

MANAGEMENT OF THE COMMONLY DIAGNOSED FOOT WOUNDS AND FRACTURES IN ONE-HUMPED CAMEL

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ABSTRACT

Fifty five camels with foot fractures or wounds were reported. Age, sex, breed, limb affected and digit involved were noted. The affected foot was thoroughly examined via inspection and palpation of lateral and medial digits, interdigital space, nails and sole region. Degree of lameness was assessed from the history and during walking. Dorsopalmar/ dorsoplantar and lateromedial radiographs were performed. The appropriate management was carried out for each case.

The results revealed that higher incidence of foot wounds and fractures in females (69.09%) than males (30.91%), in Mojaheem breed (50.91%) than other two breeds, in the fore foot (63.64%) than hind foot (36.36%) and in medial digit (67.65%) than lateral digit (32.35%). The recorded incidence of foot fractures (50.91%) was very close to that of foot wounds (49.09%). Fractures of proximal phalanx were more frequently diagnosed (45.45%) than that of middle phalanx (5.45%). All diagnosed fractures were simple. Comminuted fractures of the proximal phalanx were more frequently diagnosed (60.53%) than single diaphyseal fractures (34.21%). Granulating wounds were the most common wound type (25.45%). External fixation was found efficient for treatment of comminuted and single diaphyseal fractures of the proximal phalanx, while wound debridement, dressing and bandage was convenient for foot wounds.

Key words: Camels, foot, fractures, management, wounds

Camel has unique feet anatomy adapted for living in the desert. Both fore and hind feet are quiet similar (Masahiko *et al*, 2002). Each foot has two digits (3rd and 4th or medial and lateral). The plantar surface of foot is covered with a soft, cornified layer of epithelium called slipper. There is a single slipper covers the entire bearing surface (Fowler, 2010). Each camel digit consists of 3 phalanges; proximal, middle and distal phalanx. The frontal tip of each digit has characteristically a small non weight-bearing nail similar to human nail. Primary nail growth occurs at the coronary band and it closely attaches to the distal phalanx via corium (Smuts and Bezuidenhout, 1987; Fowler, 2010 and Badawy, 2011).

Previous literature showed that puncture wounds are quiet common in camels (Gahlot, 1984; Singh and Gahlot, 1997; Zabady, 1999 and Al-Ani, 2004), also digit fractures were mentioned (Ramadan, 1992; Gahlot and Chauhan, 1994; Ramadan, 1994; Zabady, 1999 and Gahlot, 2007). The aim of the present study on the one humped camel is to record the most commonly diagnosed foot wounds and fractures.

Materials and Methods

Twenty eight camels suffering from foot fractures and 27 from foot wounds were referred to Veterinary Teaching Hospital (VTH) of King Faisal University between January 2009 and December 2011. The age, gender and breed of each camel and the affected limb and digit were recorded. Each camel digits and interdigital space were examined for the presence of swelling and/or wound by visual inspection. The toenails were assessed for overgrowth or avulsion. The digits were palpated for assessing pain and presence of crepitation sound and the nature of swelling. The foot pad was examined by lifting affected limb or during kneeling where the foot was pulled out. The pad was inspected for cracking, wearing, ulceration and punctured or granulating wounds. Probing was also done to assess punctured wounds. Degree of lameness was assessed via history and during walking. Each animal was allowed to walk and lameness was graded on a scale of 0-5 according to the classification of the American Association of Equine Practitioners (AAEP) (Anon, 1991) as follows:

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- Grade 0= no lameness.
- Grade 1= lameness is difficult to observe but sometimes appears in weight bearing and on hard surface.
- Grade 2= similar to grade 1 but lameness consistently appears in weight bearing and on hard surface.
- Grade 3= lameness observable at trot.
- Grade 4= lameness evident at both walking and trot.
- Grade 5= minimal or non-weight-bearing lameness.

Dorsopalmar / dorsoplantar and lateromedial plain radiographs of the affected foot were also carried out.

