CLINICAL VIGNETTE

Anatomy Journal of Africa. 2021. Vol 10 (1): 2006-2012

MUSCULAR VARIATIONS IN THE GLUTEAL REGION, THE POSTERIOR COMPARTMENT OF THE THIGH AND THE POPLITEAL FOSSA: REPORT OF 4 CASES

Babou Ba[1], Tata Touré[1], Abdoulaye Kanté[1/2], Moumouna Koné[1], Demba Yatera[1], Moustapha Dicko[1], Drissa Traoré[2], Tieman Coulibaly[3], Nouhoum Ongoïba[1/2], Abdel Karim Koumaré[1].

1) Anatomy Laboratory of the Faculty of Medicine and Odontostomatology of Bamako, Mali.

2) Department of Surgery B of the University Hospital Center of Point-G, Bamako, Mali.

3) Department of Orthopedic and Traumatological Surgery of the Gabriel Touré University Hospital Center, Bamako, Mali.

Correspondence: Tata Touré, PB: 1805, email address: ttbabatoure@gmail.com, Tel :(00223) 78008900

ABSTRACT:

During a study of the sciatic nerve by anatomical dissection in the anatomy laboratory of the Faculty of Medicine and Odontostomatology (FMOS) of Bamako, 4 cases of muscle variations were observed in three male cadavers. The first case was the presence of an accessory femoral biceps muscle that originated on the fascia that covered the short head of the femoral biceps and ended on the head of the fibula joining the common tendon formed by the long and short head of the femoral biceps. The second case was the presence of an aberrant digastric muscle in the gluteal region and in the posterior compartment of the thigh. He had two bellies; the upper belly, considered as a piriform muscle accessory; the lower belly, considered a third head of the biceps femoral muscle; these two bellies were connected by a long tendon. The other two cases were the presence of third head of the gastrocnemius. These two cases were seen bilaterally in a cadaver. The anatomical variations of the hamstring muscles are rare and their knowledge is needed by radiologists and surgeons. The most common cause of popliteal artery entrapment syndrome is the presence of a third head of the gastrocnemius muscle.

Key words: Muscle variations, biceps femoral accessory, aberrant digastric muscle, third head of biceps femoral, third head of gastrocnemius.

INTRODUCTION

The muscles of the gluteal region are arranged in three planes: a superficial plane (the large gluteal muscle and tensor fascia lata muscle), a middle plane (the middle gluteal muscle) and a deep plane (comprising from top to bottom: the small gluteus, piriformis, superior twin, obturator internus, inferior twin, obturator externa and quadruple femoral muscles). The piriformis muscle originates on the endopelvic aspect of the sacrum on the lateral periphery of the 2nd and 3rd pelvic sacral foramina. It leaves the small pelvis through the large ischial notch and ends on the upper edge of the greater trochanter (Bouchet and Cuilleret, 1996).

The muscles of the posterior compartment called the hamstring muscles are the femoral biceps, semi-tendinous and semi-membranous muscles. The femoral biceps consists of two heads, long and short, which end in a common tendon on the head of the fibula (Kamina, 2002).

The gastrocnemius muscle has two heads, a medial head and a lateral head, which originate from the medial and lateral femoral condyles, respectively. The two

heads merge at the bottom and form the sural triceps with the soleus muscle. The sural triceps terminates on the calcaneus via the calcaneal tendon (Bouchet and Cuilleret, 1996)

Variation within the hamstring muscles is rare, but has been documented (Hoban et al, 2019). The presence of a third head of the gastrocnemius muscle is the most common cause of popliteal artery entrapment syndrome (Gokkus et al, 2014).

We report 4 cases of muscular variations, one case of accessory femoral biceps muscle, one case of aberrant digastric muscle in the gluteal region and the posterior compartment of the thigh, two cases of third head of the gastrocnemius muscle.

CASE REPORT

During a study of 64 cases of the sciatic nerve by anatomical dissection in the anatomy laboratory of the Faculty of Medicine and Odontostomatology (FMOS) of Bamako, 4 cases of muscle variations were observed in three male cadavers.

