUCTION

The persistent sciatic artery is a rare embryological abnormality resulting from lack of regression of the embryonic dorsal axial artery associated with a hypoplastic superficial femoral artery. The persistent sciatic artery is a continuation of the internal iliac artery into the popliteal-tibial vessels and provides the major blood supply to the lower limb after birth. There have been various reports of the persistent sciatic artery [1, 5, 8, 12, 13, 16], which may lead to the realisation that the numerous forms of PSA correspond to various embryological developments of the lower limb arteries.

The persistent sciatic artery has been called the axial, ischiatic or persistent sciatic artery or ischio-popliteal arterial trunk [12]. According to the same authors, in 80% of cases PSA was complete and was unilateral in two thirds of cases. When the anomaly was bilateral, PSA was usually complete. Of the various reports the earlier ones are mainly pathological

descriptions, whereas the more recent are clinically oriented. The abnormality has become known because of aneurysm development. Shutze et al. [14] found that in the international literature one half of all patients with a PSA develop aneurysms that are characteristically located caudal to the sciatic notch, as opposed to gluteal aneurysms that are located proximally to this landmark.

We report a case of an extremely large right persistent sciatic artery, which co-existed with a hypoplastic superficial and deep femoral artery and which had no anastomoses with the popliteal artery.

CASE REPORT

After the dissection of the gluteal region and the posterior aspect of the thigh in a male cadaver aged 79 years old used for educational purposes in our Department of Anatomy, we found an enormous vessel accompanying the sciatic nerve. This vessel corresponded to the persistent sciatic artery. The

persistent sciatic artery was a direct continuation of the anterior division of the right internal iliac artery and had a diameter obviously larger than that of the right external iliac and left internal iliac artery. After a coiled course within the pelvis, PSA entered the buttock through the infra-piriformis portion of the greater sciatic foramen. In the gluteal region PSA was situated laterally to the sciatic nerve, which was already divided into the tibial and the common fibular nerves (Fig. 1). It supplied several thin branches to the *gluteus maximus* muscle, lateral rotator muscles, the tibial nerve, the overlying skin, the semi-tendinosus, the *biceps femoris* muscle and the *adductor magnus* muscle. In the mid thigh PSA was directed anteriorly to the sciatic nerve, passing underneath the long head of the *biceps femoris* muscle. In the lower thigh PSA was situated medially to the sciatic nerve and *biceps femoris* and at the tip of the popliteal fossa gave as continuation the popliteal artery (Fig. 2). Examination of the femoral arteries showed the presence of hypoplastic superficial and deep femoral arteries that had no communication with the popliteal artery.



Figure 1. In the gluteal region the persistent sciatic artery comes through the infraspinal portion of the greater sciatic foramen together with the sciatic nerve. The persistent sciatic artery is situated laterally to the sciatic nerve.



Figure 2. In the lower thigh the persistent sciatic artery is situated medially to the sciatic nerve and *biceps femoris* and in the popliteal fossa becomes the popliteal artery.

DISCUSSION

The persistent sciatic artery is a rare embryological remnant of the axial artery of the lower limb, which disappears simultaneously with the appearance of the femoral artery. Sciatic arteries are normally present in the lower limbs of birds and reptiles. Of the mammalian group, the artery persists throughout life in the Order Chiroptera [6]. The previously mentioned axial artery, which is known in the region of the thigh as the sciatic artery, is present in 6-mm human embryos (32 days), arising as a branch of the dorsal root of the umbilical artery. In the 8.5 mm embryo the external iliac artery branches off from the umbilical artery further down from the axial artery. In the 10-mm embryo a small femoral artery appears as an extension of the external iliac accompanying the femoral nerve; in the 12-mm embryo the femoral artery extends approximately half way down the thigh, where it bifurcates into a lateral and a medial branch. The former is short and at approximately the 14-mm stage anastomoses with the sciatic artery via the superior communicating branch of the future anterior fibial, posterior tibial and peroneal arteries. Between the 22-mm and 25-mm stage the sciatic artery has regressed, and