Foot wounds management

Each camel was sedated using 2% xylazine hydrochloride (0.2 mg/kg BW IV). The wound was then covered with moist sterile compress and area around wound was clipped, shaved and cleaned thoroughly. Plastic tourniquet was applied on the mid of metacarpal/metatarsal area. Lidocaine 2% 1ml/1cm² was infiltrated subcutaneously along the margins of the wound to provide sufficient analgesia. The excess granulation tissue was excised using scalpel and all tissues 0.5 cm below the skin level were removed. In case of septic ulcerating wound, debridement was performed for removal of foreign materials, detachment of the horny pad and all devitalised tissues. To deal with punctured wounds, wooden hoof knife was used for removal of all dead necrotic tissues after insertion of probe to assess the depth and direction of the wound. A large syringe (50ml) was used to irrigate the wound with diluted 1:10 povidone-iodine solution. The spray penetrated the recesses of the wound and flushed out all the loose and devitalised tissues. Haemorrhage was controlled using thermocautery unit. The wound area was then covered with 1- 2g chlortetracycline hydrochloride powder reaching the entire depth of the wound (Metricycline)[®] (KELA N.V., Sint-Lenaartseweg 48, 2320 Hoogstraten-Belgium). The wound was then insufflated with Negavon powder in 5 camels showing myiasis. A firm cotton bandage covering the area was applied to the foot.

Foot fractures management

Each camel was sedated as mentioned in foot wounds management. The foot was cleaned and padded with even cotton layer starting from the distal third of metacarpal/metatarsal and involving all the camel foot. The cotton layer was covered with gauze,

then 2-3 fibreglass cast tapes 4 inches (Delta-Lite plus) (BSN medical – Mexico). The foot was checked radiographically at 2 weeks intervals till complete healing of fractured digit (s).

After care

All camels with foot wounds were given a systemic antibiotic oxytetracycline (Tetracyn)[®] (Laboratories Argos, Santa Fe- Argentina) at a dose of 20 mg/Kg BW every 72 hrs, additionally anti-inflammatory flunixin meglumine was injected I/M (Flunixin)[®] (Laboratories Argos, Santa Fe- Argentina) at a dose of 1.1 mg/Kg BW for 7 days. Redressing of the wound was carried out every 3 days at the beginning then at weekly bases till complete healing occurred. Camels with foot fractures were given anti-inflammatory only.

Statistical analysis

Categorical variables were analysed by the Proc frequency procedure (SAS, Instituts Inc., 2002). The Pearson's χ^2 (Chi-square) statistics were calculated according to Steel and Torrie (1960). The values were used with Chi square table to determine the significance ($P < 0.05$) of foot wounds and fractures with unilateral/ bilateral affection, breed, gender, limb and digit.

Results

The percentage of unilateral affection (one digit) of foot wounds and fractures was higher (76.37%) than bilateral (both digits) (23.63%) (Table 1). The age of examined camels ranged from 4 months to 15 years (mean 6.02 years). Mojaheem breed showed a significant increase ($P < 0.05$) in the incidence of foot fractures among the 3 breeds. Furthermore, the incidence of the diagnosed foot wounds was significantly higher in Omani than other 2 breeds (Table 2). Numbers of the affected females was higher than males in both affections. 63.64% of foot wounds and fractures took place at the forelimb and 67.64% in the medial digit with no significant differences (Tables 3).

Table 1. Frequency (F) and percentage (%) of unilateral and bilateral foot fractures or wounds (n=55).

	Unilateral		Bilateral		χ^2
	F	%	F	%	
Foot wounds	23	41.82	4	7.27	2.287*
Foot fractures	19	34.55	9	16.36	
Total	42	76.37	13	23.63	