1) In a cadaver aged about 67, we observed from the left side, the presence of an accessory femoral biceps muscle which originated by an aponeurotic tendon on the fascia of the short head of the femoral biceps and it ended on the fibular head joining the tendon formed by the long and short heads of the biceps femoral. The sciatic nerve had split at the gluteal region, the accessory muscle was innervated by a nerve that originated from the common peroneal nerve through a common trunk with an unusual sensory nerve. The latter passed between the accessory muscle and the femoral biceps before distributing to the skin of the upper part of the posterior aspect of the leg (figure 1a).

2) In a corpse of about 50 years old, the presence of an aberrant digastric muscle was also observed on the left side in the gluteal region and the posterior compartment of the thigh. The digastric muscle had an upper belly and a lower belly that were connected by a long tendon. The upper belly arose from the piriformis muscle (it was considered an accessory piriformis muscle), and the lower belly fused down to the femoral biceps (it was considered a third head of the femoral biceps). In this case, the bifurcation of the sciatic nerve was intrapelvic, the tibial nerve passed below the upper belly of the digastric muscle (accessory piriformis muscle), the common peroneal nerve passed between the latter and the piriformis muscle (figure 1b).

3) Two cases of third head of the gastrocnemius muscle were observed bilaterally in a cadaver approximately 36 years old. On each side the third head of the gastrocnemius originated on the popliteal surface of the distal end of the femur and passed superficially outside and behind the tibial nerve and popliteal vessels before joining with the medial head of the gastrocnemius (figure 2).

