Eur. J. Anat. 24 (4): 289-291(2020)

Case report on the cadaveric discovery of a unilaterally absent medial head of the gastrocnemius

Nicole Fontenot[1], Jonathan Kouts[1], Jason Bourke[2]

[1]Class of 2022. New York Institute of Technology College of Osteopathic Medicine at A-State, USA
[2]Department of Basic Sciences. New York Institute of Technology College of Osteopathic Medicine at A-State, USA

SUMMARY

We report on a unique instance of anatomical variation in the gastrocnemius muscle. A 91-year-old Caucasian male cadaver was found to have a missing medial head of his left gastrocnemius. A layer of fibrous, fatty infiltration occupied the anatomical location of the missing musculature. Dissection revealed no evidence of atrophy as a result of damage to nervous tissue, blood supply or muscle tissue death. There was no evidence of sarcopenia. No hypertrophy of the left-side-lateral head was documented when compared to the contralateral lower leg. There were no reports of a known defect in the musculature in the patient's medical history. Upon superficial inspection, the extensive amount of body fat on the cadaver hid any signs of an external deformity on the leg prior to dissection. We suspect that the missing medial head was compensated for via reliance on more motor unit recruitment from the underlying soleus, as well as potential behavioural adjustments of the patient.

Key words: Gastrocnemius – Medial gastrocnemius – Lateral gastrocnemius – Muscle atrophy

INTRODUCTION

Anatomical variations of the superficial posterior compartment of the lower leg musculature are rarely documented (Le Double, 1897). Among the few variations reported are the congenital absence of the entire superficial compartment (Tibrewal et al., 2014), including forms of muscular dystrophy such as Miyoshi Myopathy, a benign calf amyotrophy of the medial head of the gastrocnemius bilaterally and unilaterally (Felice et al., 2003), and bilateral equinus with atrophy and fatty fibrous infiltrate of the medial head of the gastrocnemius (Hagy and Cross, 2006).

CASE REPORT

A 91-year-old Caucasian male cadaver was the subject of a dissection of the lower extremity during the gross anatomy course at NYITCOM. The donor was 64 inches tall, weighed 225 lbs., and had a BMI of 38.6. The donor had substantial muscle mass covered in considerable adipose tissue throughout his entire body. The donor had a fifteen -year history of arthritis that did not appear to correlate with the abnormality stated above nor with the cause of death.

Dissection was performed bilaterally following well-established protocols. During the dissection of the leg, a unilateral absence of the medial head of the left gastrocnemius was observed (Fig. 1). Fatty, fibrous infiltration was found sheathed under the superior extension of the calcaneal tendon taking the place of the normal anatomical location of the medial head of the gastrocnemius (Fig. 1). The densely fibrous, fatty tissue was different in composition from the surrounding and contralateral adipose tissue, making it difficult to cut through, and containing bands and strings of very strong fibres that made dissection of nerves and vascula-

Corresponding author: Jason Bourke. Basic Sciences, NYITCOM at A-State, 144E Wilson Hall. Arkansas State University Jonesboro, AR 72467 USA.
E-mail: jbourke@nyit.edu

Submitted: 10 August, 2019 *Accepted:* 19 April, 2020.

ture extremely difficult. The aponeurosis containing fatty tissue connected just superior to the medial condyle of the distal femur with no muscle fibres observed near the attachment site, nor any signs of a residual muscle belly within the area that would normally contain the medial gastrocnemius (Fig. 1). The lateral head of the gastrocnemius had a normal proximal attachment just superior to the lateral condyle of the femur (Fig. 1). No medial head branch of the tibial nerve was observed during dissection. However, due to the discovery of this rare anatomical variant during a time sensitive gross anatomy lab, a more in-depth evaluation of the anatomy could not be completed, and the return of the individual to the body donor programme prevented further analysis of the structures.