* Non- significant at $P > 0.05$ χ^2 = Chi-square value
n= Number

The diagnosed foot wounds (Fig 1) included granulating, ulcerating, puncture wounds and abrasions and cracking of foot pad. Granulating wounds were the most frequently seen type (25.45%) (Table 6). The time elapsed from wound occurrence to referring to VTH varied from one month up to one year. Camels with wound duration > 2 months showed no or grade 1 lameness, while those with duration < 2 months revealed grade 3 or 4 lameness. Granulating wounds were characterised by reddish black over granulation with uneven surface and they were easily bled. The hypergranulation was either massive at the foot pad after detachment of horny layer (2 camels) (Fig 1g) and lateropalmar aspect of 4th digit (1 camel) or small fleshy at the abaxial border of 3rd digit (8 camels) and 4th digit (3 camels) (Figs 1d,e & h). Myiasis was found in two camels with granulating wound. Punctured wounds were characterised by a small tract and were present at the horny pad of the 3rd digit (3 camels) (Figs 1a, b&c) or beside the toenail (1 camel). At the site of puncture, the horny layer was detached and the tract was surrounded with blackish red devitalised tissues. Puncture wounds

were superficial as it did not reach to the foot digital cushion. Radiographically, puncture wounds appeared as a radiolucent black line at the soft tissues of the foot. Ulcerating wounds were associated with nail avulsion (6 camels) (Fig 1f) or at the interdigital space (one camel) or involving the abaxial border and horny pad of the 3rd digit (1 camel) (Fig 1j). It was characterised by loss of skin and/or horny foot pad, irregular margins with the presence of devitalised and necrotic tissues at the depth of the wound. In 3 camels, an ulcer was found covered with septic exudate and enclosed myiasis. Abrasions and cracking of foot pad was recorded in one camel and it was characterised by thinning and numerous small fissures at the horny layer of foot. It was accompanied by phlegmonous swelling of the foot up to the carpal joint.

Wounds management including excision of excess granulation, debridement, dressing and application of chlortetracycline hydrochloride powder offered satisfactory results. Wound healing took place within 4-10 weeks. The owners of 3 camels with massive granulation tissues were advised to slaughter them.

Table 2. Frequency (F) and percentage (%) of foot fractures and wounds among breeds (n=55).

Breed	Mojaheem		Magateer		Omani		c ²
	F	%	F	%	F	%	
Foot wounds	9	16.36	6	10.91	12	21.82	8.956*
Foot fractures	19	34.55	6	10.91	3	5.45	
Total	28	50.91	12	21.82	15	27.27	

* Significant at P < 0.05 c² = Chi-square value n= Number

Table 3. Frequency (F) and percentage (%) of foot fractures and wounds among gender, limb and digit.

Gender (n=55)	Male		Female		c ²
	F	%	F	%	
Foot wounds	6	10.91	21	38.18	1.874*
Foot fractures	11	20	17	30.91	
Total	17	30.91	38	69.09	
Limb (n=55)	Forelimb		Hindlimb		c ²
	F	%	F	%	
Foot wounds	19	34.55	8	14.54	1.039*
Foot fractures	16	29.09	12	21.82	
Total	35	63.64	20	36.36	
Digit (n=68)	Medial		Lateral		c ²
	F	%	F	%	
Foot wounds	21	30.88	9	13.23	0.136*
Foot fractures	25	36.76	13	19.12	
Total	46	67.64	22	32.35	

