

## Rupture of the Gastrocnemius Muscle in Neonatal Thoroughbred Foals: A Report of Three Cases

Fumio SATO<sup>1\*</sup>, Ryo SHIBATA<sup>2</sup>, Mitsumori SHIKICHI<sup>2</sup>, Katsumi ITO<sup>2</sup>, Harutaka MURASE<sup>1</sup>, Takanori UENO<sup>3</sup>, Hidehumi FURUOKA<sup>4</sup> and Kazutaka YAMADA<sup>4</sup>

<sup>1</sup>Hidaka Training and Research Center, Japan Racing Association, Hokkaido 057-0171, Japan

<sup>2</sup>Hidaka Horse Breeders Association, Hokkaido 056-0002, Japan

<sup>3</sup>Epizootic Research Center, Japan Racing Association, Tochigi 329-0412, Japan

<sup>4</sup>Department of Clinical Veterinary Science, Obihiro University of Agriculture and Veterinary Medicine, Hokkaido 080-8555, Japan

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*Rupture of the gastrocnemius muscle is occasionally found in neonatal foals associated with dystocia and assisted delivery. In this report, 3 cases of gastrocnemius muscle disruption in newborn Thoroughbred foals (6, 5 and 2 days old) are reported. In all cases, the foals were presented with inability to rise unassisted postpartum, a dropped tarsus and swelling in the caudal aspect of the thigh accompanied by a hematoma. Ultrasonography, radiography, computerized tomography (CT) and subsequent autopsy were performed to confirm the clinical and pathological features of these cases.*

**Key words:** foal, gastrocnemius muscle, hematoma, rupture, Thoroughbred

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The equine gastrocnemius muscle originates from the supracondylar tuberosities on the caudal surface of the femur and ends as a part of the common calcanean tendon on the calcaneal tuber [1]. Along with the insignificant soleus, the medial and lateral gastrocnemius muscle bellies form the musculus triceps surae, which is the main component of the caudal reciprocal apparatus [1]. The gastrocnemius muscle acts as the flexor of the stifle and the extensor of the tarsus. Its disruption has been reported in both adult horses [3, 4, 6, 7, 9] and neonatal foals in association with dystocia and assisted delivery [2, 5, 8]. Rupture of the gastrocnemius muscle result in a dropped tarsus and extension of the stifle [1]. Clinical signs may range from mild to severe swelling in the crus accompanied by a hematoma [2, 5, 8]. In cases with complete rupture of the gastrocnemius muscle, the horses are unable to bear weight on the affected limb [8]. In the case of bilateral ruptures, the horse is unable to stand because it cannot straighten the hind legs [9]. In the literature, there are only small number of case reports on postmortem examinations of equine gastrocnemius rupture

[5]. In this report, we described autopsies on 3 cases of gastrocnemius rupture in newborn Thoroughbred foals, providing the clinical and pathological features.

Case 1. A 6-day-old Thoroughbred filly was presented with inability to rise unassisted postpartum. The delivery was normal and unassisted (the gestational period was 337 days from mating). The left tarsus could not be extended, and so it was in a dropped position; the stifle joint was contracted, with swelling of the thigh (Fig. 1-a, b). The foal was able to stand while bearing weight on the left hindlimb and nurse milk with assistance. The swollen thigh was warm, but no signs of pain were apparent on palpation. On day 14, the left hindlimb lameness remained. On the other hand, the swelling was rather decreased. Radiography was used to confirm an incomplete ossified mass in the muscle of the left distal thigh (Fig. 2-a). Furthermore, a computerized tomography (CT) scan was performed after sedation with xylazine and general anesthesia using a bolus of ketamine hydrochloride (2.2 mg/kg) and diazepam (0.08 mg/kg) following maintenance with IV 5% guaiacol glyceryl ether solution containing xylazine (500 mg) and ketamine hydrochloride (2,000 mg). The CT scan revealed ruptures of the medial and lateral gastrocnemius muscle, especially on the caudal surface of the femur, with a hematoma. The gastrocnemius muscle was extensively enclosed by a highly radiolucent lesion (Fig. 2-d). Heterotopic ossification had formed around the hematoma. The owner made the deci-