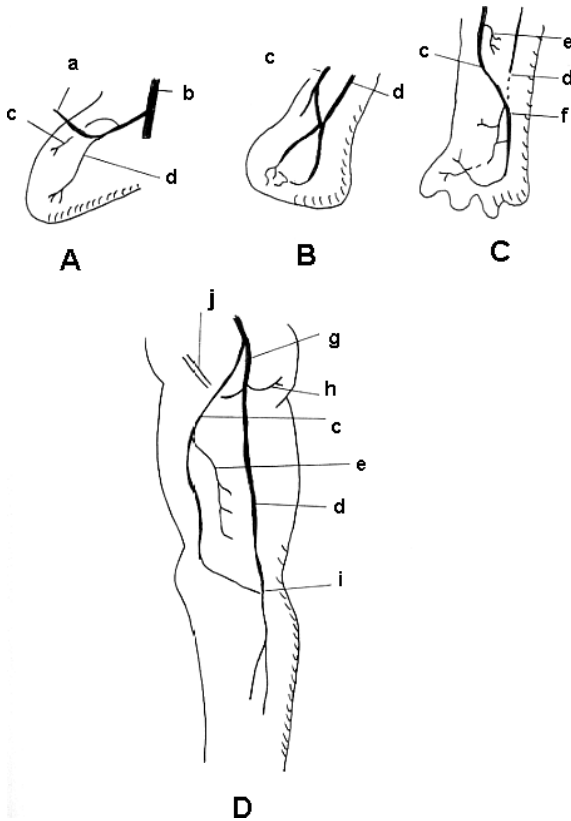


Figure 3. Schematic representation of the development of arteries of the thigh in order to show the formation of the persistent sciatic artery. **A.** In the 10-mm human embryo; **B.** In the 14-mm human embryo; **C.** In the 22-mm human embryo; **D.** Persistence of the sciatic artery in the adult. a — umbilical artery, b — aorta, c — femoral artery, d — sciatic artery, e — deep femoral artery, f — popliteal artery, g — internal iliac artery, h — inferior gluteal artery, i — popliteal artery, j — obliterated umbilical artery.

given place to the femoral artery that has taken over the major blood supply of the lower limb [2] (Fig. 3).

The sciatic artery which has been lost has left as remnants the superior and inferior gluteal arteries, the upper portion of the popliteal artery, a portion of the perforating branches of the profundus femoral artery, the proximal portion of the artery of sciatic nerve and a very fine interosseous tibio-fibular plexus [12]. However, the presence of the inferior gluteal artery in its normal position suggests that the inferior gluteal may be a branch of the internal iliac, which is derived independently and is not the remnant of the sciatic artery [7]. At times vascularisation of the lower limb is embryologically derived from 2 axial vessels, a ventral axis, which persists normally in the thigh, and a dorsal axis, which persists in the dog [6].

As has been reported, Green made the first description of the persistent sciatic artery in 1832 [12] and its incidence is very low. It is typical that Adachi [1] in 1,500 dissections found only 2 cases of PSA,

while Madson et al. [9] reported an arteriographic incidence of 0.06%. Cowie reported the first angiographically illustrated case in 1960.

The persistent sciatic artery may be complete or incomplete. The complete type is a PSA which is the continuation of a large internal iliac artery, is accompanied by the sciatic nerve and continues as the popliteal artery. The incomplete type is referred to as a PSA that is discontinuous between the pelvis and the popliteal fossa. The visualisation of a large artery along the posterior aspect of the pelvis and the presence of an enlarged internal iliac artery when compared to the homolateral external iliac artery are simple diagnostic criteria for the location of PSA [12]. Practitioners should be able to recognise this anatomical variant if they find Cowie's sign: palpable distal pulses and an absent femoral pulse [12]. In addition, to recognise such a rare lesion, an accurate whole image includes adequate angiography, a CT scan and magnetic resonance imaging [20].

Pillet gives the following classification for the various types of PSA: Type I: complete axial artery and normal femoral artery. Type II: complete axial artery and incomplete femoral artery; Type IIa: a superficial femoral artery which does not, however, reach the popliteal artery; Type IIb: no superficial femoral artery; Type III: incomplete axial artery; only the upper half of the artery can be found with a normal femoral network; Type IV: incomplete axial artery in which only the lower half can be found with the co-existence of a normal femoral network; Type V: sciatic artery branching from the medial sacral artery with an existing superficial femoral artery. Our finding, according to this classification, corresponds to Type IIa.

We must emphasise the fact that in cases of persistence of the sciatic artery the main artery of the lower limb was the femoral artery or the persistent sciatic artery [4, 11, 18]. There are very few cases in which the terminal branch of the *profunda femoris* artery had become the main artery of the leg [15] or anastomosed with a persistent sciatic artery [3]. Yamada et al. [19] suggested the possibility that one of the perforating arteries may continuously become the popliteal artery. They claimed that if such an abnormality occurs, the adductor hiatus would be located more proximally than at the normal level. Senior [16] believed that the perforating arteries develop from the *profunda femoris* artery after the femoral artery has joined the sciatic artery. Sekiya et al. [15] speculated that in their case the femoral artery was so severely hypoplastic as to be "causing" an enlargement of the 4th perforating artery, which joined the sciatic artery.

Most cases are diagnosed because of complications such as an aneurysm or ischaemic or embolic complications in the lower limb or a trauma at the buttock or the posterior aspect of the thigh [12]. This rare vascular anomaly is associated with aneurysmal formation in 15–46% of cases [10], and this is routinely located at the buttocks, between the piriformis muscle and the posterior aspect of the greater trochanter [14].