* Non-significant at P < 0.05 c² = Chi-square value n= Number

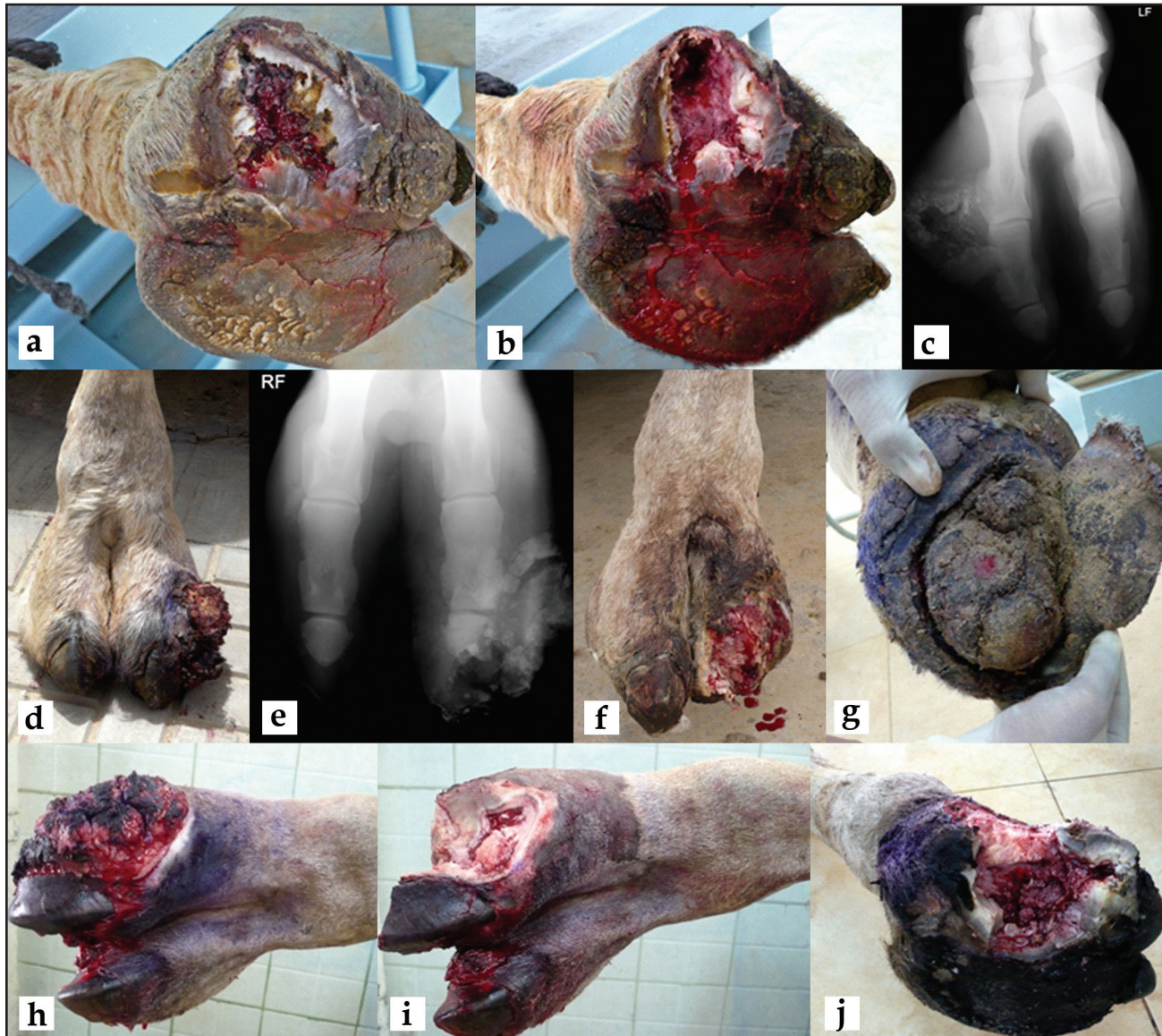


Fig 1. Different types of foot wounds: a: Punctured wound at the sole of medial digit with detached horny pad. b: The case (a) After wound debridement. c: Dorso-palmar radiograph of (a) Showing soft tissue swelling at abaxial border of medial digit with radiolucent area at the centre. d: Small granulating wound at the axial border of medial digit. e: Dorso-palmar radiograph of (d) Soft tissue swelling at the level of coffin joint. f: Ulcerating wound with nail avulsion of the medial digit. g: Large granuloma under separated foot pad. h: Wound with hypergranulation at the abaxial border of medial digit. I: The case (h) After excision of unhealthy granulation tissue. J: Large ulcerating wound after debridement.

