Original Article:
Cadaveric Study on Variations in the Arteries of the Gluteal Region with its Embryological and Clinical Significance.

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Citation

Submitted: Nov 5, 2016; Accepted: Dec 25, 2016; Published: Jan 31, 2017

Abstract: In this manuscript we report a case study on 40 lower limb specimens. In 5% of cases Inferior Gluteal Artery (IGA) was absent and a branch from trunk of Superior Gluteal Artery (SGA) was replacing the distribution of IGA to gluteal region. In 2.5% of cases an additional belly of piriformis was observed. The deep branch of SGA passed deep to it whereas the superficial branch passed between additional belly and piriformis muscle. In 2.5% of cases an arterial branch from IGA was found accompanying sciatic nerve for a short distance. In the remaining 90% of cases SGA and IGA had normal course and distribution. The developmental and clinical significance of the variations in their anatomy is discussed in this study.

Key Words: Inferior gluteal artery, Superior gluteal structures entrapment, Piriformis syndrome, Accessory piriformis muscle, Claudication, Persistent Sciatic Artery

Introduction:
The gluteal region is one of the crucial anatomical areas where there is an exit of vital neurovascular structures, well protected under the cover of large muscles. The gluteal region has an average of 21 perforators which arise from three main source arteries, namely the superior gluteal (SGA), inferior gluteal (IGA) and internal pudendal arteries. The flaps which are based on these perforators are used for breast reconstruction and for covering defects in the sacral and perineal region. The knowledge of vascular anatomy of this region is very essential from clinical point of view.

Aims & Objectives
1. To look for the variations in course and distribution of gluteal arteries.
2. To document communicating branches (if any) among the gluteal arteries.
3. To report any additional variations in relevance to our study.

Materials and Methods
Twenty well embalmed and formalin fixed adult human cadavers were dissected bilaterally (n=40) during the routine dissection for the undergraduate students in the Department of Anatomy, KMC Manipal. The dissection procedure was carried out as per Cunningham Manual of Practical Anatomy by G.J. Romanes (15th edition). The skin incision was given along the iliac crest superiorly to the gluteal fold at the lower limit of the buttock inferiorly, the incision was traced along the natal cleft between the buttocks medially. The skin flap was then reflected laterally from a line joining anterior superior iliac spine to the anterior aspect of the greater trochanter of the femur. Then the superficial fascia was cleaned and possible cutaneous nerves were retained. The thin deep fascia covering the gluteus maximus was removed and the attachment of the muscle was defined. The Gluteus maximus was then cut across the origin and reflected, to define the structures deeper to it. Care was taken to retain the distribution of superficial branch of superior gluteal artery which is immediate structure deep to maximus muscle. The relation of the arterial structures to the piriformis as they exit out of greater sciatic foramen was noted. Nerves
accompanying these arteries were also cleaned. Any variation in the piriformis muscle was noted. In addition, the caliber and distribution of persistent sciatic artery was also documented. All anatomical variations observed were photographed and recorded.

**Results**

In the present case study we noticed that in about 2/40 specimens (5%), IGA was totally absent and a branch from trunk of SGA was replacing the distribution of IGA to gluteal region.

In 1/40 specimens (2.5%), an additional belly of piriformis was observed. This muscle belly was found to take origin from the posterior surface of iliac bone above the greater sciatic notch closer to posterior superior iliac spine. The muscular part had parallel fibers running obliquely to the original muscle and those fibers got inserted to the tip of great trochanter of femur. In this case the deep branch of SGA passed deep to it whereas the superficial branch passed between accessory belly and piriformis muscle.

In 1/40 specimens (2.5%), an arterial branch from IGA was found accompanying sciatic nerve for a short distance of 12 cms and it tapered down slowly as it supplied the sciatic nerve. In 36/40 specimens (90%), Superior gluteal artery and inferior gluteal artery had normal course and distribution.