COMMENTS

Reviewing the aetiology of gastrocnemius variation, we found few instances of medial gastrocnemius absence in the literature. The most relevant case was an instance of unilateral agenesis of the medial head of the gastrocnemius along with the plantaris in a 58-year-old male (Alvarez et al., 2017). In their report, the authors noted a unique insertion pattern to the lateral head of the gastrocnemius. Further, the location for the medial head showed no evidence of muscular slips, nor any aponeurosis along the entire length of the calf. In their case, the gastrocnemius was present solely on the lateral side of the left leg. In contrast, our cadaver revealed a typical insertion pattern to the lateral head of the gastrocnemius and a covering of the medial head attachment site with a tendinous sheet. This could suggest that the medial head was lost later in the life of the donor, as opposed to agenesis. Medial head loss from atrophy can arise from trauma or entrapment of the gastrocnemius branch of the tibial nerve, causing atrophy to the affected muscle head (DiRisio et al., 1994). Isolated sarcopenia, vascular restriction, or nervous restriction can also result in a similar presentation (Tibrewal et al., 2014). The medical history of the donor revealed no trauma associated with damage of the muscle, tibial nerve, or the vasculature supplying the muscle. There were no surgeries included in the donor's history that could have contributed to denervation, devascularization, or atrophy of the muscle. Infiltration of adipose tissue is commonly seen in cases of skeletal muscle atrophy (Dulor et al., 1998). However, no evidence of a residual medial gastrocnemius muscle belly was observed during the course of the dissection. Further, muscle size and tone appeared normal throughout the rest of the body. Similar observations of normal muscle tone were observed by Alvarez et al. (2017).

No visible difference was observed between the appearance of the right and left leg prior to skinning and fat removal. There were no appreciable differences in the sizes of the existing musculature, including the plantaris and soleus when comparing right vs. left. We observed no evidence of hypertrophy of the existing left lateral head of the gastrocnemius as compensation for the missing medial head. Neither was there noted hypertrophy