Camels with foot fractures showed severe degree of lameness (grade 5/5). The animals could not bear weight of the affected limb and held the limb in semi-flexion position during walking. Camels resented during palpation of the affected digit with groaning and sudden withdrawal of the affected foot. Crepitation sound was noted in 7 camels. There was evidence of cellulitis at the affected digit(s) that extend to the level of metacarpophalangeal/metatarsophalangeal joint. The skin over fractured phalanx was intact (simple fracture). Fractures of the proximal phalanx were more frequently diagnosed

(45.46%) than that of the middle phalanx (5.45%). Fractures configurations (Fig 2) were determined from dorso-palmar/dorsoplantar radiographs. Comminuted fractures were seen in 23 phalanges (60.53%), single ones in 13 phalanges (34.21%) and chip fractures in 2 phalanges (5.26%). Comminuted fractures were characterised by the presence of more than one fracture line leading to more than one fractured fragments (mostly 3 piece fractures). In single diaphyseal fracture, only one fracture line was detected leading to 2 fragments. Chip fracture was characterised by separation of small piece of

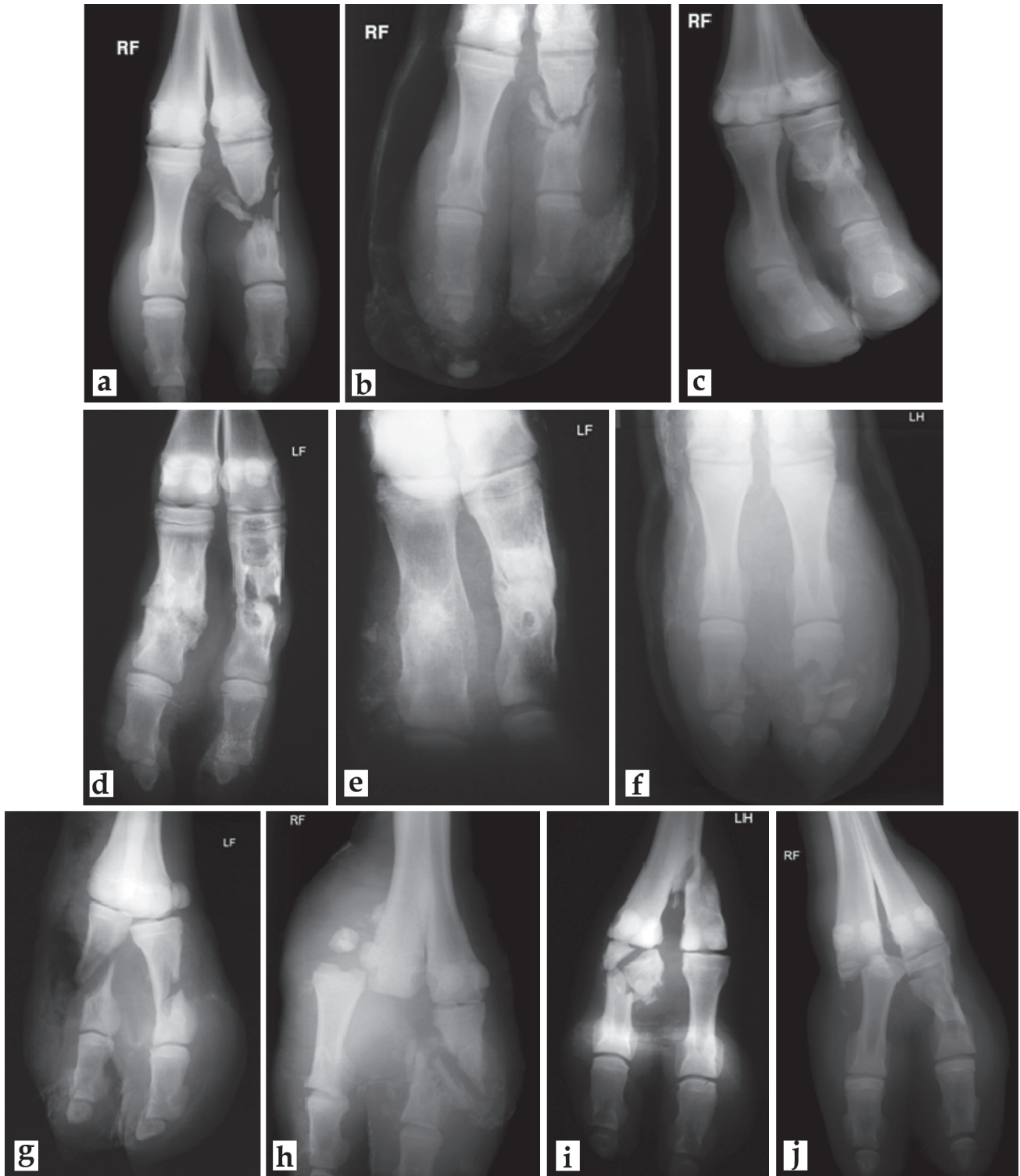


Fig 2. Dorsopalmar/dorsoplantar radiographs showing variety of foot fractures: a: Comminuted diaphyseal fracture of proximal phalanx of 3rd digit. b: The case (a) after 4 weeks showing narrowing of bone fragment gap due to callus formation. c: The case (a) after 6 weeks showing large callus fused all bone fragments. d: Bilateral healed transverse diaphyseal fracture at both proximal phalanges after 6 weeks. e: The case (d) after 12 weeks. f: Comminuted fracture at distal half of middle phalanx. g: Bilateral oblique diaphyseal fracture at proximal phalanx. h: Old oblique diaphyseal fracture of proximal phalanx of medial digit with dislocation of fetlock joint and sesamoid bones of lateral digit. i: Comminuted fracture at upper articular surface of proximal phalanx of medial digit with oblique fracture of distal metatarsal end at the bifurcation. j: Comminuted diaphyseal fracture of proximal phalanx of medial digit with chip fracture at the upper articular surface of proximal phalanx of lateral digit with complete luxation of fetlock joint.

Table 4. Frequency and percentage of different foot fractures and wounds.

	Different types of fractures and wounds	Frequency	Percentage
Foot wounds	Granulating wounds	14	25.45
	Punctured wounds	4	7.27
	Ulcerating wounds	8	14.55
