

Anatomical Study of the Digits of Fore limbs in goat

H. A. Al- Sharoot Th. A. Abid E. F. AL-Baghdady

Coll. of Vet. Med./Univ. of Al-Qadisiya.

Abstract

The study aim to explain the anatomical description of the digit of fore limb in goat (*Capra hircus*). Left and right fore limbs of 10 Iraqi healthy male goats aging (6) months, with no history of lameness and without local swelling or joint distension were utilized in this study. The study reveals that the goats have two digits; each digit has three phalanges (pI, p II, p III) and sesamoid bones. The PI longer than the other phalanx while the pII was much shorter than the pI. PIII was uniquely triangular in shape with numerous vascular channels. The proximal sesamoid bones were elongated and each bone have three surfaces while distal sesamoid bones were shuttle in shape and situated palmer to the second interphalangeal joints.

Key word: Anatomical, Digits, Goat (*Capra hircus*)

Introduction

Goats (*Capra hircus*) are small important domesticated ruminants which has served humans earlier and longer than cattle and sheep (1, 2). Goats are wide spread across the world, having adapted to many different climatic conditions and econiches (3). It can be found in all over the world particularly in arid semitropical or mountainous countries (4). More differenced between types of animals in the limb. Some types characteristic by contain fate fibrous layer cover distal phalanx and distal part of phalanx called nail or hoof, this type of animals located under

(Digitigrades) for example dog (5). While another type of animals limb characteristic by the stronger feet for the tension and pressure, this type of animals located under (Unguligrade) for example ruminant (6). The importance of the foot resides from the complex anatomical peculiarities, the biomechanical stress and the multitude of clinical conditions that are related to this region. Due to the complexity of anatomical structures located on the palmer aspect of the foot, this region is much more predisposed to injuries (7, 8)

Materials and Methods

Ten fore limbs of ten Iraqi healthy male goats aging (6) months, with no history of lameness and without local swelling or joint distension for the anatomical study were collected immediately after slaughter and kept in clean plastic container until transported to the laboratory in ice cold water bags to

perform the required examinations. The limbs were prepared by carefully dissecting the skin using surgical scalpel and surgical scissors. After dissection the following measurements were taken, the length, the width, and the thickness (proximal, middle and distal) phalanges of the third and fourth digit in right and left fore limb.

Result

Skeleton of Digit under Carpal Joint

1- Digits of Goat

The goat has two digits the (III) and (IV). The first digit was absent, the 2nd, and 3rd were remaining as dewclaw. Each digit consists of three phalanges (the proximal, middle and distal phalanx). The proximal phalanx of each digit (III, IV) appears four-sided and, longer than the other phalanges.

The shaft or body was thick proximally and have four surfaces. The dorsal surface was smooth, and convex from side to side (Fig.1A), the palmer surface was flat and have rough area for attachment of the distal sesamoid ligament (Fig.1B). The axial and abxial surface were rounded. The mean length of the (III) and (IV) proximal

phalanxes in both the left and right fore limbs was equal (Table.1).

The proximal articular extremity was large and consisted of two parts (cavities) separated by sagittal groove. The lateral part was wider and lower than the medial one (Fig.1C). Palmarly there were two facets articulated with the proximal sesamoid bones. The mean width and thickness of the proximal extremity of the third digit was differ than of that of both the fourth digit in the right and left fore

limb fore limb (Table.1).The distal articular extremity consisted of two symmetrical condyles (lateral and medial).The lateral condyle was larger than the medial. These condyles articular with the proximal extremity of the middle phalanx (Fig. 1D) .The mean width and thickness of the distal extremity in the third digit was slightly differ than that of the fourth digit in both the right and left fore limb (Table. 1).

