

## **Angular Fetlock Deformity of the Hind Limbs in Camels: Clinical, Radiological and Histopathological Studies**

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### **Abstract :**

Twenty five out of 6929 camels of different ages (2-7 years), sexes and breeds were diagnosed as having angular fetlock deformity of the hind limbs. Clinically, those camels were suffering from different degrees of valgus or varus deformities. The predominant radiographic alterations were asymmetric division of the distal end of the third and fourth metatarsals accompanied with shortening. The angle of divergence at the distal end of the metatarsals were measured and classified into 3 grades. Grade I, 22°-27°, grade II, 27.5°-32.5°, grade III, 33° or more. Necropsy and histopathological findings revealed variable degrees of secondary degenerative joint disease.

### **Introduction :**

Angular limb deformities of the metacarpometatarsophalangeal region usually occur in the distal third of the third metacarpal / metatarsal bones and varus deviations are usually encountered (Fretz, 1980, Auer *et al.* 1982, Auer, 1985). The condition is important in foals of all equine breeds. The term varus and valgus are used to identify the type and direction of the deviation. Single or multiple deformities may be exhibited, some being bilateral and approximately symmetrical (Mason, 1981, Auer *et al.*, 1982).

Radiographic studies revealed changes that included asymmetric growth of the metaphysis, wedging of the epiphysis, asymmetric longitudinal growth of the phalanges and joint laxity, particularly in young foals (Pharr and Fretz, 1981 and Stashsk, 1987).

Angular deformity of the metacarpophalangeal joint has been reported in llama (Gasthuys, *et al.*, 1996) and in camels (Singh and Ghallot 1997; Fahmy, *et al.*, 2000). In camels malformation of the fetlock joint has been named several descriptive terms such as shortened digital bones, splayed fetlock and pigeon toes (Schwartz and Dioli, 1992).

The aim of this study was to investigate the problem of angular deformities of the fetlock joint of the hind limb in the camel. Documentation of

the clinical signs, radiographic analysis, and pathological findings will be assessed and to relate these findings to prognosis.

**Material and methods:**

A total of 6929 camels of different breeds, sexes, and ages (2 – 7 years) were examined at the camel's market, Halaeib and El-Shalateen area and Cairo slaughter house for the hard abnormal swelling at the fetlock joint of the hind limbs. Clinically, twenty five camels showed hard swelling. Eleven camels out of the twenty five were slaughtered and the affected fetlock joints were collected by disarticulation at the tarsometatarsal joint. Plain radiographs of the fetlock and digits for each disarticulated limb were obtained in dorsoplantar and lateromedial projections. The exposure factors were 55 – 60 KVp, 20 mAs, and 75 cm FFD. The radiographs were interpreted for morphologic changes and geometric analysis. Measurement of the angle of the divergence of the distal end of the metatarsals was conducted utilizing a sheet of tracing paper placed on each dorsoplantar radiograph on a horizontal viewing box. Tracings of the bones were carefully made. First, a midline was drawn tangential to the line of intersection between the third and fourth metatarsals. Their two lines were drawn tangential to the deepest curvature of the outer cortices of the third and fourth metatarsals. Their two other lines were drawn parallel to the second lines bisecting the articular surfaces of the third and fourth metatarsals. The angles between the last two lines and the midline were the angle of divergence of the distal end of the metatarsals. Similar measurement were made on control group of 13 normal fetlock joints.

Necropsy of the affected fetlock joints was performed to assess the abnormal lesions on the articular surfaces. Specimens from the articular cartilage and synovial capsule were fixed in 10% formaline. The specimens were then dehydrated, cleared and embedded in paraffin. Sections at 4 – 5 microns thickness were prepared and stained with hematoxyline and eosin.

**Results :**

The number of camels affected with angular fetlock deformities was 25 from a total 6929 camels, which represents 0.36%. Most of them, 21 camels, were unilaterally affected. The rest (4 camels) were bilaterally affected (table 1). The predominant clinical signs in camels were varus deformity of the digits. In few cases valgus deformity with medial deviation of the fetlock and toe inconformation has been observed.

