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LINEAR AND ANGULAR BIOMETRIC MEASUREMENTS OF LIMBS OF CAMEL (*Camelus dromedarius*)

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ABSTRACT

Linear and angular limb conformations were carried on 208 camels of different breeds and sex using goniometer and software Auto CAD program 2013. Measurements of normal conformation in the fore and hind limbs showed the shoulder lengths in camels were nearly equal to the fore arm length. Thigh and gaskins lengths were found nearly equal in the hind limbs and the hind cannon were larger in length compared to the fore cannon. The recorded conformation traits were carpus valgus; calf knees; base wide, toe out and sloppy and upright pastern in the fore limbs. Cow, straight and sickle hocks, base wide, toe out sloppy and upright pastern were seen in the hind limbs. The mean normal angles for shoulder, elbow, carpal and pastern angles in the fore limbs and hip, stifle joints, hock and pastern joints in hind limbs were determined. The abnormal joint angles displayed carpal valgus and calf knees and these showed significant ($p<0.05$) decrease when compared with normal camels. Cow hocks and sickle hocks had significant ($p<0.05$) decrease value compare with the normal values. Sloppy pastern these showed significant ($p<0.05$) decrease while upright pastern had significant ($p<0.05$) increased value as compared with normal values. Objective conformation parameters in the present study established base line measurements for breeders and veterinarian for selecting camels with good conformations and performance.

Key words: Biometry camel, *Camelus dromedarius*, conformation, limbs, measurement, traits

Lameness in racing camels are considered to be a major welfare and economic issue encountered by camel owners in the terms of decreased milk production, decreased reproductive performance, growth retardation, culling of the camel from the competition or farm, decreased physiological vitality of the camel and additional cost in the care and treatment of the affected animal (Gahlot, 2007; Lira *et al,* 2011; Al-Juboori, 2013). There are many reason for not applying equine principles to camel because of the differences in anatomy of these animals and distinct different uses, biomechanics and geoclimatic adaptation (Gahlot, 2000).

Evaluation of conformation in equines was carried out through subjective methods (Stashak, 1987) and objective methods (McIlwraith *et al,* 2003; Anderson *et al,* 2004 and White *et al,* 2008). Digital photography has been demonstrated to provide a highly accurate method of conformation measurement in equines using linear and angular measurements (White *et al,* 2008 and Dyson *et al,* 2011).

Ideal conformation is that the body form which does not exert excess strain on any point of the body (Gahlot, 2000), Al- Ani (2004) and Anderson *et al* (2004). In general, there in lack of research done on camel conformation. Most of the research in camel was done in terms of body measurements (Osman *et al,* 2015 and Shag *et al,* 2013). Unfortunately, little attention has been given to know normal and abnormal camel limb conformations in camels. The objective of this study was to subjectively and objectively assess the normal and abnormal limb conformation parameters of one humped camel using linear and angular measurements.

Materials and Methods

This study was carried out on 208 camels of different breeds belonging to private camel farms. The camels were of both sex (159 males and 49 females) with a mean age 7.65 ± 3.88 years. Objective and subjective methods of evaluation were performed in squarely standing position on flat hard surface bearing its weight equally on all four limbs. Only one measurement was recorded for each part per day. Evaluation of camel conformations were carried out subjectively as methods (Fig 1) described for the horse (Magnusson and Thafvelin, 1985; Stashak, 1987).

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Fore limb evaluation: The conformation was taken by an imaginary line dropped from the point of the shoulder joint that should bisect the limb from a lateral view and another line dropped from the tuber spinae of the scapula that should bisect the limb down to the fetlock and end behind the foot pad (Fig 2 A and B). Deviation of the carpus medially, laterally, forward and backward; cold degree of extension of fetlock joint an deviation of the toes outward or downward were evaluated.

Hind limb evaluation: An imaginary line dropped from the point of buttock to the ground that normally was taken to touch the hock and end slightly behind the foot pad. From the rear, a line dropped from the point of the buttock to the ground that should essentially bisect the limb was also taken (fig 3 A and B).

Objective methods for conformation evaluation were applied in accordance to the Anderson *et al* (2004) in horses. The reference points and their anatomic locations were described in table 1. Lengths and angles (Table 2) were firstly measured by tape meter and goniometer, then the same measurements were confirmed by analysing the view images sing AutoCAD 2013 program (a commercial software application for 2D and 3D computer-aided design; Autodesk, Inc., California, USA). Lateral, frontal and rear views of the fore and hind limbs were taken by a digital camera (Samsung, PL80 28 mm 5X, 12 Megapixel) after labeling the reference points of the upper and the lower limb landmarks to enable easy identification during AutoCAD processing (Holmstrom, 2001). Different linear and angles measurements in apparently clinically normal and abnormal limb conformations were taken (Fig 1).

Photographic images: The examined camel should be centered within the photo frame and both the photographer and the camel should stand on the same level at a leveled ground surface, during lateral viewing the camera should be present just behind centre of gravity at midpoint of lateral thoracic wall. Lengths and angles were measured for each camel using measuring tape and goniometer used for calibration and scaling the measurements taken on the photos by AutoCAD 2013 program.