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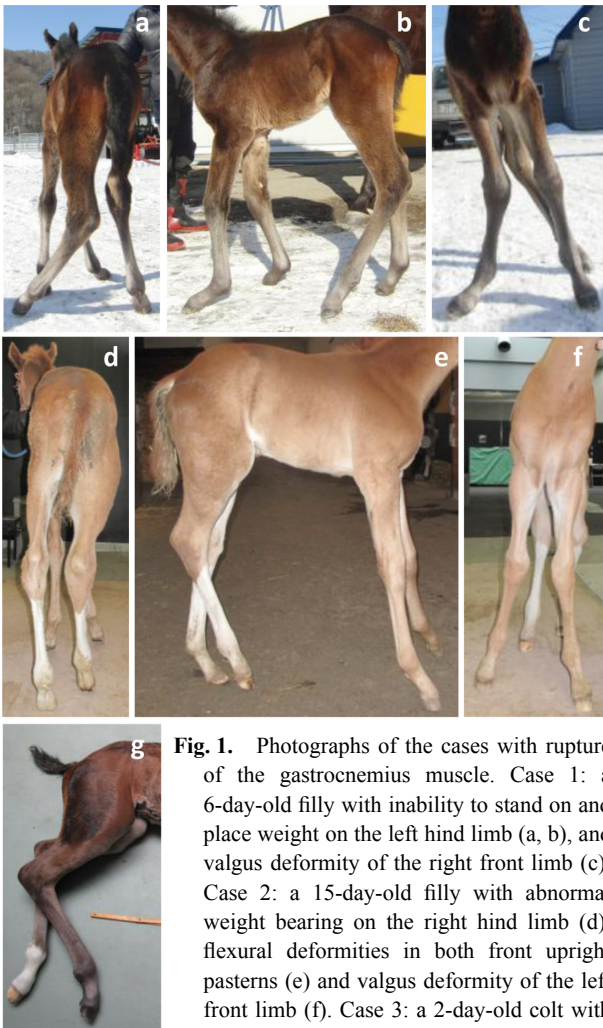
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\*Corresponding author. e-mail: Fumio\_Sato@jra.go.jp

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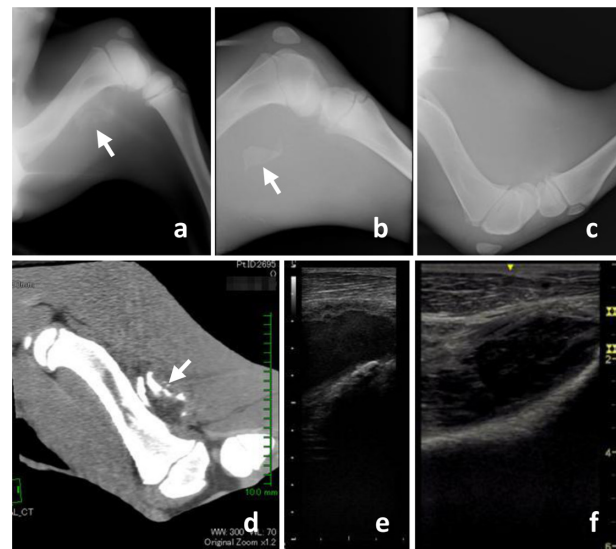
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**Fig. 1.** Photographs of the cases with rupture of the gastrocnemius muscle. Case 1: a 6-day-old filly with inability to stand on and place weight on the left hind limb (a, b), and valgus deformity of the right front limb (c). Case 2: a 15-day-old filly with abnormal weight bearing on the right hind limb (d), flexural deformities in both front upright pasterns (e) and valgus deformity of the left front limb (f). Case 3: a 2-day-old colt with swelling of the right thigh (g).