	Abrasions and cracking of foot pad	1	1.82
Foot fractures	Fractures of proximal phalanx	25	45.46
	Fractures of middle phalanx	3	5.45
Total		55	100

bone from the main bone. Comminuted fracture was observed at the upper articular end of the proximal phalanx at in 14 phalanges (Fig 2i) and in the shaft (diaphysis) in 7 phalanges (Figs 2a&j). It is also noted at the distal half of the middle phalanx was in two phalanges (Fig 2f). Single fracture was detected only in the diaphysis of proximal phalanx and the fracture line was oblique in 10 phalanges (Figs 2g&h) and transverse in 3 phalanges (Figs 2d&e). Chip fracture was identified at the upper articular surface of the proximal phalanx in one camel (Fig 2j) and at the distal articular surface of middle phalanx in another one (Fig 2f).

External fixation of phalangeal fractures using fibreglass cast tapes 4 inches proved satisfactory. The cast provided stable immobilisation of bone fragments and sustained the animal's body weight without breaking along the duration of fracture healing. Single and comminuted fractures at the diaphysis of proximal phalanx healed within 6-12 weeks with favourable outcome. Comminuted fracture at the upper articular end of proximal phalanx was treated successfully in 5 camels out of seven. The owners of 7 camels suffering from comminuted fracture associated with dislocation or fracture in metacarpal / metatarsal were advised to slaughter their animals.

Discussion

The very position of the foot at the end of limb in repeated contact with the ground places it in constant jeopardy due to trauma of sharp objects, despite its admirable design (Parks, 2008).

The obtained results showed that foot fractures and wounds were more common in the forefeet than hind feet. This is in agreement with Singh and Gahlot (1997) and disagrees with Gahlot and Chauhan

(1992) who stated that hind limb showed such affections more frequent than forelimb. However, the present results were similar with those of Bolbol and Saleh (1987) and Stashak (2002) in horses. In the meantime, fractures and wounds were more frequently diagnosed in the medial digit than lateral one. The more stress that is put on medial digit during supporting animal's body weight might be the cause. In this respect, Soliman (1981) noted that when the lateral digit was affected, the animal rested the foot on the medial digit keeping the lateral digit off the ground. He added that if the medial digit was affected, the animal did not bear weight on the whole foot and advanced the foot forward.