(Table. 1) The morphometric measurements of the proximal phalanx of third and fourth digit in the right and left fore limb in goat. n=10, M± SE (cm)

Proximal phalanx	Right limb (cm)		Left limb (cm)	
	Third digit	Fourth digit	Third digit	Fourth digit
phalanx Length	2.3± 0.08	2.3 ± 0.08	2.3 ± 0.08	2.3 ± 0.08
Width of proximal extremity	1.38 ± 0.04	1.19 ± 0.04	1.37± 0.05	1.18 ± 0.05
Width of distal extremity	1.47 ± 0.19	1.3 ± 0.18	1.45± 0.2	1.27 ± 0.18
Thickness of proximal extremity	1.36 ± 0.04	1.18 ± 0.03	1.37 ± 0.04	1.19 ± 0.03
Thickness of distal extremity	1, 27 ± 0. 08	1, 18 ± 0.08	1, 3 ± 0. 08	1, 16 ± 0.08

The middle phalanx (PII) was shorter in length than pI .Its mean length was equal in both the right and left fore limbs (Table.2). It has two extremities (Fig .2A).The proximal articular extremity consisted of two cavities (Lateral and medial cavity) separated by prominent sagittal ridge, articulated with the distal extremity of the proximal phalanx .The Lateral cavity was larger than the medial cavity (Fig .2B).The

mean width and thickness of the proximal extremity in the third digit slightly different than that of the fourth digit in both the right and left fore limb (Table.2). The distal articular extremity was similar in structure of that in pI, while its mean width and thickness of distal extremity of the third digit was slightly different than that of the fourth digit in both the right and left fore limbs (Table. 2).

(Table 2) The morphometric measurements of the middle phalanx of third and fourth digit in the right and left fore limb in goat. n=10, M± SE (cm)

Middle phalanx	Right limb (cm)		Left limb (cm)	
	Third digit	Fourth digit	Third digit	Fourth digit
phalanx Length	1.25 ± 0.08	1.25 ± 0.08	1.25 ± 0.08	1.25 ± 0.08
Width of proximal extremity	1.24 ± 0.05	1.04 ± 0.05	1.25 ± 0.04	1.06 ± 0.05
Width of distal extremity	0.88 ± 0.	0.72 ± 0.06	0.96 ± 0.06	0.77 ± 0.05
Thickness of proximal extremity	1.15 ± 0.04	1.05 ± 0.02	1.17 ± 0.03	1.07 ± 0.02
Thickness of distal extremity	0.95 ± 0.	0.83 ± 0.07	0.97 ± 0.06	0.85 ± 0.07

The distal phalanx was entirely enclosed by the claw. It was triangular in shape and has four surfaces. The axial surface was smooth proximally and has numerous vascular foramina distally. The proximal articular surface appears confined from side to side, oblique palmarly, comprised from two sided and consist of two cavities separated by prominent ridge Articulated with the middle phalanx and articulated with the distal sesamoid bone by the flat surface located along the palmer border of the proximal articular surface called the articular sesamoid surface (Fig.3A). The

mean width and thickness of the articular surface in the third digit slightly different from that of the fourth digit in both the right and left fore limb (Table. 3). The parietal surface have more vascular foramina (Fig. 3B).The solar surface concave, irregular and, divided by the semilunar line in to two parts, the dorsal part was the largest than the palmer part, also called the flexor surface. The coronary or the dorsal border had a rough, pointed eminence for the insertion of the common digital extensor tendon.

(Table 3) The morphometric measurements of the distal phalanx of third and fourth digit in the right and left fore limb in goat. n=10, M± SE (cm)

Distal phalanx	Right limb (cm)		Left limb (cm)	
	Third digit	Fourth digit	Third	Fourth digit
Width of articular surface	0.97 ± 0.04	0.8 ± 0.05	1.04 ± 0.04	0.81 ± 0.05
Thickness of phalanx	1.07 ± 0.03	1 ± 0.01	1.04 ± 0.04	1 ± 0.01

