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A macroanatomical study on the hind leg muscles and tendons of the Caucasian lynx

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ABSTRACT

Objectives: The Caucasian lynx (Lynx lynx dinniki) is a significant wild felid species in Türkiye. This study aims to provide a detailed macroanatomical description of the pelvic limb muscles and tendons of the Caucasian lynx to contribute to the comparative anatomy of felids and wildlife medicine.

Materials and Methods: In this study, three adult female Caucasian lynx (weighing 6.9 kg, 7.6 kg, and 8.3 kg), which died due to a traffic accident, were used. The muscles of the regio femoris, regio cruris, and regio pedis were dissected individually. The origins, insertions, and morphological characteristics of the muscles were recorded and photographed.

Results: It was observed that the m. gluteus medius was the largest among the gluteal muscles. The m. sartorius appeared as a single unit, similar to felines, visible as a thin band laterally and flattened medially. In the regio cruris, the m. soleus was well-developed and joined the tendo calcaneus communis. M. biceps femoris was found to have two heads (pelvic and vertebral), unlike the single-headed structure reported in some other lynx studies.

Conclusions: The muscular anatomy of the Caucasian lynx hind limb shows similarity to the domestic cat but possesses distinct robust features, such as thicker tendons and a two-headed m. biceps femoris, adapted for its predatory lifestyle in rugged habitats.

Keywords: *Anatomy, Caucasian lynx, Hind limb, Muscle, Tendon*

INTRODUCTION

The Eurasian lynx (Lynx lynx) is one of the most widely distributed wild felids, with several subspecies recognized across its range. Among these, the Caucasian lynx (Lynx lynx dinniki) holds a critical ecological position in the Caucasus region and the North-Eastern Anatolian part of Türkiye (Hunter, 2015). Despite being a top predator and a flagship species for wildlife conservation in these regions, the Caucasian lynx is currently facing threats from habitat fragmentation, illegal hunting, and vehicle collisions (Nowell and Jackson, 1996; Kaczensky, 2018). Consequently, understanding its biological and anatomical characteristics is of paramount importance for both conservation efforts and veterinary clinical medicine.

In veterinary medicine, particularly in the field of wildlife rehabilitation, detailed knowledge of musculoskeletal anatomy is essential. Hind limb injuries, such as fractures and soft tissue traumas resulting from traffic accidents, are frequently encountered in wild felids (Sebastiani and Fishbeck, 2005). Successful surgical intervention and subsequent rehabilitation of these animals depend on a precise understanding of the origins, insertions, and functional roles of the pelvic limb muscles. While the gross anatomy of the domestic

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cat (Felis catus) is well-documented and often used as a reference (Hudson and Hamilton, 2017; König and Liebich, 2020), there is a significant gap in the literature regarding the specific macroanatomical adaptations of the Caucasian lynx.

The locomotor system of the lynx is highly specialized for its unique environmental requirements. The hind limbs are notably longer and more powerful than the forelimbs, an adaptation that provides the explosive power needed for jumping and ambushing prey in rugged, snowy terrains (Hansen, 2007). Examining the muscular and tendinous architecture of the regio femoris, regio cruris, and regio pedis in this subspecies can provide valuable insights into its evolutionary biomechanics and help differentiate it from other felids (Sacks and Roy, 1982).

Previous studies have largely focused on the osteology and external morphology of lynx species. However, comprehensive studies on the soft tissue, particularly the myology of the pelvic limb in the Lynx lynx dinniki subspecies, remain scarce. Therefore, this study aims to provide a detailed macroanatomical description of the muscles and tendons of the hind limb in a Caucasian lynx. By documenting these features, we aim to contribute to the comparative anatomy of the Felidae family and provide a foundational anatomical reference for clinicians and researchers working on wildlife medicine and morphology.

MATERIALS and METHODS

Animal material

Three adult female Caucasian lynx (Lynx lynx dinniki), which was brought to the Sivas Cumhuriyet University Faculty of Veterinary Medicine after died in a traffic accident, were used as the study material (cadaver I was 6.9 kg and cadaver II was 7.6 kg and cadaver III 8.3 kg in weight, respectively). Since the animal died of natural/accidental causes and was not killed for research purposes, it was treated in accordance with internationally accepted rules and codes of conduct. The study was conducted at the Anatomy Laboratory of the Department of Anatomy, Faculty of Veterinary Medicine, Sivas Cumhuriyet University.

