Achilles tendon rupture in camel (*Camelus dromedarius*): Radiographic and Ultrasonographic findings

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**Abstract**

This study describes the clinical presentation of Achilles tendon rupture and evaluates the utility of radiography and ultrasonography in the diagnosis of such disorder in dromedary camels. Seventeen camels were included in this study based on the clinical, radiographic and ultrasonographic evidence of Achilles tendon rupture. The clinical, radiographic and sonographic findings of studied camels differ according to the type, duration, and location of the tendon rupture. Complete and incomplete rupture of the Achilles tendon was precisely diagnosed in five (29.4%) and twelve (70.6%) camels respectively; ruptured deep and superficial parts of the Achilles tendon were recorded in 10 (58.8%) and 2 (11.8%) camels respectively. Clinically, the camels exhibited an acute non-weight-bearing lameness (second to fourth-grade lameness), with swelling in the tendon near the calcaneus. Radiographs revealed swelling of the soft tissues surrounding the Achilles tendon just proximal to the calcaneal tuberosity in most of the camels with the presence of avulsion fracture of the calcaneus in few cases (n=2). Ultrasonographically, the ruptured part was precisely diagnosed as swollen, oedematous, heterogeneous structure with the presence of anechoic or hypoechoic areas (core lesion). In conclusion, lateromedial radiographs and ultrasonography were helpful in diagnosis and differential diagnosis of different types of Achilles tendon rupture and subsequent clinical decision and surgical interference in dromedary camels.

**Key words:** Achilles, radiographic, rupture, tendon, ultrasonographic.

1. **Introduction**

The importance of dromedary camel is conferred upon them through their significant contribution in milk, meat, wool and leather production, as well as camel race in many countries [1, 8]. Achilles tendon rupture is a dramatic and often fatal injury; it has been recorded in farm animals resulting in high economic losses. The most common cause of Achilles tendon rupture is reportedly acute direct trauma with hard and sharp objects (wire or shovel), resulting in its complete or incomplete rupture [4]. Achilles tendon consists of the gastrocnemius, superficial digital flexor, and the common tendon of the biceps femoris, gracilis and semitendinosus muscles. The proximal part of superficial digital flexor tendon lies cranial to the gastrocnemius, then the tendon passes distally medial to the caudal aspect of the gastrocnemius tendon. The superficial digital flexor tendon inserted on the tuber calcis then it distally continues to insert on the proximal caudal border of the second phalanges of the digit [3].

Gastrocnemius tendon rupture is reported in case of partial Achilles tendon rupture, while the superficial digital flexor remains intact; it is
associated with hyperflexion of the digit and tarsus due to superficial digital flexor contraction [3, 9]. Despite camel popularity and to the authors’ knowledge; few reports have assessed Achilles tendon rupture and little studies evaluated the ultrasonography as a non-invasive imaging technique in the diagnosis of Achilles tendon rupture in camels. Therefore, this study was designed to improve relevant knowledge, and to describe the clinical, radiographic and ultrasonographic features of Achilles tendon rupture in dromedary camels.

2. Materials and methods

2.1. Animals

A total of seventeen dromedary camels (11 males and 6 females) were admitted to Veterinary Teaching Hospital, Faculty of Veterinary Medicine, Qassim University, Saudi Arabia between April 2018 and May 2019. Their ages were ranged from 18 to 121 months (mean ± SD: 98 ± 13 months), weighing between 300 and 750 kg (480 ± 120, mean ± SD) and of different breeds (10 Wadeh, 1 Ashaal, 1 Asfar and 5 Mejhem). Camels were included in the study based on clinical, radiographic and ultrasonographic evidence of Achilles tendon rupture of various types. Achilles tendon rupture was classified into acute or chronic according to duration (time elapsed after rupture up to the presentation to the clinic), into partial or complete according to ruptured components (Table 1) (Fig. 1 and 2). The committee of animal welfare and ethics, Laboratory Animal Control Guidelines of Qassim University approved the study protocol.

2.2. Clinical examination

Camels were clinically examined to determine the physical characteristics of ruptured Achilles tendon including cause, type, and duration. The age, breed, and sex of the camels were recorded. These parameters were evaluated, compared and analyzed. Types of Achilles tendon rupture were detected by physical palpation, radiographic and ultrasonographic examinations. In all investigated camels, the type of Achilles tendon rupture is presented in Table 1.

Table 1: Clinical finding of complete and incomplete ruptures of the Achilles tendon (N=17) in camel.