The studies demonstrate that the fetlock joint was completely spherical or rounded in shape while the first interphalangeal joint was crescent-shaped. The fetlock joints surrounded by hard and soft tissue structures and composed of multiple hard and soft tissues. The dorsal surface of the

joints capsule of the fetlock, first interphalangeal and the second interphalangeal joint cover by the extensor digital tendons, while the palmer surface was covered by flexor digital tendons, where the medial and the lateral sides of the joints were supported by the collateral

ligaments. The capsule of fetlock joints was wider than the capsule of the pastern joint. The second interphalangeal joint was resemble the first interphalangeal joints. Four proximal sesamoid bones were present for each fore limb of goat, two for each digit located palmarly to the fetlock joints. Each sesamoid bone has three surfaces, apex and base. The articular surface palmarly articulated with the distal part of the large metacarpal bone and the proximal phalanx. The flexor surface was flat and oblique, while the lateral surface was convex. The base was located distally and attached with the distal sesamoid ligament. The apex was rounded and located proximally.

Two distal sesamoid bones in number were found for each fore limb of goat, one sesamoid bone for each digit. It was shuttle in shape and situated palmer to the second interphalangeal joints. It had one articular surface, two borders and two extremities. The articular surface consisted of two parts separated by a central elevated eminence and articulated with the distal end of pII. The flexor surface was same as the articular surface but rougher. The proximal border was rough for ligaments attachment and the distal border had facet for articulation with the palmer surface of pIII. The two extremities of the bone were irregular in shape.

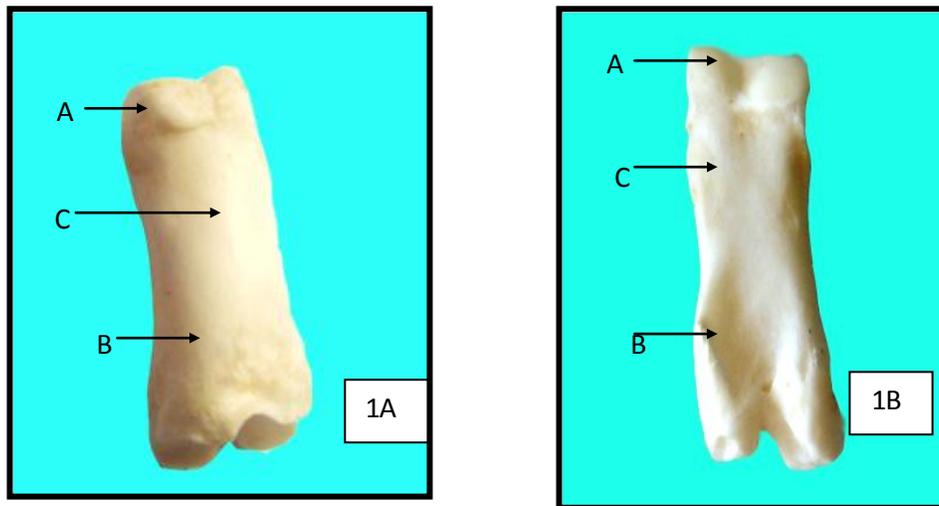


Fig (1A) dorsal surface; Fig (1B) Palmer surface of proximal phalanx

A. proximal extremity of proximal phalanx of proximal phalanx ; B. Distal extremity of proximal phalanx; C. Body

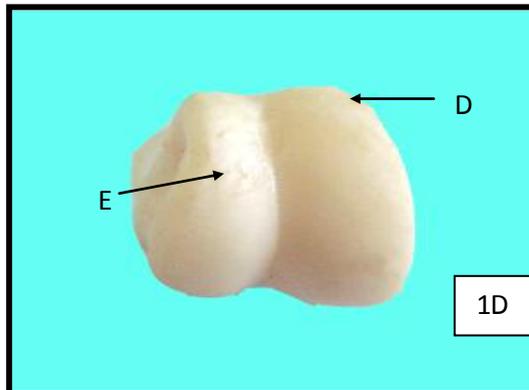
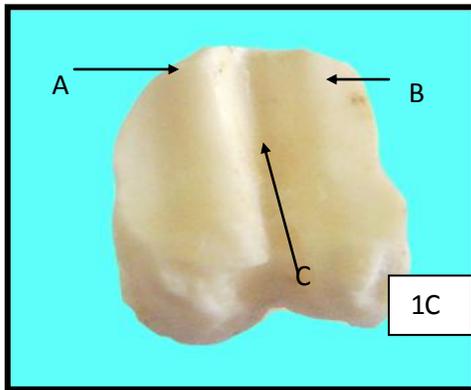


