

Case Report  
Wildlife Health and  
Conservation



# Successful treatment of gastrocnemius muscle rupture in a long-tailed goral rescued from a live trap: a case report

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## ABSTRACT

We describe a case of gastrocnemius muscle rupture in a goral that got caught in a live trap set up to capture wild boars. We established a diagnostic method based on clinical signs and imaging examination findings, including magnetic resonance imaging for gastrocnemius muscle rupture with symptoms such as hindlimb lameness and plantigrade posture of unknown cause in wild animals. Although this condition is rare, this report will help veterinarians diagnose several diseases of the musculoskeletal and nervous systems in wild animals. This is the first report of successful diagnosis and treatment of gastrocnemius muscle rupture in gorals in Korea.

**Keywords:** Gastrocnemius muscle rupture; long-tailed goral; magnetic resonance imaging; live trap; lameness

## INTRODUCTION

Gastrocnemius muscle rupture is one of the diseases of the locomotor system, especially in farm animals, and causes significant economic losses [1]. Gastrocnemius muscle rupture can be partial or complete and has been reported in humans, horses, cattle, camels, and llamas [1-5]. However, gastrocnemius muscle rupture in wild animals has not yet been well documented.

In this case, the goral was caught in a live trap to capture wild boars. Wild boar live traps are installed in several hazardous areas in Korea due to the risk of African swine fever (ASF) outbreak. In Korea, where the density of wild boar is high, live traps play a greater role as a density control method than other extermination methods to replace hunting activities [6]. However, as in this case, wild boars and other wild animals are highly likely to be captured. In addition, live traps can have some negative effects on the health and welfare of wild animals, including trauma, fear, pain, and stress response [7-10].

Herein, we describe a case of gastrocnemius muscle rupture in a goral that was caught in a live trap in Yanggu-gun, Gangwon-do, Korea. Gorals are listed as vulnerable species by the International Union for Conservation of Nature and Natural Resources (IUCN)

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JT; Funding acquisition: Kim JT; Investigation:

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administration: Kim JT; Software: Choi SY;

Supervision: Kim JT; Validation: Ahn S, Choi SY,

Kim JT; Visualization: Choi SY, Kim JT; Writing -

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**Conflict of Interest**

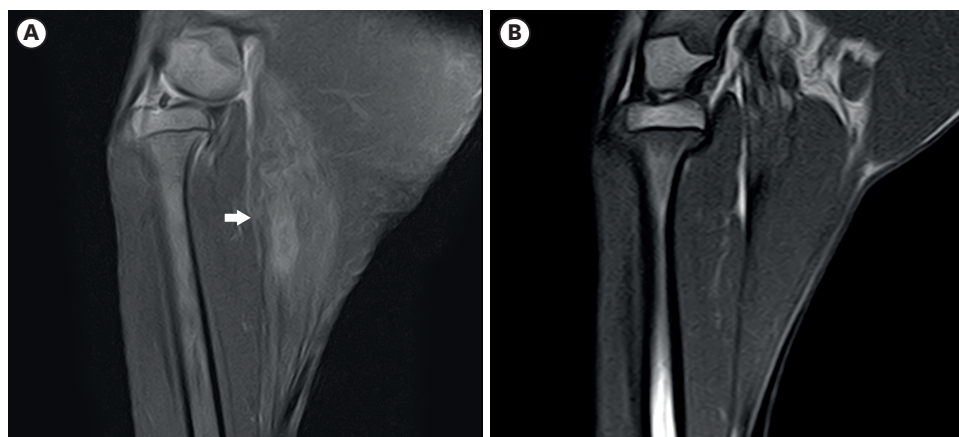
The authors declare no conflicts of interest.

[11]. Currently, gorals in Korea are in various dangerous situations; however, only a few documented veterinary cases are available [12,13]. This case is an unfortunate accident caused by the attempt to control the ASF outbreak in Korea, but it was successfully diagnosed and treated. This is the first confirmed case of gastrocnemius muscle rupture diagnosed using magnetic resonance imaging (MRI) in wildlife in Korea.