Statistical analysis: Descriptive statistical analysis for lengths and angles was done by IBM® SPSS® statistics V 20 program (IBM Corporation, 2009, New York, USA). Mean, variation coefficient % (C.V), minimum, maximum and percentile were determined for lengths according to Petrie and Watson (2006) and "t" test was used for comparing changes in joint angles. Differences were considered significant at a level of $P<0.05$.

Table 1. The reference points and their anatomic locations were described.

Reference points	Anatomic location
Withers	Highest point of camel wither
Point of shoulder (lateral)	Posterior part of the greater tubercle of humerus
Point of Elbow (lateral)	Caudal edge of lateral collateral ligament of elbow joint
Point of Carpus (lateral)	Just below the styloid process of ulna
Point of Fore-fetlock (lateral)	The central point of fetlock joint laterally
Point of Croup (lateral)	Highest point of croup (lumbosacral joint)
Point of Hip (lateral)	The groove between semitendinosus and biceps muscle just caudal to hip joint
Point of Stifle (lateral)	Distal end of the patella (over palpable tibial tuberosity)
Point of Tarsal (lateral)	Midpoint of lateral aspect of tarsal joint
Point of Hind pastern	Midpoint of lateral aspect of pastern joint

Results and Discussion

The mean shoulder lengths (Table 3) in fore limb measured lengths were 52.69 cm (SD ± 4.25 cm). Twenty five per cent of horses had shoulder length lower than 48.83 cm till 43.65 cm. Twenty five per cent had shoulder length higher than 55.86 cm 61.84 till cm. Amount of variation of shoulder length in the study was 20.63%. Mean arm lengths were 38.63±4.83 cm. Twenty five per cent had arm length lower than 35.07 cm till 32.08 cm. Twenty five per cent had higher arm length than 40.84 cm. till 50.46 cm. Amount of variation of arm length in present study was 23.37%.

The mean forearm lengths were 52.29±6.81 cm. Twenty five per cent had forearm length lower than 48.16 cm till 38.09 cm. Twenty five per cent had higher forearm length than 57.15 cm till 68.60 cm. Amount of variation of forarm length was 46.41%. The mean fore cannon lengths were 27.79±7.04 cm. Twenty five per cent had fore cannon length lower than 21.95 cm till 17.19 cm. Twenty five per cent had higher fore cannon length than 34.39 cm till 42.34 cm. Amount of variation of fore cannon length was 49.57%.

The mean fore digit lengths were 15.23±3.75 cm. Twenty five per cent had lower fore digit length

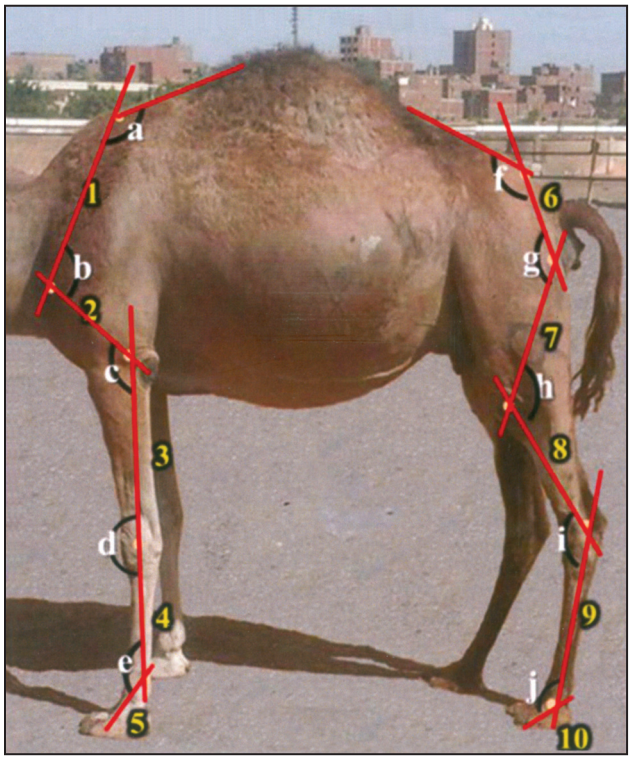

Fig 1. Reference points, legnths and angles in lateral view of camel fore limb (A) and hind limb (B). (**1.** shoulder length, **2.** Arm length, **3.** fore - arm length, **4.** fore cannon length, **5.** fore pastern length, **6.** pelvis length, **7.** thigh length, **8.** gaskin length, **9.** hind cannon length, **10.** hind pastern length. **a.** point (angle) of wither, **b.** point (angle) of shoulder, **c.** point (angle) of elbow, **d.** point (angle) of carpus, **e.** point of fore fetlock, **f.** point (angle) of croup, **g.** point (angle) of hip, **h.** point (angle) of stifle, **i.** point (angle) of hock, **j.** point (angle) of bind fetlock (after Anderson *et al,* 2004).