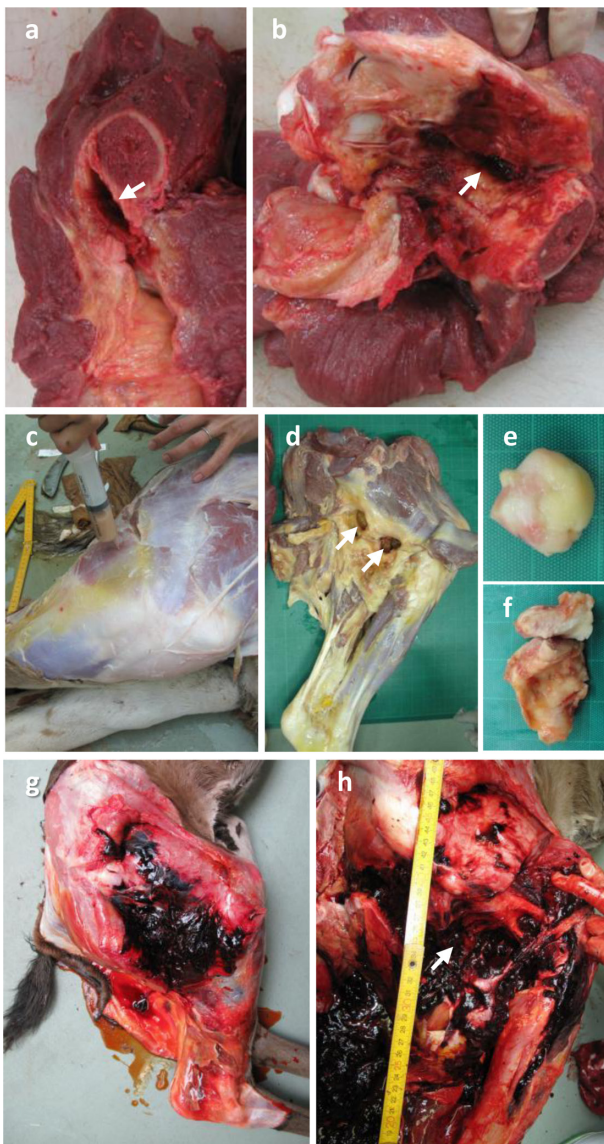
sion to euthanize the foal before recovery from anesthesia. Postmortem examination revealed that the greater part of the medial and lateral gastrocnemius muscle bellies were surrounded by fibrous tissue. Hematomas and ruptures were observed at the supracondylar tuberosity and the supracondyloid fossa on the caudal surface of the femur, which is where the lateral gastrocnemius and superficial digital flexor muscle originate, respectively (Fig. 3-a, b). Pathological investigation of the gastrocnemius muscle showed necrosis, fibrosis, calcification, and regenerative changes of the muscle fibers (Fig. 4-a).

Case 2. A 5-day-old Thoroughbred colt was delivered naturally without assistance and manifested with disability to rise during the postpartum period (the gestational period was 342 days from mating). The right hock had a dropped appearance, with swelling in the caudal aspect of the thigh. The foal was able to stand while bearing weight on the right hindlimb and orientate to nurse with assistance. By day 15, the swelling had gradually increased (Fig. 1-d, e). Further-



**Fig. 2.** Radiography, CT scan and ultrasonography images of the cases with rupture of the gastrocnemius muscle. Mediolateral radiographic views of case 1 (a), case 2 (b) and case 3 (c). CT image from case 1 (d). Ultrasonographic pictures from case 2 (e) and case 3 (f). The arrows in (a), (b) and (d) indicate the ossified mass in the muscle.