<table>
<thead>
<tr>
<th>Case No.</th>
<th>Breed</th>
<th>Age</th>
<th>Sex</th>
<th>Type of rupture</th>
<th>Cause</th>
<th>Sharp/Blunt trauma</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-</td>
<td>Wadeh</td>
<td>5 Yrs</td>
<td>Male</td>
<td>Left Achilles complete rupture</td>
<td>Sharp</td>
<td>2 Days</td>
<td></td>
</tr>
<tr>
<td>2-</td>
<td>Wadeh</td>
<td>2 Yrs</td>
<td>Female</td>
<td>Left Achilles complete rupture</td>
<td>Sharp</td>
<td>5 Days</td>
<td></td>
</tr>
<tr>
<td>3-</td>
<td>Asfar</td>
<td>9 Yrs</td>
<td>Male</td>
<td>Right Achilles incomplete rupture (deep part)</td>
<td>Sharp</td>
<td>3 Days</td>
<td></td>
</tr>
<tr>
<td>4-</td>
<td>Ashaal</td>
<td>4 Yrs</td>
<td>Male</td>
<td>Right Achilles complete rupture</td>
<td>blunt</td>
<td>3 Days</td>
<td></td>
</tr>
<tr>
<td>5-</td>
<td>Mejhem</td>
<td>8 Yrs</td>
<td>Female</td>
<td>Left Achilles incomplete rupture (superficial part)</td>
<td>Sharp</td>
<td>5 Days</td>
<td></td>
</tr>
<tr>
<td>6-</td>
<td>Wadeh</td>
<td>6 Yrs</td>
<td>Male</td>
<td>Left Achilles incomplete rupture (superficial part)</td>
<td>blunt</td>
<td>2 Days</td>
<td></td>
</tr>
<tr>
<td>7-</td>
<td>Mejhem</td>
<td>2 Yrs</td>
<td>Female</td>
<td>Left Achilles complete rupture</td>
<td>blunt</td>
<td>One day</td>
<td></td>
</tr>
<tr>
<td>8-</td>
<td>Wadeh</td>
<td>8 Yrs</td>
<td>Male</td>
<td>Right Achilles incomplete rupture (deep part)</td>
<td>Sharp</td>
<td>2 Days</td>
<td></td>
</tr>
<tr>
<td>9-</td>
<td>Mejhem</td>
<td>5 Yrs</td>
<td>Female</td>
<td>Right Achilles incomplete rupture (deep part)</td>
<td>blunt</td>
<td>2 Days</td>
<td></td>
</tr>
<tr>
<td>10-</td>
<td>Wadeh</td>
<td>4 Yrs</td>
<td>Male</td>
<td>Left Achilles incomplete rupture (deep part)</td>
<td>blunt</td>
<td>One Day</td>
<td></td>
</tr>
<tr>
<td>11-</td>
<td>Wadeh</td>
<td>7 Yrs</td>
<td>Male</td>
<td>Right Achilles incomplete rupture (deep part)</td>
<td>blunt</td>
<td>One Day</td>
<td></td>
</tr>
<tr>
<td>12-</td>
<td>Mejhem</td>
<td>3 Yrs</td>
<td>Female</td>
<td>Right Achilles incomplete rupture (deep part)</td>
<td>blunt</td>
<td>2 Days</td>
<td></td>
</tr>
<tr>
<td>13-</td>
<td>Wadeh</td>
<td>8 Yrs</td>
<td>Male</td>
<td>Left Achilles complete rupture</td>
<td>Sharp</td>
<td>One Day</td>
<td></td>
</tr>
<tr>
<td>14-</td>
<td>Wadeh</td>
<td>5 Yrs</td>
<td>Male</td>
<td>Left Achilles incomplete rupture (deep part)</td>
<td>blunt</td>
<td>2 Days</td>
<td></td>
</tr>
<tr>
<td>15-</td>
<td>Mejhem</td>
<td>7 Yrs</td>
<td>Male</td>
<td>Right Achilles incomplete rupture (deep part)</td>
<td>blunt</td>
<td>2 Days</td>
<td></td>
</tr>
<tr>
<td>16-</td>
<td>Wadeh</td>
<td>10 Yrs</td>
<td>Male</td>
<td>Left Achilles incomplete rupture (deep part)</td>
<td>blunt</td>
<td>3 Day</td>
<td></td>
</tr>
<tr>
<td>17-</td>
<td>Wadeh</td>
<td>3 Yrs</td>
<td>Female</td>
<td>Right Achilles incomplete rupture (deep part)</td>
<td>Sharp</td>
<td>6 Days</td>
<td></td>
</tr>
</tbody>
</table>

2.3. Radiographic examination

Radiographic examination was carried out in lateral recumbency using Minx ray HF 100/30 generator (Toshiba, Tokyo, Japan) with a 70 kV, 2.0 mAs and a 70 cm focal film distance. Carniocaudal and 1ateromedial standard radiographs were obtained for the ruptured Achilles tendon (Fig. 1B and C). Intravenous light sedation of studied camels using 0.2 mg/kg xylazine HCl (Seton 2%, Laboratorios Calier, S.A., Barcelona, Spain) was performed. All radiographs were subjectively interpreted.

2.4. Ultrasonographic examination

Ultrasonographic examinations of ruptured Achilles tendon were carried out in lateral recumbency, using a 3.5-5 MHz sector and 7.5 MHz
linear transducers (SSD-500, Aloka, Japan). Lightly sedation of the examined camels was achieved by using an intravenous injection of 0.2 mg/kg xylazine HCl (Seton 2%, Laboratorios Calier, S.A., Barcelona, Spain). According to the site of the rupture, preparation of the examined area on each camel was performed by clipping and shaving of the skin. For evaluation of the type of rupture, it was examined ultrasonographically by moving the transducer craniocaudally begging from the healthy part of the tendon towards the ruptured one. Ultrasonographically, the evaluation of ruptured Achilles tendon depends on the echogenicity of ruptured components.