Table (1)  
Distribution and clinical findings of angular fetlock deformity  
of the hind limb in 25 camels

Affected camels	Number	Percentage (%)
Breeds		
Saudani	22	88 %
Baladi	3	12%
Sex		
Male	18	72 %
Female	7	28 %
Unilateral	21	84 %
Bilateral	4	16 %
Medial deviation (Valgus)	5	20 %
Lateral deviation (Varus)	20	80 %

Most camels had one or more additional radiographic abnormalities other than abnormal angulation of the limb . The prevalent radiographic alteration were asymmetric division of the distal end of the metatarsals, shortening deformity of the distal end of the metatarsals, osteophyte formation, broadening and irregularity of the distal articular surface, axial subluxation of the sesamoid, osteolysis and cortical bone thickening of the metatarsals and subluxation of both fetlock joints (table 2).

The mean values of the divergence angle of the third and fourth metatarsals in the control group were  $18.16^{\circ} \pm 2.34$  and  $18.87^{\circ} \pm 2.28$  respectively, (fig. 1a,b, c &d). The angle of divergence of the 4<sup>th</sup> metatarsal was slightly wider than the 3<sup>rd</sup> one. In the affected camels, the degree of divergence of the distal end of the metatarsals was classified into three grades (table 3). Grade I, the divergence angle was ( $22^{\circ} - 27^{\circ}$ ) and grade II, the divergence angle was ( $27.5^{\circ} - 32.5^{\circ}$ ), whereas in grade III the angle of divergence was  $33^{\circ}$  or more. Grade I was considered a mild degree and grade III a severe degree of angular deformity and was most common . The correlation between clinical and radiographic findings in different grades is shown in figures 2a,b, c & 3a,b, c.

Table (2)  
Radiographic changes associated with angular fetlock deformities  
of the hind limb in 11 camels

Radiographic sign	Affected bone	Number	(%)
Osteophyte formation	- Metaphysis of 3rd metatarsal	4	36.4%
	- Metaphysis of 4th metatarsal	7	63.6%
	- Proximal extremity of 1st phalanx of the third digit	4	36.4%
	- Proximal extremity of 1st phalanx of the fourth digit	7	63.6%
Asymmetric division	- Distal end of metatarsus	11	100 %
Osteolysis	- Proximal extremity of 1st phalanx of the third digit	3	27.3%
	- Proximal extremity of 1st phalanx of the fourth digit	4	36.4%
	- Metaphyseal area of 3rd metatarsus	1	9.1%
	- Metaphyseal area of 4th metatarsus	3	27.3%
Broadening and irregularity	- Distal articular surface of 3rd metatarsal	4	36.4%
	- Distal articular surface of 4th metatarsal	5	45.4%
Broadening and flattening	- Proximal articular surface of 1st phalanx of 3rd digit.	4	36.4%
	- Proximal articular surface of 1st phalanx of 4th digit.	5	45.4%
Axial subluxation	- Sesamoid bones of 3rd metatarsophalangeal joint	1	9.1 %
	- Sesamoid bones of 4th metatarsophalangeal joint.	5	45.4%
Cortical bone thickening	- 3rd metatarsal	6	54.5%
Shortening deformity	- Distal end of 3rd metatarsal	1	9.1 %
	- Distal end of 4th metatarsal	4	36.4%
Subluxation of fetlock joint	of 3rd digit.	3	27.3%1
	of 4th digit.	2	8.2%
Distal subluxation	Sesamoid bones of 4th metatarsophalangeal joint	1	9.1 %

Table (3)  
Measurement of the divergence angle of the distal end of the metatarsus from radiographs in eleven camels of angular fetlock deformities