**Discussion**

IGA is one of the largest terminal branches from the internal iliac artery. It courses in the gluteal region as it enters through greater sciatic foramen, in relation to lower border of piriformis, supplies principally the muscles in the buttock and thigh region and terminates by dividing into cutaneous branches which anastamose with its perforating branches. Previous studies have shown that IGA can arise from Internal pudendal artery or even from Obturator artery. Variations in the origin and course of gluteal arteries are common and are of importance for many grafting surgeries. Recently, superior and inferior gluteal artery perforator flaps (SGAP and IGAP) are used for transplantation surgery. The IGA may be absent or present as a very fine anastamotic twig which forms an arch with the SGA.[1] (Yan J et al 2013). Studies by [2] Shetty S D et al 2012, [3] Reddy S et al 2007 have shown that the superficial branch of SGA can give an occasional branch which replaced the IGA and accompanied the inferior gluteal nerve, which coursed over the piriformis muscle, supplied the adjacent muscles whereas in our study we found that the trunk of superior gluteal artery itself gave the unusual branch. Study conducted by [4] Bansal R et al 2013 reported an additional belly of piriformis, arising from posterior aspect of

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**Fig 1:** Left side gluteal region where gluteus maximus muscle is cut and exposed, which shows superficial branches (1a, 1b) and deep branches (2a, 2b) from trunk of Superior Gluteal Artery (SGA) lying over Gluteus minimus (Gm) above Piriformis (P). Note the absence of Inferior Gluteal Artery in the dissected specimen.

**Fig 2:** Left side gluteal region where gluteus maximus muscle is cut and exposed, which shows superficial branches (1a) and deep branches (2a, 2b) from trunk of Superior Gluteal Artery (SGA) lying over Gluteus minimus (Gm) above Piriformis (P). Note the presence of a branch (3) from trunk of SGA replacing the distribution of IGA to gluteal region.

**Fig 3:** Left side gluteal region where gluteus maximus muscle is cut and exposed, which shows additional belly of Piriformis (aP) where superficial branch of SGA replacing between additional belly and piriformis muscle (1) and deep branch of SGA passing deep to additional belly (2).

**Fig 4:** Right side gluteal region where gluteus maximus muscle is cut and exposed, which shows Persistent Sciatic Artery. P = Piriformis.
hip bone close to the margin of greater sciatic notch. The superior gluteal nerve and artery emerged between the two bellies where as in our study, only superficial branch of SGA emerged between the two bellies however the deep branch of the same passed deep to it.

At the early embryonic period of development, the major arterial trunk supplying the lower limb bud is the sciatic artery, which originated from dorsal root of umbilical artery (5th lumbar intersegmental artery). The femoral arterial system is later established as major blood source to lower limb, the axis artery involutes. In adults the axis artery of the lower limb is represented by inferior gluteal artery, popliteal artery and the artery accompanying sciatic nerve. Persistent sciatic artery is a rare congenital vascular anomaly with its incidence varying from 0.025 - 0.04%.[5] An incomplete persistent sciatic artery was emerging from the greater sciatic foramen, below the level of piriformis muscle and ran on the surface of the sciatic nerve for a short distance of 8cm.[6] An enormous vessel emerged through the infra-piriformis portion of the greater sciatic foramen, accompanying the sciatic nerve. It was found to be direct continuation of the anterior branch of the right internal iliac artery and traced further it gave muscular branches and continued as popliteal artery. [7]

**Conclusion**

**Embryological significance:** Sciatic artery which is the axial artery, serves as the major arterial supply to the lower limb bud. In adults, remnants of proximal portion of the IGA, popliteal and fibular arteries persist as the, the sciatic artery. In the present study, the cases where the IGA is absent, the SGA represents the axis artery. Persistent Sciatric artery in adult, may serve as the major blood supply to the lower limb. A failure to recognize it, may lead to an incorrect diagnosis of vascular occlusive disorders.

**Clinical significance:** Claudication of the buttock may occur due to stenosis of gluteal artery. Atherosclerosis or compression in the greater sciatic foramen above the piriformis often affects SGA. Accessory belly of piriformis can serve as co-factor to cause entrapment of neurovascular structure which emerges deep to it. The distinctive branching pattern of the gluteal arteries may serve as useful information of versatile flaps for reconstruction surgeries and hence help the surgeons.

**Acknowledgement**

I wish to acknowledge the Department of Anatomy, Kasturba Medical College, Manipal and Manipal University for their support during the study period.

**References**