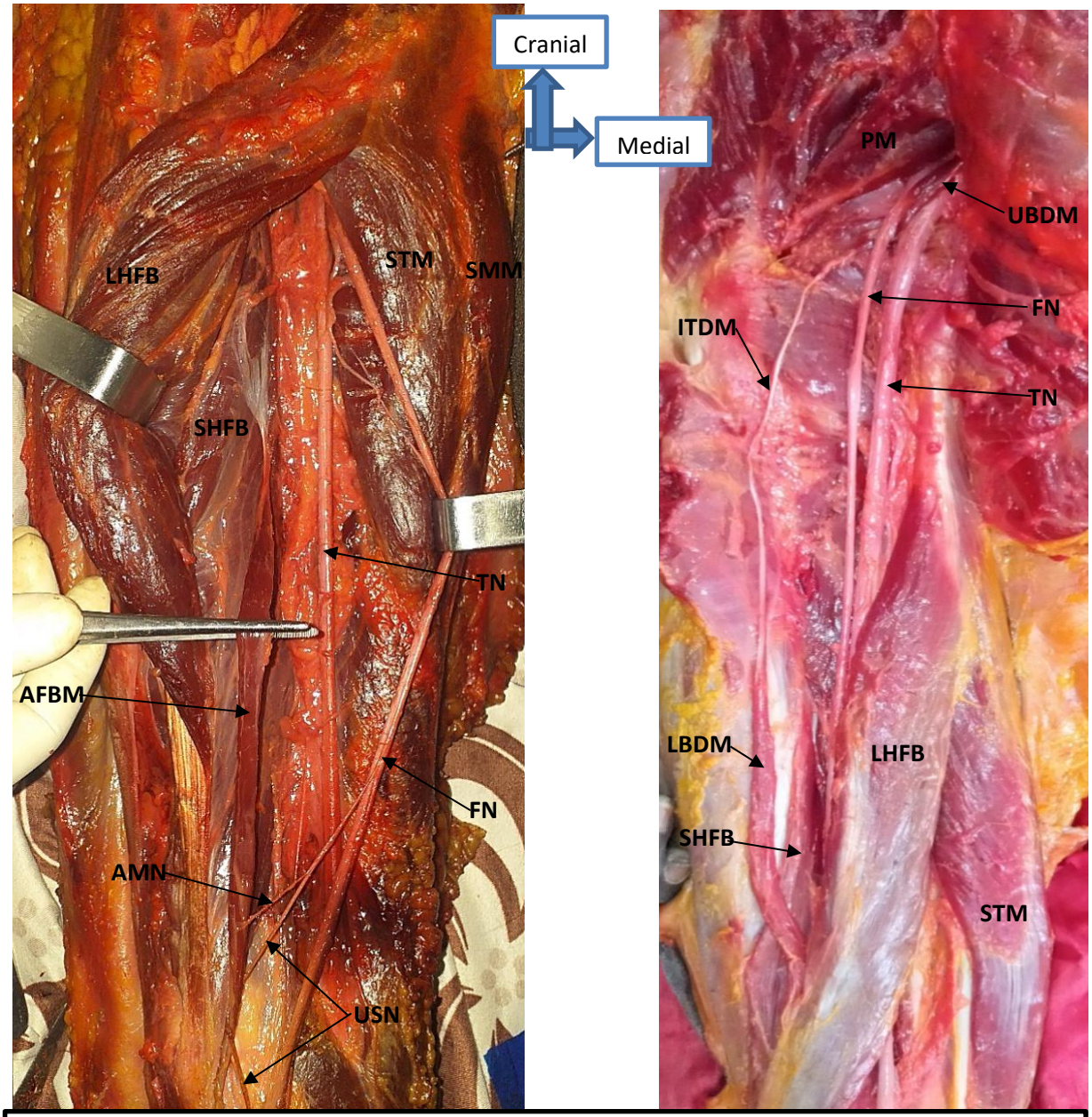

Figure 1: Presence of an accessory femoral biceps muscle (a), presence of an aberrant digastric muscle in the gluteal region and the posterior compartment of the thigh (b)

AFBM=Accessory femoral biceps muscle, AMN=Accessory muscle nerve, FN=Fibular nerve, ITDM=Intermediate tendon of digastric muscle, LBDM=Lower belly of digastric muscle, LHFB=Long head of femoral biceps, PM= piriformis muscle, SHFB=Short head of femoral biceps, SMM=Semi-membranous muscle, STM=Semi-tendinous muscle, ST=Tibial nerve, UBFB=Upper belly of femoral biceps, USN=Unusual sensory nerve