Fig (1C) proximal extremity of proximal phalanx; Fig (1D) Distal extremity of proximal phalanx
 A. lateral cavities; B. medial cavities; C. sagittal groove; D. lateral condyle; E. medial condyle

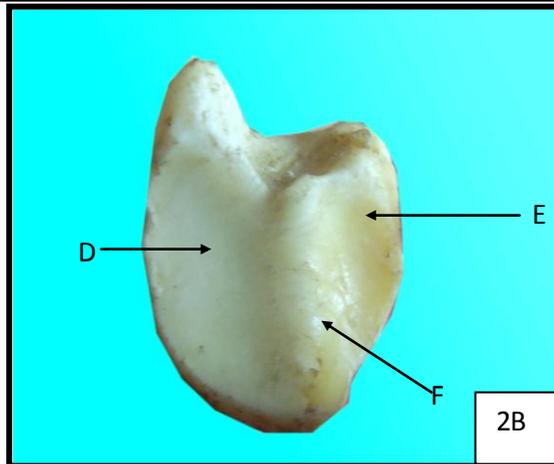
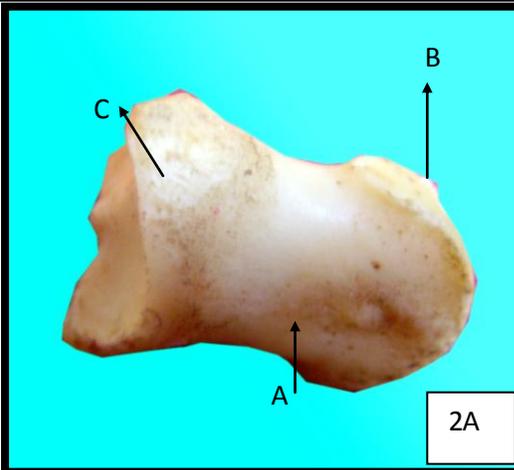


Fig (2A) Middle phalanx; Fig (2B) proximal extremity of middle phalanx
 A. Body of middle phalanx; B. proximal extremity of middle phalanx; C. Distal extremity of middle phalanx; D. lateral cavities; E. medial cavities; F. sagittal groove

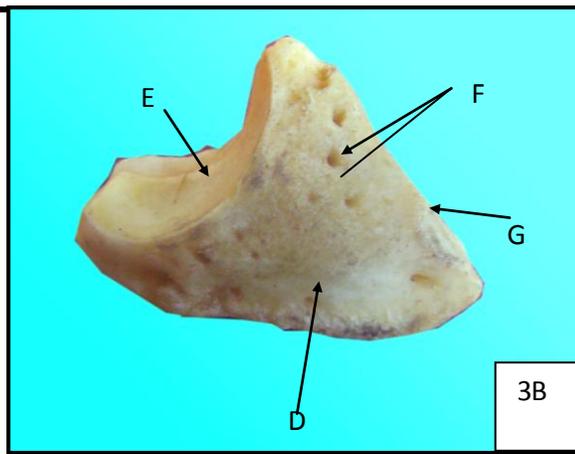
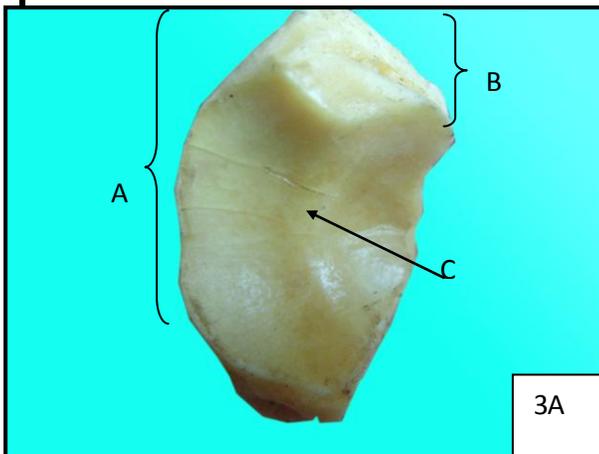