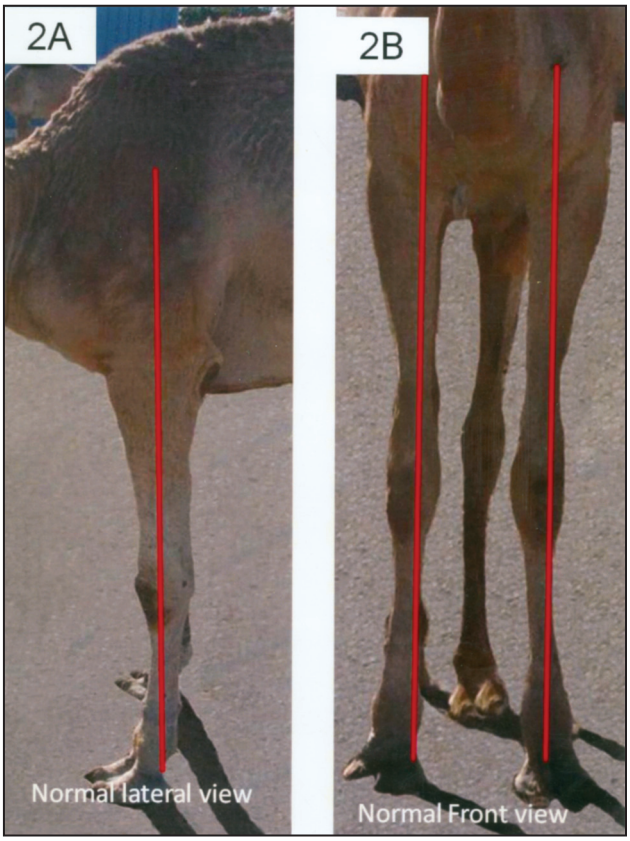

Fig 2. **A.** Normal forelimbs camel, an imaginary line dropped from the point of the shoulder joint that should bisect the limb from a lateral view **B.** Normal front forelimbs camel, an imaginary line dropped from the tuber spinae of the scapula should bisect the limb down to the fetlock and end behind the foot pad.

lower than 12.15 cm till 8.08 cm. Twenty five per cent had higher foredigit length than 17.55 cm till 23.34 cm. Amount of variation of foredigit length was 14.07%. The ratios of fore arm lengths to arm lengths were 1.35%. The ratios of fore cannon lengths to fore digit lengths represented 1.82%. The interesting findings in the present study was the shoulder lengths in camels which were nearly equal to the fore arm lengths.

The measurements of hind limb lengths are given in table 3. The mean pelvis lengths were 38.77±7.67 cm. Twenty five per cent had lower pelvis length than 34.28 cm till 24.32 cm. Twenty five per cent had higher pelvis length than 44.24 cm till 54.61 cm. Amount of variation of pelvis length was 58.76%. The mean thigh lengths were 45.34±4.81 cm. Twenty five per cent had lower thigh length than 41.35 cm till 37.45 cm. Twenty five per cent had higher thigh length than 49.39 cm till 54.71 cm. Amount of variation of thigh length was 23.17%.

The mean gaskin lengths was 46.83±5.06 cm. Twenty five per cent of gaskin lengths were lower than 42.26 cm till 38.06 cm. Twenty five per cent of gaskin lengths were higher than 50.85 cm till 55.36 cm. Amount of variation of gaskin length was 23.595%. The mean hind cannon lengths were 41.92±5.03 cm. Twenty five per cent had lower hind cannon length than 39.08 cm till 28.78 cm. Twenty five per cent had higher gaskin length than 46.42 cm till 50.44 cm. Amount of variation of gaskin length was 25.27%.

The mean hind digit lengths were 13.37±1.43 cm. Twenty five per cent had hind digit lower than 12.77 cm till 10.23 cm. Twenty five per cent had higher hind digit length than 14.32 cm till 15.82 cm. Amount of variation of hind digit was 2.05%. The ratios of pelvis lengths to thigh and gaskin lengths were 0.85% and 0.82%, respectively. The ratios of hind cannon to digit lengths were 3.14%. The interesting finding in camel hind limbs was that the lengths of the thigh and gaskin were nearly equal.

