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An uncommon anatomic variation of the sartorius muscle in a domestic dog (*Canis lupus familiaris*)

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ABSTRACT. The sartorius muscle is located in the pelvic limb of the dog and is divided into a cranial and caudal part. There is no report describing of the three parts of the sartorius muscle. The aim of the present report was to describe the presence of a third part of the sartorius muscle in a dog. Although it does not represent a malformation, it is an important anatomical variation to consider for didactic purposes of dissection and in surgeries of the pelvic limb, as in this case there is a need to move the muscles apart to maintain their integrity. Furthermore, this anatomical description is relevant for comparative purposes in this animal species.

Keywords: pelvic limb; miology; anatomic variation; animal anatomy; dog.

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Introduction

The sartorius muscle of the domestic dog is located in the pelvic limb in the medial femoral region, anatomically structuring the pelvic girdle, in which it is accessed in ventral view It is a skeletal striated muscle, has a long, flat shape, and extends into two strip-like cords approximately 3 to 4 cm wide each, that are found on the cranial and craniomedial sides of dog's thigh, extending from the ilium to the tibia. The cranial portion forms the cranial contour of the thigh and measures approximately 1 cm in width, while the caudal portion is located on the medial aspect of the thigh (Evans & Lahunta, 2013; Liebich, König, & Maierl, 2021).

The skeletal striated muscle, which coordinates voluntary movements, is made of a muscular "mass" formed by muscular fibers with thousands of myofibrils originated in the embryo by the fusion of myoblasts, which are elongated cells. An animal's body movement results from the contraction of the skeletal muscle alongside a mobile joint (Armstrong, Saubert, Seeherman, & Taylor, 1982; Klein, 2013; Maierl, Weissengruber, Peham, & König, 2021).

According to Evans and Lahunta (2013) in the dissection of the dog's pelvic limb, a remarkable quadrangular process called the tibial tuberosity can be seen in the proximocranial aspect of the tibia. Through the patella and patellar ligament, the quadriceps femoris, biceps femoris and sartorius muscles attach themselves to this tuberosity.

The sartorius muscle, one of the thigh muscles, has the function of flexing the coxal and fermoropatellar joints, also collaborating with knee extension. This muscle is divided into a cranial part, which originates from the iliac crest and ventro-cranial portion of the iliac wings. It runs through the medial aspect of the thigh and inserts onto the medial femoral fascia, below the patella. The caudal part originates from the ventral margin of the ilium, runs through the medial aspect of the vastus medialis muscle, and inserts onto the cranial margin of the tibia via an aponeurosis (Budras et al., 2007; Tudury et al., 2011; Evans & Lahunta, 2013; Liebich et al., 2021). It is very common to find anatomical variations of muscles in mammals, such as additional bundles or bellies as well as unusual insertions or even total absence of muscle (Alić et al., 2014).

The case report presented here shows an important anatomical variation in the sartorius muscle to be considered for teaching purposes of dissection in Animal Anatomy classes, mainly in Veterinary Medicine courses, as well as in surgeries of the pelvic limb, because in this case there is a need to muscle spacing

to maintain its integrity. Furthermore, it has relevance for physical therapy, as stress injuries belonging to the canine hip have been reported in several muscles, including the sartorius (Edge-Hughes, 2007).

The anatomical variation presented here in a male adult non-defined-breed dog (*Canis lupus familiaris*), used as educational material for veterinary students. The cadaver had been fixated in an aqueous formalin solution at 10% and sent to dissection for educational purposes. During this process, the presence of an uncommon anatomic variation of the sartorius muscle was noticed. The students were instructed by the teachers to proceed with the dissection. The anatomical variation of the dog's sartorius muscle was then photographed and we describe it in this case report.

Results of case report

An accessory head in the Sartorius muscle was observed Three portions were found in the sartorius muscle: the additional one was named "accessory part" and was located in the middle part between the cranial (*pars cranialis*) and caudal parts (*pars caudalis*) of the sartorius muscle and observed that it was not a division of the cranial part and the variation was observed bilaterally (Figure 1).