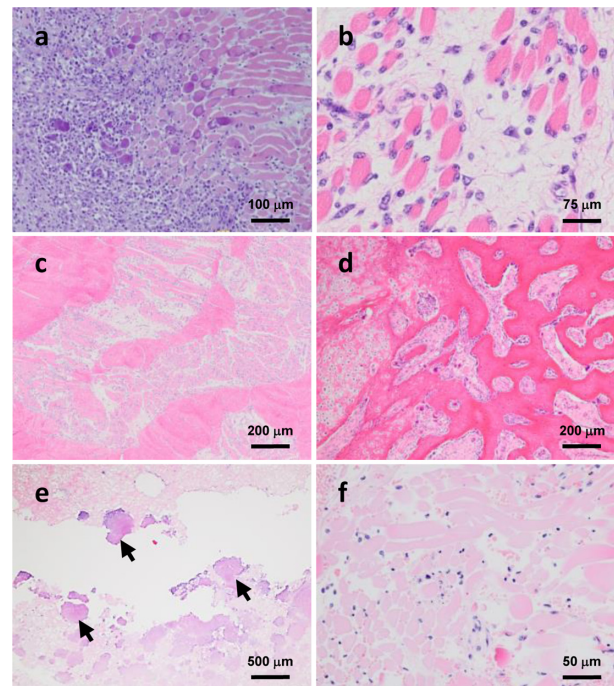
more, both forelimbs exhibited pastern flexural deformities (Fig. 1-e, f). Pain was obvious on manipulation. Astasia developed progressively. Radiography confirmed a complete ossified mass within the right distal femur muscle (Fig. 2-b). Ultrasonography demonstrated persistent abscesses under the biceps femoris (Fig. 2-e). Euthanasia was performed at the owner's request. Postmortem examination revealed that most of the gastrocnemius muscle and most of the superficial digital flexor muscle were surrounded by fibrous tissue. Some abscesses were detected at the caudal surface of the femur, which is where the gastrocnemius muscle and the superficial digital flexor muscle originate (Fig. 3-d). More than 200 ml of odorless pus and a spherical structure approximately 1.5 cm in diameter were enclosed within the abscess (Fig. 3-c, e). On bacteriological examination of the pus, aerobic bacteria such as *Staphylococcus aureus*, *Staphylococcus sp.*, *Corynebacterium sp.* and *Streptococcus group L* were isolated. Furthermore, pathological investigation of the gastrocnemius muscle showed muscle fiber atrophy surrounded by hyperplastic connective tissue including infiltration of inflammatory cells such as macrophages (Fig. 4-b). The superficial digital flexor muscle fibers were also atrophied, with hyperplastic connective tissue in the stroma (Fig. 4-c). The ossified mass was a relatively immature bone tissue (Fig. 3-f) consisting of cancellous bone with cartilage formation (Fig. 4-d). The spherical structure within the abscess (Fig. 3-e) was completely fibrin-like and necrotic, and contained macrophages. In addition, cocci bacterial



**Fig. 3.** Autopsy pictures of the cases with rupture of the gastrocnemius muscle. Case 1 (a, b), case 2 (c, d, e, f) and case 3 (g, h). The arrows in pictures a, b, d and h indicate ruptures of the origin of the lateral gastrocnemius muscle and the superficial digital flexor muscle on the caudal surface of the femur. There is odorless pus (c) and aspherical structure (e) in the abscess. The ossified mass of the case 2 (f).

growths were found as small or large masses in the center of the spherical structure (Fig. 4-e).

**Case 3.** A 2-day-old Thoroughbred colt had a history of mild dystocia with uterine inertia and assisted delivery (the gestational period was 343 days from mating). The dam had developed a bladder rupture. The colt was unable to stand and had gradual swelling in the caudal aspect of the thigh. It weakened and died the next morning. Hyperflexion was observed in the right tarsus (Fig. 1-g). Abnormal find-



**Fig. 4.** Histopathological images of the cases with rupture of the gastrocnemius muscle. The gastrocnemius muscle fibers with necrosis, fibrosis, and heterotopic ossification with inflammatory cells such as neutrophils and lymphocytes (a, case 1; b, case 2). Atrophy of the superficial digital flexor muscle fibers (c, case 2). The ossified mass consisted by cancellous bone tissue with cartilage tissue (d, case 2). Growth of cocci in the center of the spherical structure in the abscess (e, case 2). Coagulative necrosis of the gastrocnemius muscle fibers (f, case 3).

ings such as gastrocnemius muscle calcification or femoral fracture were not found on radiography of the right stifle region (Fig. 2-c). Ultrasonography illustrated a persistent hematoma under the biceps femoris (Fig. 2-f). Moreover, postmortem examination revealed a large blood clot under the biceps (Fig. 3-g). Ruptures of the medial and lateral gastrocnemius and the superficial digital flexor muscle were observed at the supracondylar tuberosity and the supracondyloid fossa on the caudal surface of the femur, respectively (Fig. 3-h). Pathological investigation showed coagulative necrosis, commonly caused by hypoxia, ischemia or infarction, including RBC infiltration at the site of the gastrocnemius muscle rupture. However, little infiltration of inflammatory cells was found (Fig. 4-f).