Grade I			Grade II			Grade III		
No	3 <sup>rd</sup> metatarsal	4 <sup>th</sup> metatarsal	No	3 <sup>rd</sup> metatarsal	4 <sup>th</sup> metatarsal	No	3 <sup>rd</sup> metatarsal	4 <sup>th</sup> metatarsal
1	18°	23.5°	1	27°*	32°	1	25°*	40°
2	25°	40°***	2	19°	30°	2	25°*	36.5°
3	24°	33.5°***				3	19.5°	38°
						4	21.5°	41.5°
						5	23°*	33°
						6	55°	33°

\* Grade 1

\*\* Grade 2

\*\*\* Grade 3

Necropsy findings displayed varying degrees of degenerative joint disease. The predominant lesions were erosions, broadening and irregularity, fibrillation and roughening of the articular cartilage (table 4). The correlation between the necropsy lesions and the clinical and radiographic findings is shown in figure 2d and 3d. The severity of the lesions had a positive relation to the higher grade of angular deformity in most examined cases. Histopathological examination showed articular cartilage degeneration characterized by multiple fissures of the articular surface and fibrillation of the matrix. Variable numbers of small cysts were detected in the deep layers (fig.4a). Some chondrocytes showed different degenerative changes including myxomatous, hydropic and fatty degeneration and even necrosis. These changes were associated with widening of the lucunae. In occasional cases focal area of cartilage necrosis and ulceration exposing the underlying bony trabeculae were seen (fig.4b). The macerated bone specimens were more supportive to the clinical and radiographic results (fig. 2e & 3e).

Table (4)  
Necropsy findings in eleven camels with angular fetlock deformities

lesions	Affected articular surface	No.	%
Erosions	- 3 <sup>rd</sup> metatarsal	4	36.4
	- 4 <sup>th</sup> metatarsal	2	18.2
	- 1 <sup>st</sup> phalanx of the third digit	2	18.2
	- 1 <sup>st</sup> phalanx of the fourth digit	1	9.1
Deep ulceration	- 3 <sup>rd</sup> metatarsal	2	18.2
	- 4 <sup>th</sup> metatarsal	6	54.5
	- 1 <sup>st</sup> phalanx of the third digit	2	18.2
	- 1 <sup>st</sup> phalanx of the fourth digit	4	36.4
Broadening and irregularity	- 3 <sup>rd</sup> metatarsal	2	18.2
	- 4 <sup>th</sup> metatarsal	6	54.5
	- 1 <sup>st</sup> phalanx of the third digit	2	18.2
	- 1 <sup>st</sup> phalanx of the fourth digit	6	54.5
Fibrillation and roughening	- 3 <sup>rd</sup> metatarsal	5	45.4
	- 4 <sup>th</sup> metatarsal	5	45.4
	- 1 <sup>st</sup> phalanx of the third digit	3	27.3
	- 1 <sup>st</sup> phalanx of the fourth digit	4	36.4

#### Discussion :

Angular fetlock deformity in foals is a well-recognized clinical syndrome. In camels few reports described the condition on the basis of clinical findings (Schwartz and Dioli, 1992). The clinical symptoms were abnormal swelling of the fetlock joint with medial or lateral deviation. Unlike the findings in horses, the medial deviation of the fetlock with valgus deformity was the prevalent clinical signs in the forelimb (Fahmy, *et al.*, 2000) while in the hind limb lateral deviation with varus deformity was the predominant clinical signs like horses.

The predominant radiographic changes were asymmetric division and shortening deformity of the distal end of the metatarsals, broadening and irregularity of the distal articular surfaces of the metatarsals. These radiographic findings were usually accompanied with secondary degenerative joint disease in adult camels. The shortening deformity of the distal end of the metatarsals may be explained as a Salter and Harris type V physal injury causing local trauma to the physis followed by diminished growth and eventual premature closure of the physis in that area (Watkins and Auer, 1984). Moreover, asymmetry of the cortical thickness secondary to altered stress was

fairly common (Pharr and Fretz, 1981) and (Fahmy, *et al.*, 2000). In addition to the above radiographic changes, the subluxation of both fetlock joints is observed in the hind limb.