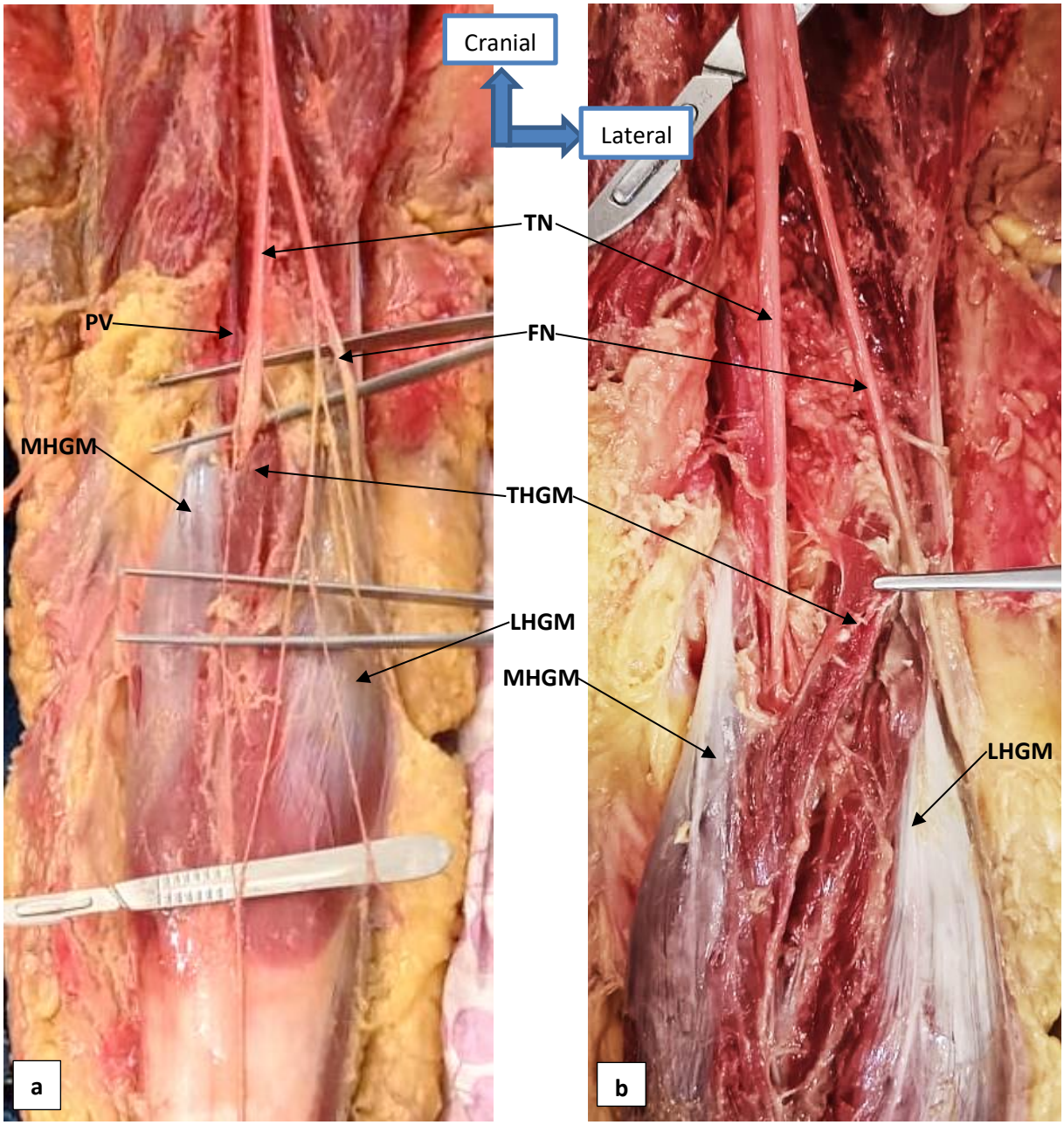

Figure 2: Presence of third head of the gastrocnemius muscle

FN=Fibular nerve, LHGM=Lateral head of gastrocnemius muscle, MHGM=Medial head of gastrocnemius muscle, PV=Popliteal vein, TN=Tibial nerve

DISCUSSION

Variation within the hamstring muscles is rare (Hoban et al, 2019). In the literature, a few cases of muscle bundle or muscle slippage originating from the long head of the femoral biceps muscle have been reported. Sinav et al (1995) reported two types of accessory muscle bundles originating from the long head of the femoral biceps muscle; one was bilateral, originated from the lower part of the long head of the femoral biceps and passed deep into the fascia of the popliteal fossa to be inserted into the fascia of the leg; the other, which was seen only on the right side, started from the upper part of the long head of the biceps and entered the semi-tendon muscle. Bang et al (2015) reported a similar muscle bundle between

the long head of the femoral biceps and the semi-tendon. In their report, the muscle bundle originated from the long head of the femoral biceps and fused with the semi-tendon. Cetkin et al (2017) reported a case of an aberrant muscle bundle that originated from the long head of the femoral biceps and fused with the semi-tendon. Hoban et al (2019) found a variant of muscle slip in the hamstring region on both sides in a cadaver. Muscle fibers ran from the long head of the femoral biceps to the semi-tendon at mid-thigh. Arakawa et al (2017) reported a case of multiple muscle variations. Among these muscular variations, a muscle started from the long head of the femoral biceps to merge with the semi-tendon muscle. Chakravarthi (2013) reported a case in which, an abnormal muscle and a third head of the femoral biceps were inserted into the semi-tendon, and the long and short, non-united heads of the femoral biceps were inserted on the head of the fibula. According to the latter author, a muscle slip could alter the biomechanics of the muscle. In one of our 4 cases, there was an accessory femoral biceps muscle which originated on the fascia of the short head of the femoral biceps and ended on the head of the fibula joining the common tendon formed by the long and short heads of the biceps femoral. To our knowledge, such anatomical variation has not been noted in English and French literature.

According to Akita et al (1992), among the aberrant muscles of the posterior compartment of the thigh, several variants of the digastric muscle have been reported (Moore, 1922; Stevenson, 1922; Seelaus, 1927; Niizima, 1937; Suda and Takahashi, 1958; Akita et al, 1992). Stevenson (1922), Seelaus (1927), Niizima (1937), Suda and Takahashi (1958) have suggested that the upper belly is formed from the piriformis, the lower belly from an aberrant bundle of the femoral biceps, and that both bellies are united by a tendon. Akita et al (1992), in their case, found that the upper belly originated from the sacrotuberal ligament. In one of the cases present, we observed an aberrant digastric muscle in the gluteal region and the posterior compartment of the thigh. The upper belly originated from the piriformis muscle (it was considered an accessory piriformis muscle), the lower belly inserted down into the femoral biceps muscle (it was considered a third head of the femoral biceps), and the two bellies muscles were connected by a long intermediate tendon.