**CASE PRESENTATION**

On November 16, 2020, a 3-year-old male goral was found in a live trap in Yanggu-gun, Gangwon-do (latitude 38. 238465; longitude: 127. 978686) and brought to the Gangwon Wildlife Medical Rescue Center at Kangwon National University. The main clinical sign was hindlimb lameness. The patient was in good condition and alert; however, it was unable to maintain both hindlimbs extended straight and raise the tarsal joint off the ground. The tarsal joint of the patient showed an angle of 90° with the tibia, and both metatarsal bones leaning completely against the ground. This change in posture caused the goral, who had a normal digitigrade posture, to adopt a plantigrade posture. This abnormal posture led to decubitus on both sides of the tarsal joint. Furthermore, swelling, heat, and crepitation were also detected when the gastrocnemius muscles were palpated. However, the right limb was more severely affected than the left limb. Blood tests did not reveal other abnormalities, but the level of aspartate aminotransferase (AST) was 312 U/L (108–292 U/L) and creatine kinase (CK) was 502 U/L, suggesting an increase in muscle-related enzyme levels [14].

To date, MRI has been widely used to assess muscle, tendon, and ligament abnormalities, as in this case. MRI was performed using a 1.5 T unit (Vantage Elan, Toshiba, Tokyo, Japan), using a combination of a 16 channel flexible coil (16-channel Flex SPEEDER Large, Toshiba, Tokyo, Japan) and a spine coil (Octave SPEEDER Spine, Toshiba, Tokyo, Japan). The goral was sedated with xylazine (Rumpun, Bayer, Germany) 0.3 mg/kg and midazolam (Midazolam, Bukwang Pharm Co., Korea) 0.1 mg/kg, and anesthesia was maintained with isoflurane inhalation. MRI of the hindlimb demonstrated hypersignal changes, and heterogeneous signals were confirmed in the medial and lateral branches of the right gastrocnemius muscle, while weak hypersignal changes were observed on the left side (**Fig. 1A**). Based on these



**Fig. 1.** MRI of the right gastrocnemius muscle. (A) hypersignal changes and heterogenous signals are confirmed in the medial and lateral branches of the right gastrocnemius muscle (arrow). (B) At follow-up examination, it was confirmed that the rupture was recovered on MRI. MRI, magnetic resonance imaging.

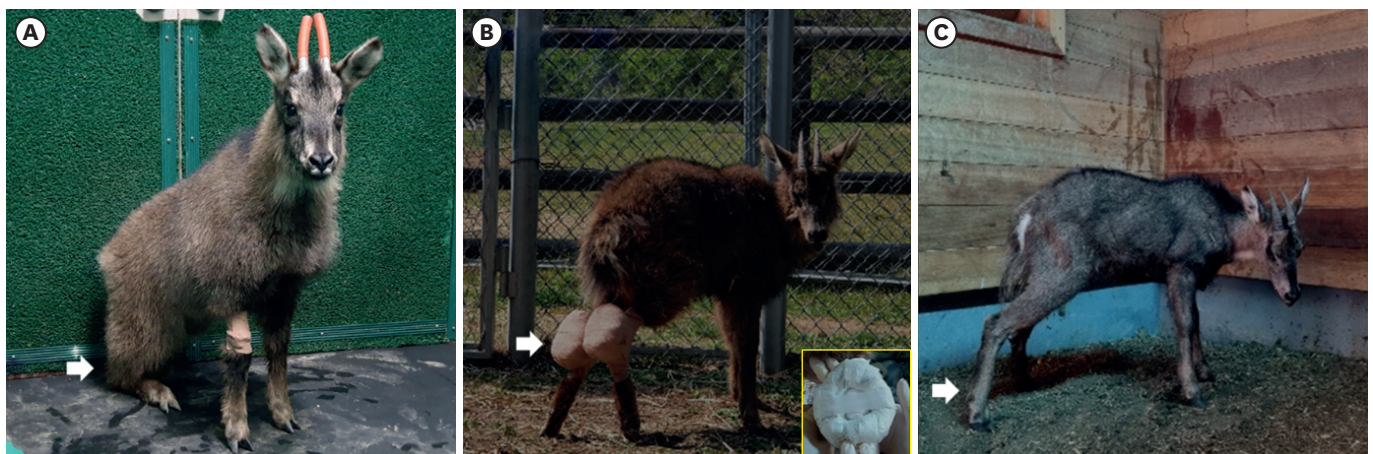
findings, bilateral partial gastrocnemius muscle rupture was confirmed in relation to the symptoms of the gorals.