Preparation and dissection

The cadavers were initially examined for external integrity, and then 10% formaldehyde solution were injected through the arteria carotis communis for fixation. After the fixation process, the cadavers were kept in a storage tank containing the same solution.

For the dissection of the hind limb muscles, the skin was carefully removed from the pelvic region down to the distal phalanges of the digits. The muscles and tendons were dissected layer by layer, from superficial to deep, using standard surgical instruments (scalpels, forceps, and dissection scissors).

Anatomical identification and documentation

The muscles were categorized into four main groups for systematic evaluation:

Musculi coxae (Muscles of the pelvic girdle), Musculi femoris (Muscles of the thigh), Musculi cruris (Muscles of the leg), Musculi pedis (Muscles of the foot).

The origin (origo), insertion (insertio), and morphological characteristics of each muscle were recorded. The formation of the tendo calcaneus communis and the distribution of the digital flexor tendons were specifically examined. During the dissection process, high-resolution photographs were taken at each stage using an iPhone 8 to document the findings.

Terminology

The anatomical nomenclature used in this study was based on the Nomina Anatomica Veterinaria (2017). Abbreviations for muscles followed the American Medical Association Manual of Style, ensuring they were defined at their first use in the text.

Ethical approval

This study was approved by the Sivas Cumhuriyet University Local Ethics Committee for Animal Experiments with decision number 65202830-050.04.04-127 dated 26.12.2025.

RESULTS

The macroanatomical findings of the hind limb muscles in the Caucasian lynx (Lynx lynx dinniki) were categorized into four main regions: pelvic girdle, thigh, leg, and pes.

M. gluteus medius: This was the largest and most developed muscle of the gluteal group. It originated from the gluteal surface of the ala ossis ili and inserted into the trochanter major (Figure 1).

M. gluteus superficialis: It was observed as a thin, triangular muscle layer covering the caudal part of the m. gluteus medius (Figure 1).

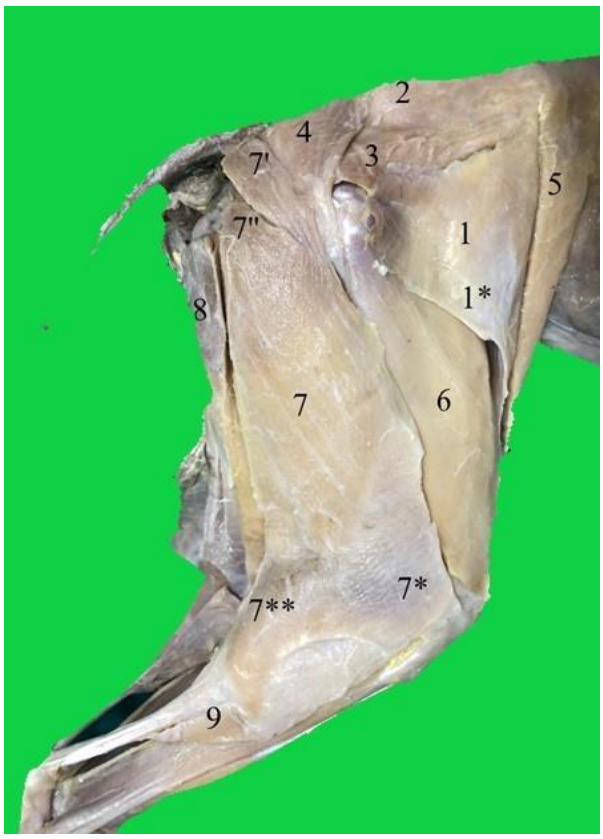


Figure 1. Muscles of the Gluteal Region and Thigh (Lateral View): * 1: M. tensor fasciae latae. 1*: Ventral apex of m. tensor fasciae latae. 2: M. gluteus medius. 3: M. gluteus profundus. 4: M. gluteus superficialis. 5: M. sartorius. 6: M. vastus lateralis. 7: M. biceps femoris. 7′: Vertebral head of m. biceps femoris. 7″: Pelvic head of m. biceps femoris. 7*: Aponeurosis of m. biceps femoris joining the fascia femoralis. 7**: Aponeurosis of m. biceps femoris joining the fascia cruralis and tendo calcaneus communis. 8: M. semitendinosus. 9: M. soleus.