3. Results

3.1. Clinical findings
Out of the 17 studied camels, complete and incomplete ruptures of the Achilles tendon were precisely diagnosed in five (29.4%) and twelve (70.6%) camels respectively; ruptured deep and superficial parts of the Achilles tendon were recorded in 10 (58.8%) and 2 (11.8%) camels respectively. The camels suffered from rupture of the Achilles tendon exhibited an acute non-weight-bearing lameness, (second to fourth-grade lameness were reported in all studied camels) with moderate to severe swelling in the tendon near the calcaneus. In case of the absence of penetrating laceration, careful palpation revealed the disruption in the tendon at or proximal to the calcaneus. The rupture of the Achilles tendon in camels occurred due to sharp cutting wound by a sharp object such as barbed wire and due to blunt trauma as in case of car accidents. In the present study, the duration of the tendon rupture (time elapsed after rupture up to the presentation to the clinic), varied in the studied camels from one to six days. Achilles tendon rupture in camels had a higher prevalence in Wadeh camels than other studied breeds (10 vs 7) (Table. 1).

3.2. Radiographic findings
Craniocaudal and lateromedial radiographs revealed severe swelling of the soft tissues surrounding the ruptured Achilles tendon just proximal to the calcaneal tuberosity in most of the affected camels, in addition to the presence of increased density in the area of the calcaneal attachment. Avulsion fracture of the calcaneus was diagnosed in two camels (Fig. 1B and C).

3.3. Ultrasonographic findings
Ultrasonographic examinations of 17 camels revealed that, the ruptured part of the Achilles tendon was typically appeared as a swollen, edematous, inhomogeneous structures, as well as presence of anechoic or hypoechoic areas and thickening of the proximal and distal edges, in addition to focal area of fibrillar interruptions and blurring of the tendon texture (Fig. 2).
4. Discussion

Achilles tendon rupture is a common serious affection in camels, it frequently required surgical interference to overcome their complications in such animals. Because of the limited knowledge about Achilles tendon rupture in camel and its incidence in the available literature. Therefore, the present study was to describe the use of clinical, radiographic and ultrasonographic findings in the diagnosis of such affection in dromedary camels.

The occurrence of Achilles tendon rupture in different breeds of the camel was reported in the present study. Wadeh camels represent the highest prevalence in comparison to other studied breeds (10 vs 7). This may be contributed to the high number of Wadeh camels among other camel breeds in the Kingdom of Saudi Arabia in relation to their productive and reproductive and economical values [1, 8].

Case history and physical examination are routinely performed for the diagnosis of Achilles tendon rupture in camels. Radiographic and ultrasonographic examinations are non-invasive imaging techniques that could be used for diagnosis and differential diagnosis of various types of Achilles rupture in such animals, especially when physical examinations do not provide an accurate and conclusive clinical decision. In the present study, the radiographic and ultrasonographic appearance of Achilles tendon ruptures varied according to their type, duration, and location. These findings were in coinciding with, Piermattei et al., 2006 [7], Hashefi, 2009 [5] and Kofler, 2009 [6].

Sonographic features of damaged Achilles tendon included areas of lower echogenicity and blurring of the tendon texture. The echogenicity differed according to the type of the Achilles rupture; it varied from anechoic to hypoechoic areas with thickening of the proximal and distal edges in superficial or in deep part in case of partial rupture or both of them in case of complete one diagnosed in this study. These findings were in coinciding with Hashefi, 2009 [5] and Kofler, 2009 [6]. Radiographs of the ruptured Achilles tendon showed severe swelling of the soft tissues surrounding the ruptured tendon just proximal to the calcaneal tuberosity in most of the studied camels. Similar results were reported by Piermattei et al., 2006 [7].

The Achilles tendon consists of three tendinous parts [2, 3]. In this study, Complete and incomplete rupture of the Achilles tendon was precisely diagnosed in five (29.4%) and twelve (70.6%) camels respectively; ruptured deep and superficial parts of the Achilles tendon were observed in 10 (58.8%) and 2 (11.8%) camels respectively. Rupture of the Achilles tendon in studied camels exhibited an acute non-weight-bearing lameness (second to fourth-grade lameness) with swelling in the tendon near the calcaneus. Similar results were reported by Fubini and Ducharme, 2017 [4].

In this study, Achilles tendon rupture is common surgical disorders mostly caused by sharp or blunt trauma such as by barbed wire and car accident respectively. Its diagnosis is considered as an important challenge for veterinarians, given their complexity on physical examinations. Therefore, the utility of radiography and ultrasonography for the evaluation of various types of Achilles tendon rupture provides a fast and reliable paradigm for their diagnosis. These findings were in coinciding with, Piermattei et al., 2006 [7] and Fubini and Ducharme, 2017 [4].

Conclusion

Ultrasonographic and radiographic examinations are non-invasive diagnostic imaging techniques provide diagnosis, differentiation and subsequent surgical decision of various types of Achilles tendon rupture in dromedary camels.

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References