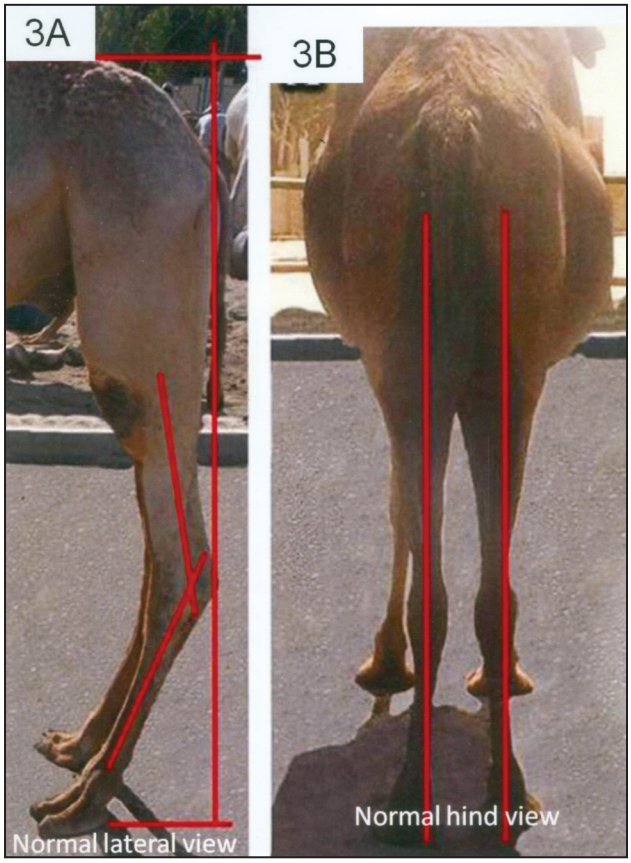

Fig 3. **A:** Normal lateral hind limbs camel, an imaginary line dropped from the point of buttock to the ground that normally was taken to touch the hock and end slightly behind the foot bad. **B:** Normal rear hind limbs, a line dropped from the point of the buttock to the ground should essentially bisect the limb.

The findings in the present study revealed that the shoulder and fore-arm were the longest regions of the limbs and the digits were the shortest. Thigh and gaskin lengths were nearly equal. Both shoulder and fore-arm lengths were nearly equal. The lengths of arm and pelvis were found nearly equal (39 cm). It is important to notice that pelvis was the highest variable length among camels. Both fore-arm and fore-cannon were second in the variability coefficient, whilst the least variabile were digits and the fore-digit.

Abnormal fore and hind limb conformations in 208 camels were represented in table 4. The carpus valgus and calf knee had the highest forelimbs conformations 32.2% and 31.7%, respectively. Base wide, toe out and sloppy pastern conformations were 26.9%, 25.4% and 18.2%, respectively. Fore limbs camped back, upright pastern, base narrow and steep shoulder were 15.3%, 13.9%, 10.1% and 5.2% consequently (Fig 4).

Cow hocks, base wide, toe out and sloppy pastern were the common prevelance hind limb conformations in camels and represented 29.3%, 28.3%, 25.9% and 19.7%, respectively. Upright pastern, sickle hocks, straight hocks and base narrow were represented 15.8%, 14.9%, 12.9% and 12.5%, respectively (Fig 5).

It is obvious in this study that carpus valgus, calf knee and cow hocks were the predominant abnormalities present in camels. They represented one third of the investigated population. Base wide

Table 2. Measuring pattern of body lengths and angles in one humped camel (McIlwraith *et al,* 2003).

Parameters	Items	Items	Exam. View	Description
Body Lengths	Fore limbs	Shoulder	Lateral	From point of withers to point of shoulder
		Arm	Lateral	From point of shoulder to point of elbow
		Fore-arm	Lateral	From point of elbow to point of carpus
		Fore cannon	Lateral	From point of carpus to point of fetlock joint
	Hind limbs	Pelvis		From point of croup to point of hip
		Thigh	Lateral	From point of hip to point of the stifle
		Gaskin	Lateral	From point of the stifle to point of tarsal joint
		Hind cannon	Lateral	From point of tarsal to point of fetlock joint
Body Angles	Fore limbs	Shoulder	Lateral	Between shoulder and arm
		Elbow	Lateral	Between arm and fore-arm
		Carpus	Lateral	Between fore-arm and fore cannon
		Fore pastern	Lateral	Between first and second phalanx
	Hind limbs	Hip	Lateral	Between pelvis and thigh
		Stifle	Lateral	Between thigh and gaskin
		Tarsal	Lateral	Between gaskin and hind cannon
		Hind pastern	Lateral	Between first and second phalanx