Generally, rupture of the gastrocnemius muscle occurs when the stifle is forced into overextension during parturition while the tarsus is flexed [2, 5, 8]. In particular, a causal relationship of hip locked dystocia with assisted delivery and gastrocnemius muscle ruptures has been reported [2]. In this report, one foal had a mild dystocia history (case 3), but the other two foals had no history of dystocia or assisted delivery

(case 1 and 2). In the cases with normal deliveries, it could be assumed that the gastrocnemius muscle was injured by application of excessive tension during the postpartum period, for instance, when the foals fell behind on their attempts to stand up, or as a result of the tarsal joint being stiff by nature. Although abnormalities were observed in the left tarsus and both front fetlocks in case 2, the cause of the gastrocnemius muscle rupture could not be identified. Further investigation is needed to elucidate the factors and mechanisms of the disruption of the gastrocnemius muscle in normal deliveries.

Ultrasonography, radiography and CT scan were effective means in diagnosing disruption of the gastrocnemius muscle. In cases 1 and 2, hypochoic areas of fluid accumulation and ossified mass images were confirmed at the caudal femoral region by ultrasonography and radiography, respectively. On the other hand, in case 3, hypochoic areas indicating hematoma were also confirmed, but no ossified mass was observed. Ossified masses have been reported to be avulsion fractures of the distal femur at the origin of the gastrocnemius muscle [2, 8]. In this report, the histopathological findings revealed that the ossified masses were composed of immature bone tissue. Furthermore, atrophy and calcification were observed in the muscle fibers around hematomas. Such changes were considered to have been caused by an external impact to the muscles. However, injury to the gastrocnemius muscle alone as a result of external force is unlikely because the gastrocnemius muscle is located intermediate to the biceps femoris and semitendinosus muscles. The origin of the gastrocnemius muscle had been torn away from its attachment to the femur in all three cases. Gastrocnemius muscle rupture was accompanied by damage to the femoral artery or popliteal artery. The resulting circulatory failure induced necrosis and heterotopic ossification in the gastrocnemius muscle and the superficial digital flexor muscle fibers approximately 2 weeks after onset of the disruption.

In case 2, abscess formation was confirmed in the gastrocnemius disruption. Tull *et al.* reported that abscess formation at the gastrocnemius muscle injury site occurred in 14% (4/28) of foals [8]. Abscess formation may have a negative effect on athletic performance [8]. Incomplete transfer of maternal antibodies may cause infection of hematomas that develop secondary to gastrocnemius rupture in a foal. We also suspect that the prognosis with abscess formation is poor.

For treatment of rupture of the gastrocnemius muscle in adult horses, stall rest, fixation of the affected limb by a full limb cast or Robert Jones bandage and administration of anti-inflammatory agents have been reported [3, 4, 6]. A good prognosis for athletic function has been reported in neonatal cases unaccompanied by complications (such as hypoxic-ischemic encephalopathy) caused by dystocia [8]. In this report, cases 1 and 2 were treated with not treated with an external cast or splint. These foals were gradually

allowed to stand and nurse milk with human assistance. At these times, the front limb diagonal to the affected limb stood in a base-wide position to balance the weight borne by the limbs (Fig. 1-c, f). Although use of a hemicircumferential splint has been reported for neonatal foals, it requires long-term fixation (about 3 to 4 months) and frequent replacement of the cast according to the growth of the foal [2, 8]. Health is an important factor determining whether a neonatal Thoroughbred foal becomes a racehorse. A defect in conformation inevitably has a negative effect on the performance and economic value of a racehorse. Thus, treating such a severe case of gastrocnemius rupture may be unrewarding in Thoroughbred foals. Further investigation of the prognosis is necessary to evaluate the severity of gastrocnemius muscle disruption based on diagnostic imaging and clinical findings and to establish a therapeutic strategy.

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