The magnitude of angular fetlock deformity was measured in the affected fetlock joint and compared with a group of normal control. The measured angles were categorized into three grades. Generally, the degree of the angle of divergence of the distal end of the metatarsals could be taken as indication for poor prognosis. The grade III was considered the worst degree of the divergence angle and predominated in the hind limb. But in some cases of grade I, angular deformity showed severe secondary degenerative joint disease. Therefore, the severity of the secondary degenerative joint disease depends not only on the degree of the angle of divergence but also on the duration of the affection.

The autopsy of the affected fetlock joints in the camels displayed the criteria of secondary degenerative joint disease. It was in contrast with Ramadan *et al.*, (1984). The articular cartilage showed fibrillation, superficial erosion and deep ulceration with exposure of the subchondral bone. These findings were similar in equine degenerative joint disease (Riddle, 1970; Nilson and Olsson, 1973). Also Fahmy *et al.* (2000) found identical results when they studied angular fetlock deformity of the fore limb in camels.

The cause of angular deformities remained speculative but would appear to be mechanical injury (Fretz, *et al.*, 1978, Kirk, 1979), overfatness or unusual feeding regime (Mason, 1981), and congenital (Stashak, 1987).

In conclusion, early recognition of angular fetlock deformity is important. If the deformity is detected early, when the growth plate is still open and the bone is still in a growing phase, it may be surgically corrected.



Fig. 1a: A two year-old male camel notice symmetrical appearance of the fetlocks and digit.



Fig. 1b: Dorsoplantar radiographs of the same case revealing symmetrical division of the distal end of the metatarsals.

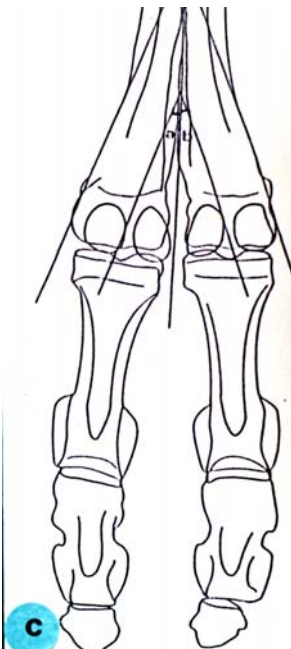


Fig. 1c: Sketch of normal radiograph, showing the angle of divergence of the third ( $b = 18.16^\circ$ ) and fourth ( $a = 18.87^\circ$ ) metatarsals from the midline.



Fig. 1d: Macerated bone specimen in a normal fetlock and digit. Notice symmetric division of the distal end of the 3rd and 4th metatarsals.

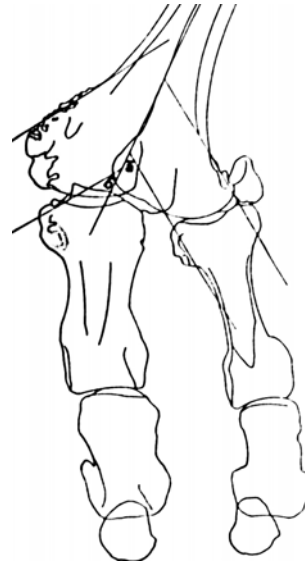




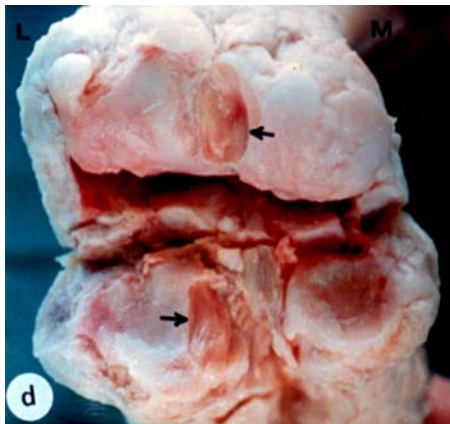
(Fig. 2a) : A seven year - old male Sudanese camel with bilateral angular fetlock deformity Grade III of both 3rd and 4th digit in the hind limb. Notice large swelling of the fetlock joint with lateral deviation (varus) and toe-in of the digits.