In the present work, granulating wounds were more frequently seen than punctured wounds. On the other hand, Singh and Gahlot (1997), Zabady (1999) and Al-Ani (2004) found that punctured wounds of the foot were quiet common in camels. They added that such type of wounds were caused by penetration of sharp foreign bodies such as nails, wires, glass pieces and thorns. Such wounds were usually complicated with infection leading to abscess formation within the foot (Singh and Gahlot, 1997 and Al-Ani, 2004). Despite the anatomical advantages that camel foot has a thick keratinised sole surface that makes foreign body penetration difficult, punctured wounds at sole were recorded. However, Milner (2011) and Furst and Lischer (2012) reported that punctured wounds and penetrating injuries of the foot are extremely common in equine. The severity of such wounds depend on the location and depth of the wound. The superficial puncture could be managed conservatively with a good prognosis, but the deeper one results in serious complications. Ulcerating wounds were also recorded after nail avulsion. Sometimes, infection of the nail might follow trauma or wound. Moreover, trauma of the coronary bands might lead to incomplete separation of the nail followed by its avulsion (Al-Ani, 2004). Moreover, Ramadan *et al* (1986); Singh and Gahlot (1997) and Zabady (1999) reported clinical signs of abrasions and cracking of foot pad. It is worth while to mention that foot pads are subjected to laceration, contusion, foreign body penetration, erosion, and ulceration. Such footpad abscess may result in complete undermining of the pad (Fowler, 2010).

In the present study, small granulating wounds were successfully treated via surgical excision of the growth followed by pressure bandage. Singh and Gahlot (1997) used the same technique for treatment of exuberant granulation. Ulcerating and

punctured wounds were managed by removal of the detached slipper and making a cone shaped drainage (Gahlot, 1984 and Fowler, 2010). The sensitive underlying tissue was protected by bandaging until being cornified. Insufflations of chlortetracycline hydrochloride powder in the wounds was beneficial as it guarded against infection allowing the growth of healthy granulation. Moreover, chlortetracycline as one of the long acting antibiotics remains efficient in the tissues for long time.

In the present study dorsopalmar/dorsoplantar radiographs proved an important tool for the diagnosis of fracture. Singh and Gahlot (1997) and Nixo (2012) reported that radiographic examination is mandatory particularly when the musculoskeletal system is involved. The recorded fracture configurations (comminuted, single and chip fractures) of the proximal phalanx are closely similar to that previously reported in camel (Ramadan, 1994) and in equine (Dechant *et al*, 1998; Rose *et al*, 1997 and Nixon 2012).

Fractures of proximal phalanx were more frequently diagnosed than that of middle phalanx. Such result might be attributed to the anatomical difference between the 2 bones. The length of the proximal phalanx is about double of middle phalanx and is vertically situated in the foot, compared to middle phalanx which is horizontally situated (Badawy, 2011). The use of fibreglass cast tapes was adequate for holding the foot fracture. Ramadan (1994) used a plaster of Paris cast reinforced with aluminum or metal bars for supporting simple and comminuted fracture of the proximal phalanx.

It could be concluded that granulating wounds were the most commonly diagnosed type. Simple comminuted and single fractures were the frequently diagnosed fractures in the proximal phalanx. External fixation with fibreglass tape was convenient procedure. Wound debridement with insufflations of chlortetracycline powder and bandage was an appropriate treatment.

References

Al-Ani FK (2004). The musculoskeletal system. In: Camel Management and Diseases, Al-Ani, FK (ed.). 1st Edition, Al-Sharq printing press, Jordan. pp 317-340.

Anon J (1991). Guide for Veterinary Service and Judging of Equestrian Events, fourth Ed. American Association of Equine Practitioners, Lexington. KY. pp 19.

Badawy AM (2011). Computed tomographic anatomy of the fore foot in one-humped camel (*Camelus dromedarius*). *Global Veterinaria* 6(4):417-423.

Bolbol AE and Saleh AS (1987). Survey of equine hoof affections in upper Egypt. *Journal of the Egyptian Veterinary Medical Association* 42(1/2):545-553.