Green (1931) proposed that the tenuissimus and femorococcygeus could be considered to represent the aberrant muscle in this region. Akita et al (1992) believe that the tenuissimus and femorococcygeus in humans are phylogenetic remnants of the division of iliofibularis in reptiles into the gluteus maximus and the short head of the femoral biceps. These latter authors, in their case report, pointed out that the aberrant muscle although having two bellies may be homologous to the femorococcygeus.

These muscle variations in the posterior thigh compartment are important to know by radiologists to accurately diagnose muscle ruptures in the posterior thigh compartment and by surgeons who must intervene to repair these muscle ruptures.

The presence of a third head of the gastrocnemius muscle is the most common variation of the gastrocnemius muscle, also described as gastrocnemius tertius (Bergamn et al, 1995). In a study of gastrocnemius in the Nigerian population, Ashaolu et al (2014) give an incidence of 13.3% for three-headed gastrocnemius. Ashok et al (2016) in a study on soleus muscle reported a case of three gastrocnemius heads with an accessory soleus head. Ashok et al (2017), in their study of gastrocnemius muscle from the perspective of entrapment syndromes, found that the incidence of a third gastrocnemius muscle head was 6.66%. They observed it in 4 cases including 2 bilateral cases. Koplas et al

(2009), in their prospective study of 1039 consecutive magnetic resonance muscle examinations of the knee, found in 20 cases (1.9%) a third head of gastrocnemius which was seen to originate near the midline of the posterior aspect of the distal end of the femur and joined the medial aspect of the lateral head of the gastrocnemius; in 1 additional case of a third head of the gastrocnemius, they observed that the latter joined the medial head of the gastrocnemius. Yildirim et al (2011) reported a case of bilateral gastrocnemius tertius with unilateral accessory soleus head. Among the cases present, we observed bilaterally a third head of the gastrocnemius muscle which originated on the popliteal surface of the distal end of the femur and passed laterally and behind the tibial nerve and popliteal vessels before joining the medial head of the gastrocnemius.

The presence of a third head of the gastrocnemius may be a potential problem for the structures of the popliteal fossa as illustrated by Frey (1919), as well as Tochihara and Onozawa (1932). The third head joining the medial head of the gastrocnemius is most often cited as the cause of entrapment syndromes. Decreased pulse of the distal arteries on passive dorsiflexion suggests entrapment of the popliteal artery, while pain and tenderness in the popliteal fossa indicate nerve compression in the popliteal fossa (Yildirim, 2011).

Popliteal entrapment syndrome was first reported by Anderson Stuart. Unilateral calf pain in a young athletic patient is a symptom seen in popliteal artery entrapment syndrome. The accessory bundle of the medial gastrocnemius compressing the artery into the popliteal fossa is the most common cause. Artery stenosis and early atherosclerotic changes can be seen in chronic cases. Surgery to relieve the compression is considered. The popliteal artery is surgically decompressed by myotomy. This is followed by embolectomy and prophylactic fasciotomies (Gokkus et al, 2014).

The presence of a third head of the gastrocnemius can be explained by embryological development. The gastrocnemius muscle originates embryologically from the calcaneal blastomere and then migrates upwards, ascending to the lower epiphysis of the femur. Before its termination on the femur, it divides into medial and lateral heads. Any variation in the pattern of migration and embryonic termination can lead to variation in the number of heads and attachments (Ashaolu et al, 2014).

CONCLUSION:

The anatomical variations of the hamstring muscles are rare and their knowledge is needed by radiologists and surgeons. The most common cause of popliteal artery entrapment syndrome is the presence of a third head of the gastrocnemius muscle. If popliteal artery entrapment syndrome is suspected, MRI should be performed to look for variation in the gastrocnemius muscle.