M. gluteus profundus: Situated beneath the m. gluteus medius, it was observed to be shorter and more muscular (Figure 1).

M. Sartorius: The sartorius muscle, seen anterior to the femur, appears to be a single unit, similar to that in felines; it is visible as a thin band laterally, but has a more flattened appearance medially (Figure 1, 2).

M. quadriceps femoris: Composed of four heads: m. rectus femoris, m. vastus lateralis, m. vastus medialis, and m. vastus intermedius. The m. rectus femoris originated from the ilium, whereas the three heads originated from the proximal femur (Figure 1, 2).

M. abductor cruris caudalis: A long, ribbon-like muscle was identified under the m. biceps femoris (Figure 3).



Figure 2. Internal muscles of the pelvis.P: m. gluteus profundus, G: mm. gemelli İ: m. obturatorius internus, Pr: m. pyriformis, S: m. gluteus superficialis, M: m. gluteus medius, GF: m. gluteofemoralis (cut), BF: m. biceps femoris (cut), TFL: m. tensor fascia latae, Sar: m. sartorius, T: Trochanter major, TC: Tuber coxae, İs: Nervus ischiadicus.



Figure 3. Course of the musculus abductor cruris caudalis. A: m. abductor cruris caudalis, BF: Medial surface of the m. biceps femoris, İ: Nervus ischiadicus.

M. gastrocnemius: This muscle had two prominent heads (caput laterale and caput mediale). Each head contained a small sesamoid bone (fabella) near its origin on the supracondylar tuberosities of the femur (Figure 4, 5).

M. soleus: This muscle was clearly identified and was relatively well-developed, originating from the fibula and join the tendo calcaneus communis. Its presence is a significant differentiator from canids (Figure 1, 5).



Figure 4. Muscles of the Knee Joint. P: m. popliteus, T: Tibia, F: m. flexor digitorum profundus, G: m. gastrocnemius.

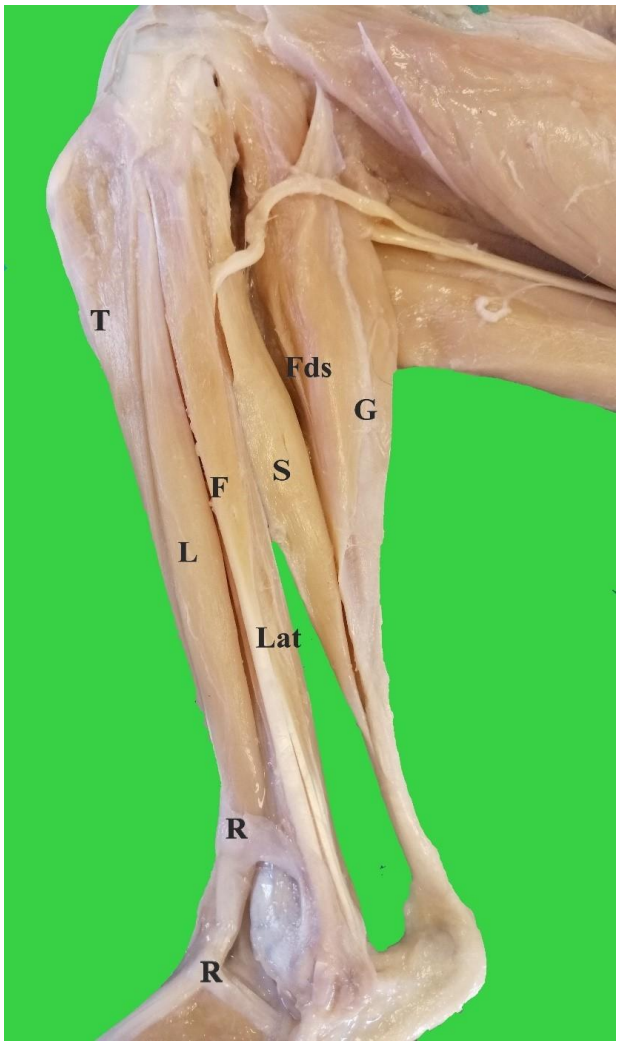


Figure 5. Muscles of the tarsal (hock) joint. T: m. tibialis cranialis, L: m. extensor digitorum longus, F: m. fibularis longus, Lat: m. extensor digitorum lateralis, S: m. soleus, Fds: m. flexor digitorum superficialis, G: m. gastrocnemius, R: Retinaculum

M. flexor digitorum superficialis: It was originated from the lateral supracondylar tuberosity and its tendon passed over the tuber calcanei to reach the digits (Figure 5).