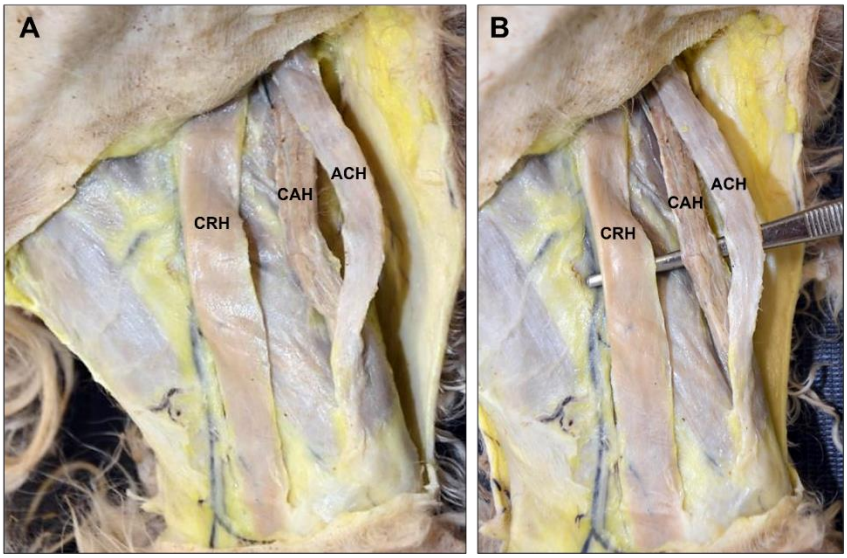

Figure 1. A) Medial view of the left pelvic limb of a dog with anatomical variation of the sartorius muscle. (CRH) caudal part, (CAH) cranial part and (ACH) accessory part. B) The same region photographed with anatomical tweezers inserted to highlight the three parts.

Discussion

Anatomical variations in the musculature of several animal species and body regions have been reported, such as the neck of the dog (Alić et al., 2014), the forearm of the *Cerdocyon thous*, crab-eating fox, with inter and intraspecific variations in the ulnar head of the flexor carpi ulnaris and vestigial presence of the anechoic epitrochlear muscle (Veléz-Garcia, Patiño-Holguín, & Duque-Parra, 2018) and pectoral muscle of primates - *Pan troglodytes*, *Pan paniscus* and *Homo sapiens* - with a high degree of anatomical variations (Potau et al., 2018).

Functional studies involving cats' sartorius muscle were developed (Loeb, Pratt, Chanaud, & Richmond, 1987; Pratt & Loeb, 1991), especially to evaluate the muscle separation in cranial and caudal parts. In dogs, functional studies explain this muscle (Tokuriki, 1973ab; Tokuriki 1974; Wentink, 1976; Goslow, Seeherman, Taylor, McCutchin, & Heglund, 1981; Armstrong et al., 1982). However, even these functional studies did not report macroscopic findings of an accessory head of the sartorius muscle. Thus, reports of variations are important records for the veterinary literature.

In humans, the sartorius muscle presents a single head (Paulsen & Waschke, 2013). However, Garbelotti, Rodrigues, Nobeschi, Seiji, and Olave (1999) described a case of anatomical variation in a black male adult, whose muscle had two heads in the left lower limb. The authors hypothesized that this anatomical variation could be considered a state of involutive persistence and an atrophied vestige of a muscular fasciculus, since mammals that are evolutionarily inferior to humans generally possess it. Moreover, it was also stated that it could be related to an embryonic malformation or possible anatomical variation. Melling and Zweymuller

(1996) described the presence of a distal division of the sartorius muscle during the dissection of anatomical human parts, and this atypical part of the muscle moved anteriorly.

The third head of the sartorius muscle found in the dog during the dissection described in our report apparently does not represent any impairment to the movement of the pelvic limb of animals or some abnormal pathological state. It is most likely some involutive persistence or, as mentioned in the work by Garbelotti et al. (1999), a malformation or anatomical variation.

Conclusion

For Veterinary Anatomy, the study of parts of animals of various species is fundamental, since anatomical differences can be detected macroscopically. The muscle parts described in this case report apparently do not represent a malformation, but an anatomical variation, as it was identified bilaterally with each part well defined in terms of origin and insertion. Since the material studied was cadaveric, we concluded that further studies with images and biomechanical tests of the canine musculature are needed, in order to be able to state that an accessory part of the sartorius muscle would be advantageous in moving the pelvic limb.

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