(Fig. 2b): Dorsoplantar radiograph of the same case. Showing absence of the incisura intertrochlearis of the metatarsal bone with subluxation of both fetlock joints. Osteoperiosteal reaction at the abaxial metaphyseal area of 4th metatarsal and proximal end of both 1st phalanges. Bone sclerosis of the distal metatarsal end.



(Fig. 2c): Sketch of dorsoplantar radiograph of grade III angular fetlock deformity. Notice the angle of divergence of the third (a = 55°) and the fourth (b = 33°) metatarsals.



(Fig. 2d): Autopsy findings of the same camel reveal roughening and fibrillation of all articular cartilage with broadening and irregularity, deep ulceration (arrows) on the articular cartilage of 3rd metatarsal and the 1st phalanx of fourth digit.



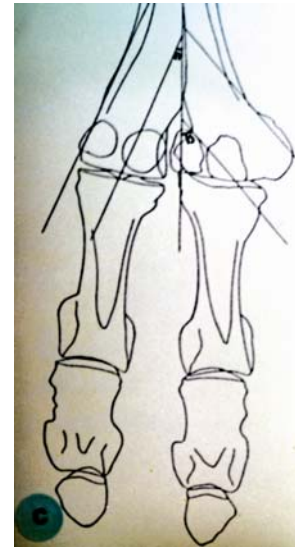
(Fig. 2e): Macerated bone specimen of the same case. Notice fusion of the distal metatarsal end with subluxation of both fetlock joints.



(Fig. 3a): An eight-year old male Sudanese camel with unilateral angular fetlock deformity Grade III of the 4th digit in the hind limb. Notice asymmetric appearance of the fetlock joint with large swelling at the lateral aspect



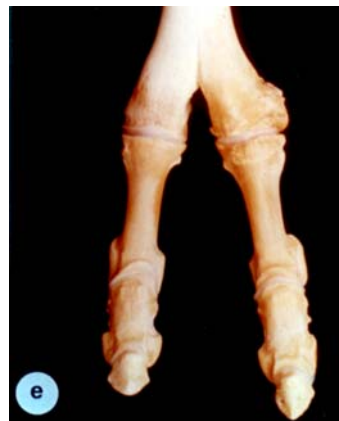
(Fig. 3b): Dorsoplantar radiograph of the same camel showing asymmetric division of the distal end of the metatarsus, broadening of the articular surface of the 4th metatarsal and axial subluxation of the sesamoid bones of lateral fetlock joint, and osteoperiosteal reaction at the proximal end of 1st phalanx of the 4th digit.



(Fig. 3c): Sketch of orsoplantar radiograph of grade III angular fetlock deformity. Notice the angle of divergence of the third (a = 21.5°) and the fourth (b = 41.5°) metatarsals.



(Fig. 3d): Autopsy findings of the same camel illustrating broadening and irregularity of the articular surface of 4th metatarsal with deep laceration (arrow). Erosions and roughening of articular cartilage of 1st phalanx of 4th digit.



(Fig. 3e): Macerated bone specimen of the same case. Notice the difference in the angle of the divergence at the distal end of the metatarsals, the articular surface of 4th metatarsal is wider than the 3rd metatarsal one.