REFERENCES

1. Akita K, Sakamoto H, Sato T. 1992. Innervation of an aberrant digastric muscle in the posterior thigh: stratified relationships between branches of the inferior gluteal nerve. J Anat, 181:503–506.
2. Arakawa T, Kondo T, Tsutsumi M, Watanabe Y, Terashima T, Miki A. 2017. Multiple muscular variations including tenuissimus and tensor fasciae suralis muscles in the posterior thigh of a human case. Anat Sci Int, 92:581–584.
3. Ashaolu J, Oni-Orisan, Ukwenya V, Alamu, Adeyemi D. 2014. Variability of the morphology of gastrocnemius muscle in an African Population. Anatomy Journal of Africa, 3 (3): 400-404.

4. Ashok SA, Patel DK, Bharambe VK. 2016. A study of soleus muscle – clinical and embryological consideration. International Journal Of Biomedical And Advance Research, 7(12):608-611.
5. Ashok SA, Patel DK, Bharambe VK. 2017. A cadaveric study of Gastrocnemius muscle from point of view of entrapment syndromes. Indian Journal of Clinical Anatomy and Physiology, 4(4):407-411.
6. Bang JH, Gil YC, Yang HJ, Lee JH et al. 2015. Multiple muscular variations in the neck, upper extremity, and lower extremity biased toward the left side of a single cadaver. J Korean Med Sci, 30(4):502-505.
7. Bergman RA, Walker CW & El-Khour GY. 1995. The third head of gastrocnemius in CT images. Ann. Anat, 177(3):291-4.
8. Cetkin M, Yoruk MD, Golpinar M, Dinc M, Pi-Nar Y. 2017. An anomalous muscular bundle connecting biceps femoris to semitendinosus. *MOJ Anat Physiol*, 4(3): 00137.
9. Chakravarthi KK. 2013. Unusual unilateral multiple muscular variations of back of thigh. Ann Med Health Sci Res, 3(1):1-2.
10. Frey H. 1919. Musculus gastrocnemius tertius Gegenbaurs Morphol Jahrb, 50:517-30.
11. Green HL. 1931. The occurrence of a tenuissimus muscle in a human adult. J Anat, 65:266- 271.
12. Gokkus K, Sagtas E, Bakalim T, Taskaya E, Aydin AT. 2014. Popliteal entrapment syndrome. A systematic review of the literature and case presentation. Muscles Ligaments Tendons J, 4(2):141–148.
13. Hoban KJ, Holcomb KJ, Holst G, Ibezim KO, Sakthi-Velavan S. 2019. Bilateral variant hamstring musculature with unilateral variant sciatic nerve. Eur. J. Anat, 23(3):227-232.
14. Koplas MC, Grooff P, Piraino D, Recht M. 2009. Third head of the gastrocnemius: an MR imaging study based on 1039 consecutive knee examinations. *Skeletal Radiol, 38(4)*:349-54.
15. MOORE AT. 1922. An anomalous connection of the piriformis and biceps femoris muscles. Anat Rec, 23:307–309.
16. NIIZIMA M. 1937. Ein Fall von iiberzahligem Kopf des M. biceps femoris beim Menschen. Okajiimas' Folia Anatomica Japonica, 16:187–192.
17. SEELAUS HK. 1927. On certain muscle anomalies of the lower extremity. Anat Rec, 35:185–191.
18. SINAV A, GÜMÜŞALAN Y, ARIFOĞLU Y, ONDEROĞLU S. 1995. Accessory muscular bundles arising from biceps femoris muscle. Kaibogaku Zasshi, 70(3):245-247.
19. STEVENSON PH. 1922. On an anomalous digastric muscle in the thigh of a Chinese. Anat Rec, 23:281–290.
20. SUDA M, TAKAHASHI A. 1958. A Rare case of an anomalous digastric muscle in the thigh. Sapporo Med J, 14:134–137.
21. TOCHIHARA J, ONOZAWA TM. 1932. Gastrocnemius tertius in Japanese. Jpn J Anat, 5:589-600.
22. YILDIRIM FB, SARIKCIOGLU L, NAKAJIMA K. 2011. The co-existence of the gastrocnemius tertius and accessory soleus muscles. J Korean Med Sci, 26(10): 1378–1381.