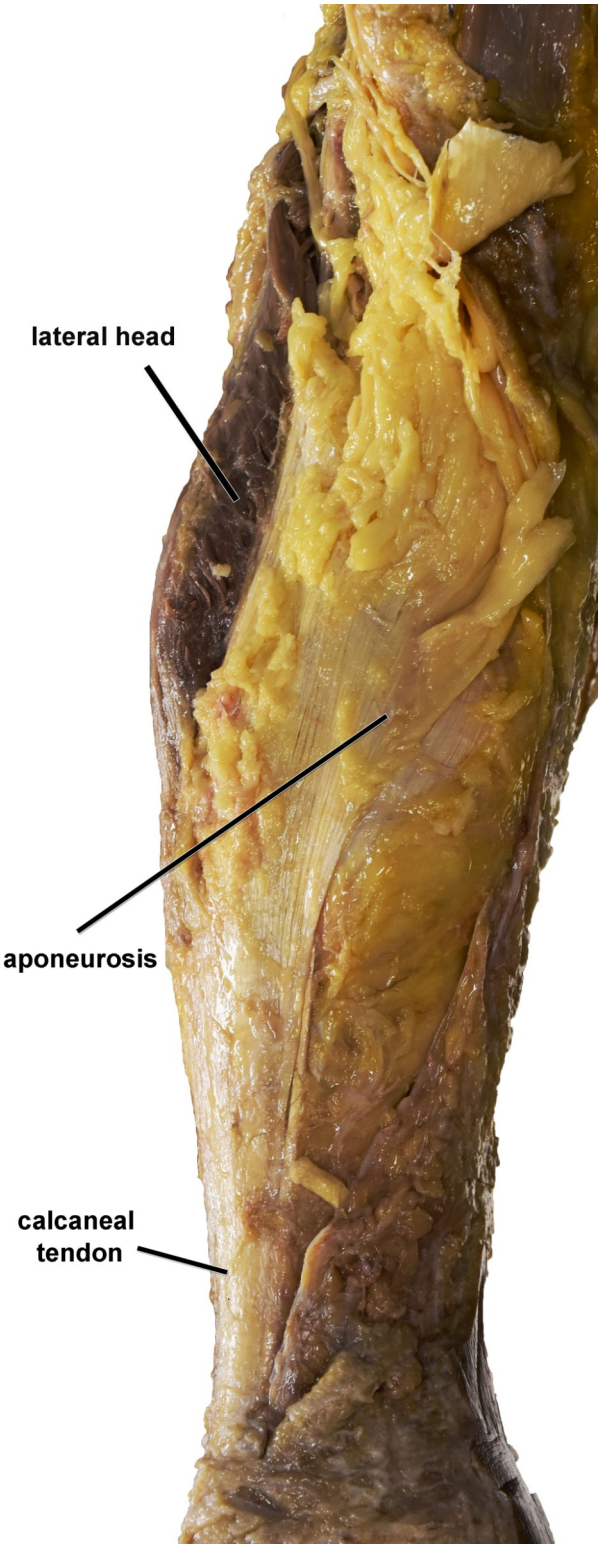

Fig 1. Medial view of leg showing an extensive, flat aponeurosis leading to the calcaneal tendon. Lateral head of gastrocnemius can be observed in background.

of the left hamstring muscles: semitendinosus, semimembranosus, and biceps femoris when compared to the right. The lack of a medial head could potentially impede extended periods of plantar flexion, such as during long spans of time spent standing. This could be offset by more motor unit recruitment from the soleus. Behavioural adjustments could have further compensated for the lack of a medial head of the gastrocnemius by placing more bodyweight over the opposite leg during extended standing phases. Unfortunately, without more knowledge of the donor's history, it is impossible to confirm these compensatory behaviours. Variation within the human body tends to be the rule rather than the exception. Whereas adaptations are commonly seen in vascular and nervous structures, variation within the musculoskeletal system is less common. Reports of congenital absence in muscles are very rare, occurring in 1:11,000 cases (Tibrewal et al., 2014).

Anomalies to muscles of the lower extremities can impair locomotor function and aesthetics. However, partial muscle loss or dysfunction can be compensated for via adjustments from other muscles, as well as changes in behaviour that can reduce muscle recruitment in that region, which may result in the missing / dysfunctional muscle going unnoticed by the individual affected. It is unknown if the donor had knowledge of his asymmetric calf muscles during his life. The restricted window of time available to study this unique anatomy limited our testing to gross comparisons of the right and left sides. The exact cause for this anatomical variation remains unknown, and additional tests, including histological sampling, would be needed to determine possible pathologies that could lead to agenesis, complete atrophy, and fatty infiltration of the muscle.

ACKNOWLEDGEMENTS

We would like to thank the donor for the selfless gift of their remains to further the education of future physicians. We would also like to thanks B. Dalley for their consultation on the case, NYIT-COM at A- State faculty and lab staff, along with OMS-I Anatomy lab members: S. Young, H. Rennie, J. Sanz, L. Ferdman, D. Cox, A. Hendricks and D. Nguyen.

REFERENCES

ALVAREZ MF, BUENO CA, BALLESTEROS LE (2017) Agenesis of the medial gastrocnemius and plantar muscle. Case presentation. Int J Morphol, 35(1): 34-36.

DETTON AJ (2017) Grant's Dissector. 16th ed. Wolters Kluwers, New York, pp 202-210.

DIRISIO D, LAZARO R, POPP A (1994) Nerve entrapment and calf atrophy caused by a Baker's cyst: Case report. Neurosurgery, 35(2): 333-334.

DULOR J-P, CAMBON B, VIGNERON P, REYNE Y, NOUGUES J, CASTEILIA L, BACOU F (1998) Expression of specific white adipose tissue genes in denervation-induced skeletal muscle fatty degeneration. FEBS Lett, 439: 1873-3468.

FELICE KJ, WHITAKER CH, GRUNNET ML (2003) Benign calf amyotrophy: Clinicopathologic study of 8 patients. Arch Neurol, 60(10): 1415-1420.

GORGEY A, DUDLEY GA (2007) Skeletal muscle atrophy and increased intramuscular fat after incomplete spinal cord injury. Spinal Cord, 45: 304-309.

HAGY ML, CROSS MJ (2006) Neurogenic atrophy of the medial head of the gastrocnemius presenting in a toe walker: A case report. Iowa Orthop J, 26: 119-121.

LE DOUBLE AF (1897) Traité des variations du système musculaire de l'homme. Vol. 2. Schleicher Frères, Paris, pp 303-310.

TIBREWAL S, ALYAS F, VEMULAPALLI K (2014) Congenital absence of superficial posterior compartment calf muscles. J Orthop Traumatol, 15(2): 137-139.