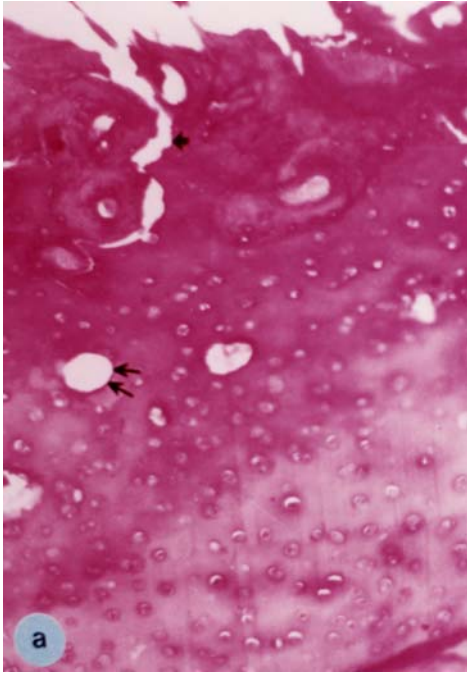


Fig. 4a: Proximal articular cartilage of 1st phalanx. The cartilage surface showed Multiple fissures (arrow) with the presence of few cysts (two arrows) in the depth. Note the degenerative changes of the chondrocytes.

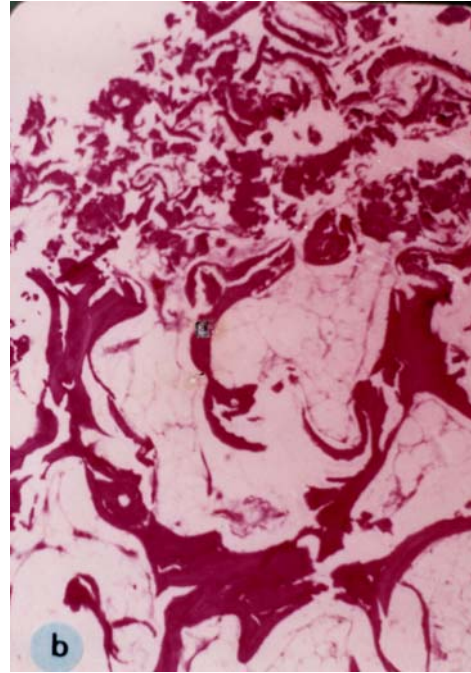


Fig. 4b: Distal articular cartilage of the 3rd metatarsal. The cartilage surface appeared ulcerated with exposure of the underlying cancellous bone.

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## تشوهات زاوية لمفصل الزمعة (الثثة) من الرجل الخلفية للإبل: دراسة اكلينيكية إشعاعية وباثولوجية

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### الملخص :

تم فحص ٦٩٢٩ من الأبل من الجنسين والسلالات والأعمار المختلفة للكشف عن وجود أي تورم صلب عند مفصل الزمعة (الثثة) من الرجل الخلفية (المؤخرة). وجد أن ٢٥ من الأبل تعاني من تورم صلب عند مفصل الزمعة، وقد اجري الفحص المرضي والأشعاعي علي مفصل الثثة في ١١ حيوان تم ذبحهم بالمسلخ. أظهرت النتائج أن هذه الحالات كان بها تشوهات زاوية في الزمعة (أو الثثة) وكانت الأعراض المرضية السائدة هي تشوه الأصبع الأصفر (الأفحج). أما التغيرات الإشعاعية الشائعة فشملت الانقسام اللامتناظر في الجزء الأسفل من السن (الوظيفي)، وتشوه السن وقصره، تكوين زوائد عظمية (العرق أو النيج) ، وتوسع وعدم انتظام السطح المفصلي الأسفل، و خلع جزئي محوري في العظام السمسمانية و انحلال العظم وزيادة سمك لحاء السن. وقد تم تصنيف درجات انحراف النهاية السفلى للسلاميات الى ثلاث مستويات . المستوى الاول بين ٢٢ - ٢٧ درجة ، المستوى الثاني بين ٢٧,٥ - ٣٢ درجة والثالث ٣٢ درجة واكثر. أما الفحص المرضي فقد أوضح درجات متفاوتة من اعتلال المفاصل التتكسي.