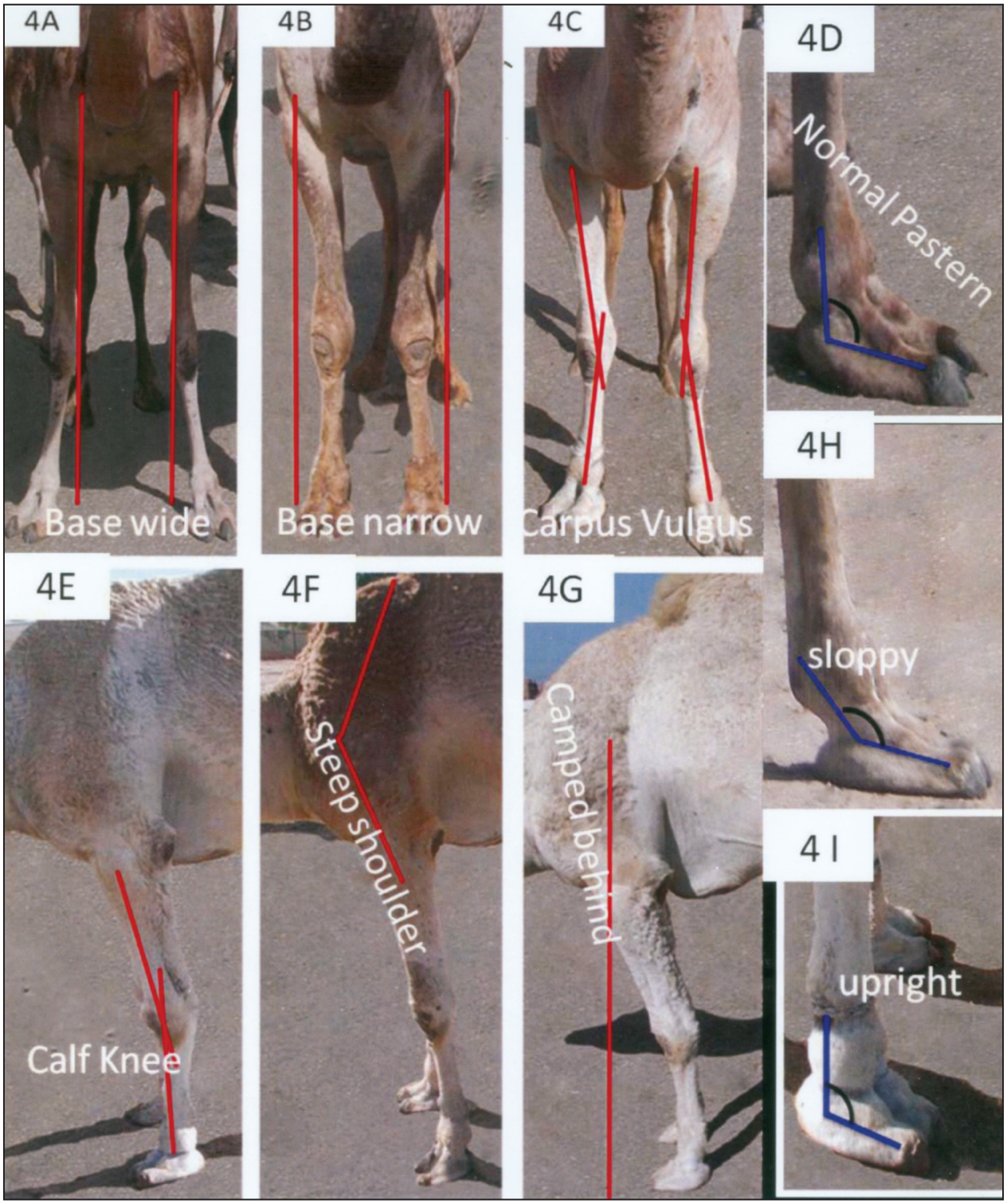

Fig 4. Abnormal limb conformation in camels: **A:** Base wide: the forelimbs are angled out from the perpendicular plumb line and the feet placed further apart than the top of the limb (Front view) **B:** Base narrow: The forelimbs are angled in from the perpendicular plumb line and the feet placed nearer together than the top of the limb (Front view). **C:** Carpus valgus: the carpal joint is directed medially from the front (Front view). **D:** Normal fore pastern angle: measured from the midpoint of the lateral pastern joint. **E:** Calf knee: the carpal joint is directed backward from lateral view. **F:** Steep shoulder: the scapular angle with the horizontal line and the scapula-humeral joint were wider. **G:** Standing under in front (camped behind): in which the entire forelimb is placed too far under the body when the camel is viewed from the lateral side. **H:** Sloppy pastern: low pastern angle when compared with normal angle. **I:** Upright pastern: high pastern angle when compared with normal, pastern more vertical.

Table 3. Mean lengths of fore and hind limbs in apparently normal camels.

Limbs	Lengths (cm)	Mean±SE (cm)	Var. Co. (%)	Min.	Max.	Percentiles		
						25	50	75
Forelimb	Arm	38.63 ± 4.83	23.37	32.08	50.46	35.07	37.21	40.84
	Forearm	52.29 ± 6.81	46.41	38.09	68.60	48.16	52.64	57.15
	Fore cannon	27.79 ± 7.04	49.57	17.19	42.34	21.95	24.89	34.39
	Fore Digit	15.23 ± 3.75	14.07	8.08	23.34	12.15	15.29	17.55
Hindlimb	Pelvis	38.77 ± 7.67	58.76	4.32	54.61	34.28	37.08	44.24
	Thigh	45.34 ± 4.81	23.17	37.45	54.71	41.35	45.42	49.39
	Gaskin	46.83 ± 5.06	25.59	38.06	55.36	42.26	47.51	50.85
	Hind cannon	41.92 ± 5.03	25.27	28.78	50.44	39.08	41.59	46.42
	Hind digit	13.37 ± 1.43	2.05	10.23	15.82	12.77	13.49	14.32

and toe out in both limbs were next in order in their percentage by one quarter of all animals under study. Sloppy pastern was nearer to them in its percentage by around one fifth. Lastly, steep shoulders were the least in their representation.

Table 4. Percentage (%) of abnormal fore and hindlimbs conformation in camels.