Dechant JE, MacDonald DG and Crawford WH (1998). Repair of complete dorsal fracture of the proximal phalanx in two horses. *Veterinary Surgery* 27:445-449.

Fowler ME (2010). Integumentary System. In: *Medicine and Surgery of Camelids*. Fowler ME (editor). 3rd edition, 289-309. Wiley-Blackwell- USA.

Fürst AE and Lischer CJ (2012). Foot, in Auer JA and Stick JA (eds): *Equine Surgery*. 4th edition, Elsevier Saunders, Missouri, USA. pp 1264-1299.

Gahlot TK (1984). Surgical management of deep punctured wounds of foot in camel. *Indian Journal of Veterinary Surgery* 5:140-142.

Gahlot TK and Chauhan DS (1994). Fractures in dromedary (*Camelus dromedarius*)- a retrospective study. *Journal of Camel Practice and Research* 1:9-16.

Gahlot TK (2007). Lameness in camels. Proceedings of the International Camel Conference "Recent trends in Camelids research and future strategies for saving camels". Rajasthan, India, 16-17 February 2007. pp 158-165.

Masahiko F, Tetsuye Y, So K and Rai B (2002). Regional anatomy of the camel II. Comparison of the sole pads of the forelegs and hind legs of the two-humped camel (*Camelus bactrianus*). *Yamaguchi Journal of Veterinary Medicine* 29:11-18.

Milner PI (2011). Diagnosis and management of solar penetrations. *Equine Veterinary Education* 23(3):142-147.

Nixon AJ (2012). Phalanges and the metacarpophalangeal and metatarsophalangeal joints, in Auer JA and Stick JA (eds): *Equine Surgery*. 4th edition, Elsevier Saunders, Missouri, USA. pp 1300-1325.

Parks A (2008). Horse health: Equine Foot Wounds. Proceedings of the 2003 Alberta Horse Breeders and Owners Conference.

Ramadan RO, Kock RA and Higgins AJ (1986). Observations on the diagnosis and treatment of surgical conditions in the camel. *British Veterinary Journal* 142(1):75-89.

Ramadan RO (1992). Incidence, classification and treatment of 179 fractures in camels (*Camelus dromedarius*). Proceeding of the 1st International Camel Conference. Dubai (UAE) Feb. 2-6 pp 347-351.

Ramadan RO (1994). Fractures. In: *Surgery and Radiology of the Dromedary Camel*. Al Ahsa. Saudi Arabia: Al-Jawad Printing Press. pp 246.

Richardson DW (1996). Fractures of the proximal phalanx. In: Nixon AJ (ed.): *Equine Fracture Repair*. Saunders Company, Philadelphia, Pennsylvania, USA pp 117-128.

Rose PL, Seeherman H and O'Callaghan M (1997). Computed tomographic evaluation of comminuted middle phalangeal fractures in the horse. *Veterinary Radiology and Ultrasound* 38:424-429.

Singh G and Gahlot TK (1997). Foot disorders in camels (*Camelus dromedarius*). *Journal of Camel Practice and Research* 4(2):145-154.

- SAS (2002). Statistical Analysis System. User's Guide. SAS Institute Inc., Cary, NC, USA.
- Smuts MMS and Bezuidenhout AJ (1987). The Skeleton. In: Anatomy of the Dromedary. Clarendon Press, Oxford. pp 31-34.
- Soliman IAS (1981). Surgical studies on foot pad affections in one humped camel. Ph D thesis, Zagazig University, Egypt.
- Steel RG D and Torrie JH (1960). Principles and Procedure of Statistics. Mc Graw-Hill Book Comp. Inc., New York, USA.
- Stashak T (2002). Adams Lameness in Horses, 5th Edn. Lea and Febiger, Philadelphia.
- Zabady MKE (1999). Studies on some limb affections in camels (*Camelus dromedarius*). Ph.D. thesis Faculty of Veterinary Medicine. Cairo University- Egypt. The Camel Applied Research and Development Network. ACSAD.