M. tibialis cranialis: A strong muscle situated on the craniolateral aspect of the tibia, responsible for the flexion of the hock joint (Figure 5).

The tendo calcaneus communis (Achilles' tendon) was formed by the participation of the tendons from the m. gastrocnemius, m. soleus, m. biceps femoris, m. semitendinosus, and m. flexor digitorum superficialis.

In the regio pedis, the tendons of the m. flexor digitorum profundus were observed to split into four branches, inserting on the distal phalanges of digits II-V.

DISCUSSION

The macroanatomical architecture of the hind limb in the Caucasian lynx (Lynx lynx dinniki) exhibits significant specialized features that reflect its predatory lifestyle and environmental adaptations. While the general muscular arrangement shows similarities with the domestic cat (Felis catus), as described by Hudson and Hamilton (2017) and König and Liebich (2020), several distinct differences were observed, particularly in muscle volume and specific attachment points.

It has been reported that the gluteal muscles, responsible for hip joint extension, are only active during movement in domestic cats (Rassmussen et al. 1978). However, a study in Eurasian lynxes found that some hip and knee joint extensors were larger compared to domestic cats (Viranta et al. 2021). The study specifically noted that the gluteus profundus muscle showed positive allometry. In our study, we also found the gluteal muscles to be stronger compared to other cat species; however, since measurements were not taken during the study planning, it is difficult to prove an allometric situation as in the aforementioned study (Viranta et al. 2021). Nevertheless, in our study, the gluteus medius muscle was found to be particularly robust and stronger (Figure 1). This development is consistent with the findings of Sacks and Roy (1982), who stated that felines living in rugged terrain require a larger physiological cross-sectional area in the gluteal muscles for powerful jumping and climbing.

The sartorius muscle, seen anterior to the femur, appears to be a single unit, similar to that in felines; it is visible as a thin band laterally, but has a more

flattened appearance medially (Figure 1,2). This finding is consistent with observations in domestic cats (Sebastiani and Fishbeck, 2005).

In domestic cats, the soleus muscle originates from the proximal part of the fibula and contributes to the formation of the Achilles tendon by sharing a tendon with the gastrocnemius muscle (Sebastiani and Fishbeck, 2005). In tigers (Panthera tigris), the origin is the same, but it remains separate from the gastrocnemius tendon up to just proximal to the ankle joint, where it joins the calcaneus tendon (Dunn et al., 2025). However, it has been emphasized that in the Caucasian lynx, the attachment of the musculus soleus to the tendo calcaneus communis provides additional torque during plantar flexion, a finding consistent with studies on other wild cats such as the leopard and the Iberian lynx, and that this is a conserved feature among the Felinae subfamily to enhance locomotor stability (Hansen, 2007). In our study, it was determined that the musculus soleus originates from the proximal fibula, consistent with the literature, but unlike in tigers, it joins with the tendo calcanus, as in domestic cats, to form the tendo calcanus (Figure 5).

The biceps femoris muscle, which covers approximately three-quarters of the lateral aspect of the hind leg, originates from the tuber ischiadicum in cats (Sebastiani and Fishbeck, 2005). Unlike other domestic mammals, this muscle is not bicuspid (Sebastiani and Fishbeck, 2005). In domestic mammals other than cats, it consists of two heads: vertebral and pelvic (König and Liebich, 2020). A single-headed muscle has also been reported in the Eurasian lynx (Viranta et al., 2021). In our study, unlike in domestic cats, the biceps femoris muscle was found to have two heads, pelvic and vertebral (Figure 1). Furthermore, the vertebral head does not attach to the gluteal muscles as it does in ruminants (Figure 1).

In domestic cats, the biceps femoris muscle terminates by attaching to the proximal third of the tibia and the lateral aspect of the patella (Sebastiani and Fishbeck, 2005). A study on the Eurasian lynx reported that the tuberosity of the tibiae and tuberosity of the calcanei terminate by attachment to the lateral edge of the tibiae and via the fascia cruris and tendo calcanealis (Viranta et al. 2021). In our study, it was also observed that it attaches to the patella, the lateral side of the tibiae and tuberosity of the patella via the fascia cruris, and to the tendo calcaneus (Figure 1).