Fig (3A) Proximal articular surface of distal Phalanx; Fig (3B) lateral side distal Phalanx
 A. articular surface with the middle phalanx ; B. articular surface with the distal sesamoid bone, C. prominent ridge; D. Parietal surface of distal Phalanx, E. articular surface with the middle phalanx, F. vascular foramina, G. dorsal border

Discussion

Study confirmed, two fully developed digits (III) and (IV) in goats. The first digit is absent, the second and fifth was remaining as dewclaw. Each digit in goats consist of the (proximal, middle and distal phalanx) .The present observations are consistence with those observations of (11) and (15) in cattle, sheep and goats. Each phalanx (proximal and middle) consists of body and two extremities. The body has dorsal and palmer surfaces, the dorsal surfaces smooth, convex from side to side, while the palmer surface flat and have rough area for attachment with the ligament, that is disagreed with (9) who presented in camels the body of the (proximal and middle) were large, long and the two extremities of the proximal and the middle phalanxes were pointed. The distal phalanx was uniquely triangular in shape, its much smaller than the other phalanxes, further more, the parietal surface of PIII has more nutrient foamen for the pass of artires that is in agreement with (10) in impala, and (11) in goat .The proximal articular surface appears confined from side to side, oblique palmary, comprised from two sided for the articulation with the middle phalanx and with the distal sesamoid bone. This result confirmed the studies of (6) in cattle and sheep. The study declares that goats have

spherical fetlock joint was surrounded by hard and soft tissue structures. Capsule of fetlock joints is wider than the capsule of the pastern joint due to the presence of proximal sesamoid bones which help to increase extension of the capsule. This is in accordance with (12), and (6) in ox. The study observed four proximal sesamoid bones were present in goat, two for each digit. The proximal sesamoid bones are encased within the elastic suspensory ligament proximally and the nonelastic distal sesamoidean ligaments distally on the palmer surface of the fetlock joint because that proximal sesamoid bones provide stability to the suspensory apparatus as, by acting as lever arm for the suspensory apparatus. This result confirmed the studies of (13), and (14) in horses, (11) in goats, and (6) in cattle and sheep. Distal sesamoid bones in goats are two in number, one for each digit shuttle-like in shape, situated palmer to the second interphalangeal joints because that it increased the surface area of the coffin joint and reduced the impact loading of the deep digital flexor tendon away from the centre of the coffin joint. This finding seems consistent with (15), (16), and (6) in horse and cattle, while disagreed with the (17) who presented that the distal sesamoid bone in camels disappear.

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دراسة تشريحية للأصبع في الماعز

أيمان فيصل عبد الحسن

ثاير علوان عبد

حسنين علي الشاروط

كلية الطب البيطري/جامعة القادسية

الخلاصة

تناول البحث دراسة تشريحية للأصبع للقائمة الأمامية في الماعز. استخدم في هذه الدراسة عشرة أطراف أمامية من عشرة حيوانات ذكور عراقية، أعمارها (6) أشهر، أطرافها سليمة ليس تاريخ بالعرج، أورام موضعية وإصابات مفصليّة لغرض الدراسة. لقد بينت الدراسة أن الماعز يمتلك أصبعين وكل أصبع يتألف من ثلاث سلاميات وعظام سمسمانية. السلامية الأولى هي أطول السلاميات بينما السلامية الثانية فهي أقصر من السلامية الثالثة مثلثة الشكل وتمتلك العديد من القنوات الوعائية. العظام السمسمانية ألدانية تكون متطاولة في الشكل وكل عظم يتألف من ثلاثة سطوح أما العظام السمسمانية القاصية تكون مكوكية الشكل يقع راحيا للمفصل المتكون بين السلاميتين الوسطى والقاصية.

* بحث مستل من رسالة الماجستير للباحث الأول