Limbs	Variables	Number	Percentage (%)
Forelimb	Base Wide	56	26.92 %
	Base Narrow	21	10.10 %
	Toe Out	53	25.48 %
	Upright Pastern	29	13.94 %
	Sloppy Pastern	38	18.27 %
	Carpal Valgus	67	32.21 %
	Calf Knee	66	31.73 %
	Open S-H angle	11	5.29 %
	Camped Back	34	16.35 %
Hindlimb	Base Wide	59	28.37 %
	Base Narrow	26	12.50 %
	Toe Out	54	25.96 %
	Upright Pastern	33	15.87 %
	Sloppy Pastern	41	19.71 %
	Cow Hocks	61	29.33 %
	Straight Hock	27	12.98 %
	Sickle Hock	31	14.9 %

The normal camels forelimb joint angles are given in table 5. Mean shoulder joint angles were 107 ± 5.38°. The mean elbow joint angles were 149.26± 6.09°. The mean carpal joints were 174.62±3.06°. The mean pastern joint angles were 123.17° ± 3.42°. The hind limb joints angle are given in table 5. The hip joint angles were measured between pelvis length and thigh length. Mean hip angles were 148.58° ± 25.06°. The mean stifle, hock and hind pastern joint angles were 160.32±5.93°; 153.58± 3.07° and 130.79± 4.53°, respectively.

Measurements of abnormal limb conformation angles in the fore limbs in the present study showed

Table 5. Mean joint angles in apparently clinically normal camels.

Normal angles		Abnormal angles	
Joints	Mean±SE Min.- Max.	Joints	Mean±SE Min.- Max.
Shoulder	107.43°±5.38 (96.10-117.41)	Steep shoulder	127.25*±1.55° (125.08-129.89)
Elbow	149.26°± 6.09 (140.03-165.51)	ND	ND
Carpal	174.62±3.06° (169.66-179.82)	Calf knee	157.32 **±1.65° (154.13-159.48)
		Carpus Valgus	159.67±4.47° (150.119-166.47)
Fore Pastern	123.75±3.42° (118.2-129.68)	Sloppy pastern	102.38 *±3.97° (98.42-109.59)
		Upright pastern	141.69±3.07 ** (136.82-148.29)
Hip	148.58±4.14° (140.13-155.13)	ND	ND
Stifle	160.32±5.93° (160.42-5.93)	ND	ND
Hock	153.58±3.07° (146.35-159.00)	Cow hocks	146.03 *±2.53° (142.53149.44)
		Sickle hock	128.83 **±3.15° (123.99- 133.32)
		Straight hock	165.42 **±2.31° 165.42.20-169.77
Hind Pastern	130.79±4.53° (121.29-138.55)	Sloppy pastern	97.0 **±4.38° (91.48-104.23)
		Upright pastern	157.0 *±4.69° (148.28-162.55)