At present 88 cases, including the present case, have been reported in the international literature [10]. It is interesting from the standpoint of the embryology of the sciatic artery that this location of aneurysm formation corresponds to the site in which PSA had a slight S-shaped curve [15]. The presence of aneurysms can be explained by the decreased amount of elastic fibres in the hypoplastic arterial wall or by repeated flexion/extension traumatism of the arterial wall in this often stressed area. These aneurysms can cause buttock pain and thrombosis of these aneurysms can produce compression of the sciatic nerve, severe pain, vascular claudication or emboli [12]. Treatment has included aneurysmal exclusion and femoro-popliteal by-pass with an inverted autologous saphenous vein in the case of a complete PSA, or else ligature or balloon embolisation [20, 17].

The persistent sciatic artery has occasionally been associated with other anomalies including Mullerian and left renal agenesis, arterio-venous fistula formation, hypertrophy or hypotrophy, multiple haemangiomas, neurofibromatosis or anomalies of the leg arteries [9]. Various vascular anomalies may also be noticed which show an ontogenetically earlier condition in the development of the vascular system. The persistent sciatic artery may thus be accompanied by a superficial brachial artery [21], a right retro-oesophageal subclavian artery, accessory renal arteries, a left accessory hepatic artery branching off from the left gastric artery and an intermesenteric arterial anastomosis [15].

We have reported a very rare case of a large complete persistent sciatic artery with the co-existence of a hypoplastic deep and superficial femoral artery. The rarity of this congenital abnormality is probably due to the fact that it often goes unrecognised [12].

REFERENCES

- Adachi B (1928) *Das Arteriensystem der Japaner*. Band II, Kyoto, pp. 136–142.
- Arey L (1954) *Developmental Anatomy*, 6th Ed., WB Saunders Co, Philadelphia, pp. 375–376.
- Blair C, Nandy K (1965) Persistence of the axis artery of the lower limb. *Anat Rec*, 152: 161–172.
- Emura S, Shoumura S, Utsumi M, Chen H, Yamahira T, Hayakawa D, Isono H (1991) A case of the persistent sciatic artery. *Acta Anat Nippon*, 66: 27–30.
- Finerty J (1947) Persistent ischiatic artery. *Anat Rec*, 98: 587–595.
- Grosser O (1901) Zur Anatomie und Entwicklungsgeschichte des Gefässsystems der Chiropteren. *Anat Hefte*, 17: 205–424.
- Job T. (1933) Persistence of a left ischiatic artery. *Anat Rec*, 58: 101–105.
- Kubota K, Haibara T, Noguchi M (1957) A case of bilateral existence of ischiatic artery in man. *Okajima Folia Anat Jpn*, 30: 339–340.
- Madson D, Wilkerson D, Ciocca R, Graham A (1995) Persistent sciatic artery in association with varicosities and limb length discrepancy: an unrecognized entity? *Am Surg*, 61: 387–392.
- Maldini G, Teruya T, Kamida C, Eklof B (2002) Combined percutaneous endovascular and open surgical approach in the treatment of a persistent sciatic artery aneurysm presenting with acute limb-threatening ischemia: a case report and review of the literature. *Vasc Endovascular Surg*, 36: 403–408.
- Nakamura I, Kasai T (1956) One case of the sciatic artery. *Acta Anat Nippon*, 31: 423–430.
- Papon X, Picquet J, Fournier H, Enon B, Mercier P (1999) Persistent sciatic artery: report of an original aneurysm-associated case. *Surg Radiol Anat*, 21: 151–153.
- Savov J, Wassilev W (2000) Bilateral persistent complete sciatic artery. *Clin Anat*, 13: 456–460.
- Schutze W, Garrett W, Smith B (1993) Persistent sciatic artery: collective review and management. *Ann Vasc Surg*, 7: 303–310.
- Sekiya S, Horiguchi M, Komatsu H, Komada S, Yokoyama S, Yoshida K, Isogai S, Nakano M, Koizumi M (1997) Persistent primitive sciatic artery associated with other various anomalies of vessels. *Acta Anat*, 158: 143–149.
- Senior H (1919) The development of the arteries of the human lower extremity. *Am J Anat*, 25: 55–95.
- Sottiurai V, Omlie W (1994) Femoral artery hypoplasia and persistent sciatic artery with blue toe syndrome: a case report, histologic analysis and review of the literature. *Int Angiol*, 13: 154–159.
- Tohno Y, Tohno S, Watanabe T, Watanabe M, Kimura Y (1993) Anomaly of bilateral persistent sciatic artery. *Acta Anat Nippon*, 68: 422–428.
- Yamada M, Mannen H (1985) *Anatomy for dissectors*, Tokyo, Nankodo.
- Yamaguchi M, Mii S, Kai T, Sakata H, Mori A (1997) Intermittent claudication associated with persistent sciatic artery: report of two cases. *Surg Today*, 27: 863–867.
- Yoshimura R, Wake N, Watanabe T, Yamamoto M, Yoshioka Y, Yoshioka M, Yoshimoto T, Ukeshima A, Fujimoto T (1988) A case of bilateral sciatic artery. *Acta Anat Nippon*, 63: 384.