The initial treatment goals were to treat decubitus and improve muscle function. For the treatment of decubitus, the pustular exudate was continuously removed from the affected area, hock joint and dressings were applied. Moreover, a thick donut-shaped cushion was applied to prevent the decubitus area from being stimulated by the hock joint touching the floor. Flunixin meglumine (Fluximine, Bayer, Korea) 1.1 mg/kg and famotidine (Gaster, Dong-A ST., Korea) 0.4 mg/kg were applied for the first 2 weeks. In addition, selenium agent (Selevit, Fatro S.p.A., Italy) 0.05 mg/kg was applied once a week for 2 weeks to treat muscular dystrophy, and movement was restricted to a narrow room covered with soil to prevent additional trauma from slipping.

MRI was performed for the follow-up examination of the gastrocnemius muscle rupture, and it was confirmed that the rupture had recovered (**Fig. 1B**). No complications, such as additional decubitus, wounds, and muscle atrophy, were found after removing the dressing, including a thick donut-shaped cushion. Furthermore, the abnormal plantigrade posture was restored to the normal digitigrade posture (**Fig. 2**). Blood tests confirmed a marked decrease in muscle-related enzyme levels (AST, 131 U/L and CK, 354 U/L). Therefore, it is judged that the goral is currently cured; it has good vitality and appetite and can be released into the wild after an adaptation period. Finally, goral was released into the demilitarized zone located in Yanggu-gun on October 15, 2021, exactly 11 months after rescue.

## DISCUSSION

The gastrocnemius and surrounding tendons, such as the Achilles tendon, are important structures for normal standing and weight support. As the rupture develops at this site, the individual is usually unable to hold weight and has a poor prognosis [15]. Severe lameness in the limb is the main symptom of gastrocnemius muscle rupture and can occur for various reasons. Consequently, it is necessary to differentiate between several causes related to fractures, trauma, mineral deficiency, and nutritional myopathy due to vitamin E and



**Fig. 2.** Change from abnormal to normal posture of the goral. (A) Abnormal plantigrade posture; The tarsal joint of the patient showed an angle of 90 degrees to the tibia, and both metatarsal bones were completely leaning against the ground (arrow). (B) Dressing (arrow) with thick donut shaped cushion (inset) was applied to prevent the decubitus area from being stimulated by the hock joint touching the floor. (C) Normal digitigrade posture (arrow).

selenium deficiency [1]. Therefore, it is necessary to diagnose serum minerals (Ca, Mg, P, and Fe) and muscle-related enzymes (CK and AST) through blood tests and imaging modalities such as X-ray, computed tomography, and MRI [2]. Although studies have been performed on hematological and biochemical references to goral, there are limitations that further studies on CK levels are needed [14]. In this case, it was confirmed that the gastrocnemius muscle rupture of the goral had recovered through MRI and blood tests (decrease in AST and CK levels). In addition, it was possible to determine that the release of the goral was possible through adaptation for a certain period of time.

For moderate to severe degrees of gastrocnemius muscle rupture, surgical repair can be attempted, but the prognosis is poor [3]. Instead, it can be successfully treated with immobilization, including casting or bandaging of the affected limb [3]. Stabilization of ruptured limbs and movement restriction in wild animals, especially gorals, presents significant difficulties but can be achieved with attentive supervision, and care and application of well-designed fixation devices including casting and bandaging [5]. Above all, careful monitoring is necessary due to the fragility of the skin and the risk of severe decubitus lesions due to long-term treatment. In addition, careful bedding management is required to prevent slippage and falling [1,4]. The hindlimb of the goral, in this case, was bilateral but partial, and the mobility of the leg was gradually restored; therefore, additional lesions were prevented with a dressing, including a thick donut-shaped cushion, instead of choosing cast treatment. In addition, it was an excellent management method to restrict the movements of the goral alone in a small, soil-covered ward.

The goral, in this case, was an individual who unfortunately suffered an accident due to the negative effect caused by the outbreak of ASF in Korea. Currently, wildlife live traps are used worldwide without any assessment of animal welfare [7]. However, few scientific studies have reported behavioral or physiological harm to wildlife other than target animals caught in various types of traps [6]. There are no studies related to wild animals injured by live traps, especially in Korea. According to a study of the effects of live traps on wild boars, trapped animals can develop minor skin abrasions to severe lesions [7]. Furthermore, when a wild boar is captured, the animals run and bump into all sides of the live traps, and wild boars caught alone respond with a stronger startle reaction to external stimuli than animals caught in groups, leading to more serious injuries [7]. The aim of live traps is to keep the animal safe with minimal stress until the trap is inspected. Since live traps have the lowest number of injuries and appear to be physiologically the least stressful; therefore, they are used in many ways as the most advantageous option for physical trapping [9]. Thus, it is necessary to further study the damage of live-trapped wild animals and its solutions, especially in endangered wild animals.