*significant at (0.05) Min.-Max: minimum-maximum
ND: not determined

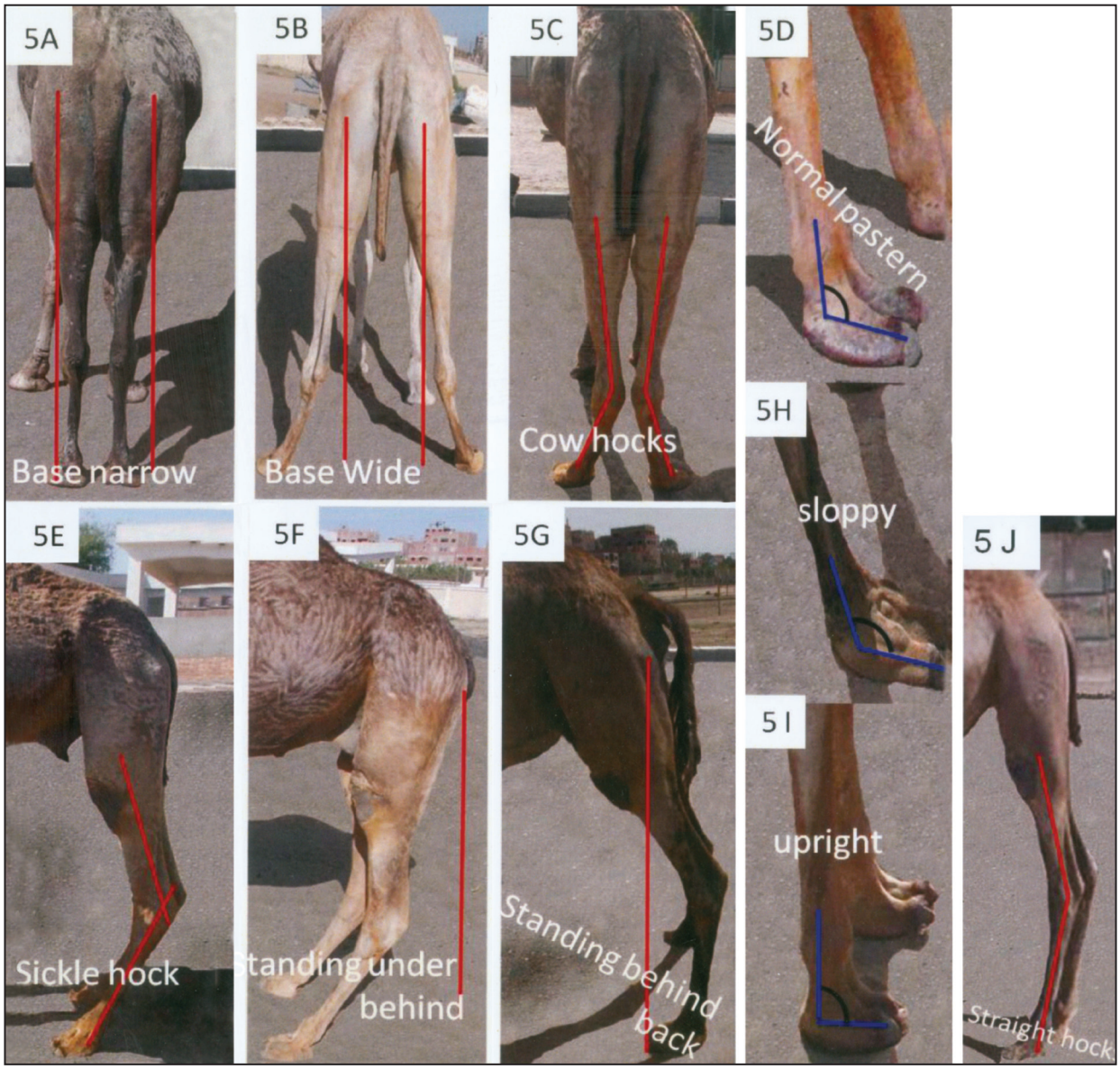

Fig 5. Abnormal hindlimb conformation: **A:** Base narrow: The hindlimbs are angled in from the perpendicular plumb line and the feet placed nearer together (rear view). **B:** Base wide: the hind limbs are angled out from the perpendicular plumb line and the feet placed further apart than the top of the limb (rear view). **C:** Cow hocks: The hocks are too close together and point toward one another and the feet are widely separated. **D:** Normal hind pastern angle : measured from the midpoint of the lateral pastern joint. **E:** Sickle hocks: small hock angle, the angle less than 150° to 153° are considered sickle. **J:** Straight hock: there is very little angle between the tibia and femur and the hock is excessively straight (large hock joint) when viewed from the lateral side. **F:** Standing under behind: the entire limb is placed too far forward when viewed from the side. The perpendicular plumb line drawn from the point of the buttock (*tuber ischii*) would strike the ground slightly far behind the limb. **G:** Standing behind back (Standing out behind): the entire limb is placed too far caudally when viewed from the lateral side. A perpendicular line dropped from the point of the buttock would be forward the foot pad. **H:** sloppy hind pastern: low pastern angle as compared with normal angle. **I:** Upright hind pastern: high pastern angle as compared with normal, pastern more vertical.

significant (P<0.05) increase in steep shoulder and upright pastern compared with normal shoulder angles. Camels with carpus valgus, calf knees and sloppy pastern conformations showed statistically significant (P<0.05) decrease in value as compared with the normal values (Table 5).

The abnormal hindlimbs joint angles were cow hock, straight hock and sickle hock. The mean values of cow and straight hocks and upright pastern had significant (P<0.05) increase as compared with normal values. The mean angles of sickle hocks and sloppy pastern had statistically significant (P<0.05)

decrease in the mean values. There were no significant differences between lengths and angles measured by AutoCAD program and that obtained by tape meter and goniometer.

In the current study subjective conformation evaluations of normal camels had straight limbs when viewed from the front and these were not too close together and hind limbs were far enough apart. Similar findings were reported in Alpaca and LIama (Fowler, 2011). Subjective evaluations of camels in the present study displayed abnormal fore and hind limbs conformation. The fore limbs had carpus valgus and calf knees, base wide, toe out and sloppy and upright pastern, base narrow and steep shoulder. The common hind limb conformations were cow, sickle, straight hocks base wide, toe out and sloppy and upright pastern, sickle hocks, straight hocks and base narrow. Similar findings were reported in fore and hind limbs in horses (McIlwraith *et al,* 2003) and Alpaca and Llama (Fowler, 2011).

Accordingly, the finding of present study showed that carpus valgus, calf knees and cow hocks were the dominant abnormality present in camels and represented one third of the investigated population. Base wide and toe out in both limbs were 2nd in their percentage by one quarter of all animals under study. Sloppy pastern was nearer to them in its percentage by around one fifth. Lastly, steep shoulders were the least in their representation.

The interesting findings in the present study the shoulder lengths in camels were nearly equal to the fore arm lengths. The ratios of hind cannon to digit lengths were 3.14%. Furthermore, the hind cannon were found larger in lengths compared to the fore cannon. Moreover, the lengths of the thigh and gaskin lengths were nearly equal. Contrary to our findings, Smuts and Bezuidenhout (1987) concluded that camel metacarpal and metatarsal were equal in lengths and tibia is slightly shorter than the femur. Therefore, the findings in the present study could be concluded that the shoulder and fore-arm were found the longest regions of the limbs and digits were the shortest. Similarly, thigh and gaskins were nearly equal in the hind limbs. In this respect, Robert *et al* (2013) reported that the ideal horse has a long gaskin, short hind cannon and low sets hocks. Similar findings were reported in thoroughbred horses (Elemmway, 2015).