The origin and insertion of the tensor fascia latae muscle were determined to be similar to those in domestic cats (Figure 1).

In the Eurasian lynx, the origin of the gluteofemoral muscle is generally the second and third caudal vertebrae, and the insertion is in the fascia cruris (Viranta et al, 2021). In our study, the origin and insertion of this muscle were found to be similar to those of the Eurasian lynx (Figure 2).

The thickness of the tendons of the muscles involved in the formation of the calcaneus tendon in the Caucasian lynx was significantly greater than that reported in domestic cats. This can be explained by the fact that the lynx is larger and heavier than domestic cats. In addition, considering that lynxes roam in deep snow or rocky outcrops and need to have explosive power to ambush prey, the thickness of the tendon can also be considered an adaptation to these conditions (Hunter, 2015).

CONCLUSION

This study presents a comprehensive macroanatomical documentation of the hind limb muscle structure of the Caucasian lynx (Lynx lynx dinniki), based on the examination of three specimens. Our findings reveal that while the general muscle plan is consistent with feline anatomy, the Caucasian lynx exhibits specialized adaptations, such as a highly developed gluteus medius muscle and a robust calcaneus communis tendon, likely supporting its explosive movement needs in challenging environments. These detailed descriptions fill a significant gap in the literature concerning this particular subspecies. Clinically, the anatomical data presented here serve as a vital reference for wildlife veterinarians in the diagnosis and surgical treatment of musculoskeletal injuries. Furthermore, these results contribute to the field of comparative anatomy of the Lynx genus. Future studies of this kind, using not only macroscopic but also more quantitative, measurement-based data, will allow for the elucidation of differences with the domestic cat and the scientific elucidation of adaptation to wildlife. In conclusion, the muscular anatomy of the Caucasian lynx's hind limb is a sophisticated system designed for strength and precision. Besides providing new data for comparative anatomy, the findings of this study also serve as a practical guide for veterinary surgeons when performing reconstructive procedures on the hip limbs of injured wild lynxes.

REFERENCES

Dunn RH, Hotchner A, Gubatina A, et al. (2025). Muscular anatomy of the hindlimb of the tiger (Panthera tigris). Journal of Mammalian Evolution, 2025; 32(1), 4.

Hansen K. Bobcat: Master of survival. 1st ed. Oxford: Oxford University Press; 2007. pp.45-62.

Hudson L, Hamilton W. Atlas of feline anatomy for veterinarians. 2nd ed. Boca Raton: CRC Press; 2017. pp.183-214.

Hunter L. Wild cats of the world. 1st ed. London: Bloomsbury Publishing; 2015. pp.32-48.

ICVGAN. Nomina anatomica veterinaria. 6th ed. Ghent: Editorial Committee; 2017. pp.98-105.

Kaczensky P. IUCN Red list mapping for the regional assessment of the Eurasian lynx (Lynx lynx) in Europe. Supplementary information to von Arx (2018), Lynx lynx. Gland: IUCN; 2018.

König HE, Liebich HG. Veterinary anatomy of domestic animals: Textbook and colour atlas. 7th ed. Stuttgart: Georg Thieme Verlag; 2020. pp.256-294.

Nowell K, Jackson P. Wild cats: status survey and conservation action plan. 1st ed. Gland: IUCN; 1996. pp.1-48.

Rasmussen S, Chan AK, Goslow GEJr. The cat step cycle: Electromyographic patterns for hindlimb muscles during posture and unrestrained locomotion. J Morphol. 1978; 155(3): 253-269.

Sacks RD, Roy RR. Architecture of the hind limb muscles of cats: functional significance. J Morphol. 1982; 173(2):185-195.

Sebastiani A, Fishbeck DW. Mammalian anatomy: the cat. 2th ed. Colorado: Morton Publishing Company; 2005. Pp. 37-78

Viranta S, Holmala K, Laakkonen J. (2021). Unique hip and stifle extensor muscle patterns in the Eurasian lynx, Lynx lynx (Carnivora: Felidae). J Morphol, 2021; 282(4): 553-562.

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