This is the first successful diagnosis and treatment of gastrocnemius muscle rupture in endangered gorals in Korea. Herein, we established a diagnostic method for gastrocnemius muscle rupture using clinical signs and imaging modalities, including MRI, for symptoms such as hindlimb lameness and plantigrade posture of unknown cause in wild animals. Although the occurrence of this injury is rare, this report will help veterinarians diagnose several diseases of the musculoskeletal and nervous systems in wild animals.

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## REFERENCES

- Mori AP, Schwertz CI, Henker LC, Stedille FA, Christ R, Lorenzett MP, et al. Bilateral gastrocnemius muscle rupture in a bovine. *Acta Sci Vet.* 2017;45(Suppl 1):189.  
**CROSSREF**
- Altuğ N, Özkan C, Yüksek N, Karasu A, Keleş I, Ağaoğlu ZT, et al. Rupture of the gastrocnemius muscle in a cow two months after twin birth. *Bull Vet Inst Pulawy.* 2007;51(4):615-619.
- Tyler JW, Middleton JR, Barbee DD, Parish SM. Conservative management of a ruptured gastrocnemius muscle in a male llama. *Can Vet J.* 1998;39(11):712-713.  
**PUBMED**
- Purohit NR, Chouhan DS, Choudhary RJ, Deora KS. Rupture of the gastrocnemius muscle in a camel. *Br Vet J.* 1989;145(3):293.  
**PUBMED | CROSSREF**
- Jesty SA, Palmer JE, Parente EJ, Schaer TP, Wilkins PA. Rupture of the gastrocnemius muscle in six foals. *J Am Vet Med Assoc.* 2005;227(12):1965-1968.  
**PUBMED | CROSSREF**
- Wyckoff AC, Henke SE, Campbell T, VerCauteren KC. Is trapping success of feral hogs dependent upon weather conditions? In: *Proceedings of the Vertebrate Pest Conference.* 2006, 370-372.
- Fahlman Å, Lindsjö J, Norling TA, Kjellander P, Ågren EO, Bergvall UA. Wild boar behaviour during live-trap capture in a corral-style trap: implications for animal welfare. *Acta Vet Scand.* 2020;62(1):59.  
**PUBMED | CROSSREF**
- Powell RA, Proulx G. Trapping and marking terrestrial mammals for research: integrating ethics, performance criteria, techniques, and common sense. *ILAR J.* 2003;44(4):259-276.  
**PUBMED | CROSSREF**
- Lossa G, Soulsbury CD, Harris S. Mammal trapping: a review of animal welfare standards of killing and restraining traps. *Anim Welf.* 2007;16:335-352.
- Schütz KE, Ågren E, Amundin M, Röken B, Palme R, Mörner T. Behavioural and physiological responses of trap-induced stress in European badgers. *J Wildl Manage.* 2006;70(3):884-891.  
**CROSSREF**
- Bragina E, Kim S, Zaumyslova O, Park YS, Lee W. *Naemorhedus caudatus*. IUCN Red List Threat. Species [Internet]. Cambridge: IUCN; <https://iucnredlist.org/species/14295/22150540>. Updated 2021. Accessed 2021 Apr 1.
- Ahn S, Oh H, Choi SY, Kim JT, Kim HC. Cerebral coenurosis of a long-tailed goral, *Naemorhedus caudatus*, in Korea. *Korean J Parasitol.* 2021;59(1):55-59.  
**PUBMED | CROSSREF**
- Choi SJ, Kim JT, Oh YS, Kang BJ. Pin and bone cement fixation of fifth-sixth lumbar vertebral fracture-luxation in a Korean goral (*Nemorhaedus caudatus*). *J Vet Clin.* 2017;34(2):115-118.  
**CROSSREF**
- Ahn S, Kim JT. Reference values of body measurements, hematology and biochemistry and parasite prevalence in fecal samples of proliferating and restoring Korean gorals (*Naemorhedus caudatus*). *Ann Anim Resour Sci.* 2018;29(3):134-141.  
**CROSSREF**
- Peek SE, Divers TJ. *Rebhun's Diseases of Dairy Cattle.* 3rd ed. Wisconsin: Saunders; 2017, 578-579.