The wide variations in pelvis measurements in the present study could be attributed to different types of camel breeds. Furthermore, the short pelvis length minimises the length of the muscles needed for powerful and rapid muscular contraction (Robert *et al,* 2013) in the horses.

The mean measurements of fore limbs angles related to the mean normal shoulder, elbow, carpal and pastern angles were 107.4° ± 5.3°; 149.2° ± 6.09°; 174.6° ± 3.06° and 123.7° ± 3.42°, respectively. The mean values of camel fore limb angles were found large in comparison with horses (Holmstrom *et al,* 2001; Anderson *et al,* 2004; Elemmway, 2015). This could be attributed to a unique anatomical structure and environmental adaptions of the camels (Janis *et al,* 2002). Steep shoulder was reported in 5.2% of the camels and the mean joint angles showed significant ($P<0.05$) increase. Marks (2000) and Elemmway (2015) reported that steep shoulder were more common in jumper horses and provides the vertical propulsive forces for the fore limbs during jumping.

Carpal valgus and calf knees were recorded 32.% and 31.7% of the examined camels and the mean joint angles showed significant ($p<0.05$) decrease as compared with normal camels. Lawrence (2001) considered the carpus 'normal' if it was straight and any deviation forward or backward were considered abnormal. Carpus valgus and calf knees were considered normal findings in thoroughbred jumping horses (Weller *et al,* 2006 and Kawcak *et al,* 2009).

The common observed abnormal conformation in the hind limbs were cow, straight and Sickle hocks in animals of present study. Similar findings have been reported in horses with less mean hock angles in the horses and found the tarsal joint less than 150° - 153° (Marks, 2000 and Baxter *et al,* 2011). Sickle hocks bears more stress on plantar ligaments thus producing curby hocks, worn joint out from fatigue, limits the straightening and backward extension of hocks, predispose the horse to bone spavin (Lawrence, 2001 and Thomas, 2005). In addition, horses with lameness and back problems usually had significantly smaller hock angles than sound horses (Holmstrom, 2001). Straight hocks predispose to upward fixation of patella, suspensory desmitis and fetlock osteoarthritis in horses (Ross and Dyson, 2011). Ross and Dyson (2011) found cow-hocked conformation in combination with or without base-wide or base-narrow deformities. Cow-hocked faults lead to lameness but have a substantial effect on gait.

The mean measurements of normal camels fore and hind pastern joint angles were 123.7° ± 3.42° and 130.7° ± 4.53°, respectively. There is no data concerning measurement of pastern joint angles in camels. The abnormal pastern conformation

measured was seen in upright and sloppy pasterns. The mean sloppy pastern angles had significant ($p<0.05$) decrease and upright pastern angles were significantly ($p<0.05$) increased as compared with normal values. Ross and Dyson (2011) reported that pastern angle in the horse are related to the pastern length, long pastern have more slope or lower pastern angle.

Upright pastern in horses predisposes to concussion and injuries to the fetlock, phalangeal joints and soft tissue structures behind the third metacarpus (Marks, 2000 and Stashak and Hill, 2002). Base wide, base narrow and toe out conformations were commonly observed in both fore and hind camel limbs in animal of present study. Thomas (2005) and Anderson *et al* (2004) mentioned that toe-out creates excess strain on the inner side of the hoof, pastern and fetlock predisposing the horse to DJD, ringbone and strain of deep digital flexor tendon and extensors branches of the suspensory ligaments.

Ross and Dyson (2011) reported that base-narrow conformation may occur alone or in combination with toed-in or toed-out conformation, resulting in overload of the medial aspect of the lower limb, predisposing to lameness and appeared with carpus valgus deformities. Lameness in racing camels occupied the 4th position among economically important problems in camel cows after mastitis, reproductive problems and metabolic diseases and represented 67.76% in forelimbs and 32.24% in the hind limbs (Aljuboori, 2013).

In conclusion, objectives of morphometry in the present study showed that fore and hind limbs in camels had some abnormal limb conformations. Moreover, our findings of normal conformation parameter would prove an important guideline in selecting camels for breeding and sport purposes.

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News

Government keen to promote camel racing in Saudi Arabia

The camel field in Taif is witnessing the influx of camel owners from various Gulf and Arab countries to participate in the Crown Prince Festival for Camels. The event will be organized by the Saudi Federation of Camels.

A total of 658 rounds have been allocated to camel races during the festival, starting with warm-up rounds, followed by two production and marathon rounds, and concluding with closing rounds as the festival ends.

The organizing committee of the Crown Prince Festival for Camels has prepared and equipped a 10-km race track, including seven paved tracks, three for camel owners and one for the media surrounded by an outer fence that prevents people from entering the field. The Saudi Arabian Camels Federation has announced the opening of online registration for those wishing to take part in the Crown Prince Camel Festival.

Participants are invited to submit their registration applications from Aug. 4 via www.cpcf.scrf.sa. The website includes various forms to fill out, and information about the festival and accompanying activities.

(Courtesy: Arab News)