Iraqi Journal of Veterinary Sciences

www.vetmedmosul.com

Anatomical study on the stifle (knee) joint in local breed of Awassi sheep

A.A. Al-Hasso, A.Gh. Alhaaik and M.J. Yousif

Department of Anatomy, College of Veterinary Medicine, University of Mosul, Mosul, Iraq

Article information

Article history:
Received November 21, 2022
Accept March 29, 2023
Available online June 12, 2023

Keywords:
Anatomical
Stifle joint
Awassi sheep

Correspondence:
A.A. Al-Hasso
adnanhassoali@gmail.com

Abstract

This study focuses on the knee joint of Awassi sheep in Nineveh Governorate to identify its morphological characteristics. Ten healthy knee joints were used from both sexes. Our study showed that the knee joint is a complex joint consisting of a femur-patellar and a femur-tibial articular surfaces. The femoral-patellar articular surface is formed among the ridges of the femoral trochlea, which comprises two parallel and oblique ridges, as the medial ridge continues with medial condyloid of femur and lateral ridge separates from lateral condyle by the extensor fossa. The patella bone is the other part of this articulating surface, smaller than the trochlear articular surface. The articular capsule is thin and wide, and it is a fibrous layer that connects and lies around articular surfaces' edges, which are strengthened medially and laterally by femoral-patellar ligaments, both medial and lateral. The femoral-patellar joint contains the medial and lateral femoro-patellar ligaments, which are in the form of straps that connect the patella bone to the tibia and the middle patellar ligament. The two femur condyles and the proximal end of the tibia come together to form the tibial-femoral articular surface, with meniscus cartilage overlapping. The medial and lateral menisci are crescent-shaped sheets of fibrocartilage corresponding to the femoral and tibial articular surface. Each meniscus is connected to the tibia anteriorly by the anterior tibial meniscus ligaments, the medial meniscus attached posteriorly to the tibia by posterior cartilaginous ligament, and the lateral meniscus cartilage posteriorly bonded to the femur by the cartilaginous menisco-femoral ligament. The fibrous sheet of the articular capsule is connected around the edges of the condyles of femur and tibia, and articular capsule is attached to the medial and lateral tibiofemoral ligaments. There are two vesicular sacs with a simple connection between the cruciate ligaments. This study concluded that the fibrous sheet of the articular capsule is connected around the edge's condyles of femur and tibia, and the articular capsule is attached to the medial and lateral tibiofemoral ligaments. There are two vesicular sacs with a simple connection between the cruciate ligaments.

DOI: 10.33899/ijvs.2023.137053.2633,

Introduction

Sheep are an important source of livestock in the country, where they are raised primarily for producing meat, milk, wool, and leather. There are three breeds of sheep in Iraq: Al-Awassi, Al-Karadi, and Al-Arabi, and Al-Awassi is the most prevalent breed in Iraq and some parts of the Arab world, Turkey, and others (1). Musculoskeletal studies frequently employ adult sheep bones as large animal models (2,3). Animal paws have great importance as they help animals to move and graze, and the bones and joints injuries should be considered the complex stifle joint (4). This joint is often prone to many complications that may require surgical intervention, for instance, patellar dislocation, synovitis, joint destruction, meniscal tear, and cruciate ligament damage (4-6).

As a result of the injuries mentioned above, the stifle joint is exposed to injury in sheep and knowing the exact structure

of this joint gave us the incentive to do this research on the local Awassi sheep in Nineveh Governorate, which aims to study the morphological characteristics of stifle joint in Awassi sheep by using macroscopic anatomy.

Materials and methods

Ten hind limbs of apparently healthy adult Awassi sheep of both sexes aged 2.5 - 3.5 years old were purchased from Mosul slaughterhouse and dissected to expose the stifle joint. The samples were divided into two groups. Group one four joints were placed after removing the soft tissues from them as much as possible in a solution of sodium hydroxide NaOH at a concentration of 10% for 48 hours at room temperature to perform the maceration process for these joints in order to study the joint surfaces (7,8). Group two six joints were dissected to study the ligaments and cartilage and describe the joint capsule.

Ethical approve

Ethical approval was not required for this study because data were collected from slaughterhouse.

Results

In Awassi sheep, our results presented that the knee joint is one of the complex joints, where further than one articular surface participates in its formation, and it consist of articular surface of femur and patella as articular surfaces of femur and tibia.

femoral-patellar articular surface

It formed between the femural and patellar articular surfaces (Figure 1). The femur's trochlea included two oblique and parallel ridges with a broad, deep groove between them. The medial edge is lower than lateral ridge and larger, especially in its distal part, where it continues with the medial condyle of the femur. The extensor fossa demarcates the lateral ridge from the lateral condyle (Figure 2).

Compared to articular surface of trochlea, the patella is significantly smaller than supplemented medially with a plate of parapatellar fibro-cartilage, which bends over a medial margin of the trochlea, a simple middle ridge dividing the surface of the articulation of the patella that extends from the base proximally to apex distally into a small lateral part and a large medial part (Figure 3).

Articulated capsule

The articular capsule of the patellofemoral articular surface in Awassi sheep was thin and broad, and it is a fibrous layer that connects and surrounds the edges of the articular surfaces. This capsule was strengthened laterally by the lateral patellar ligament, which is partially fused with it, while it is attached medially to the fibrous layer of the medial patellar femoral ligament from which it separated (Figures 4 and 5). The capsule is located under the quadriceps femoris muscle for about 1.5 cm, separated from this muscle by a piece of fat. A thick layer of adipose tissue separates the capsule from the patellar ligaments.

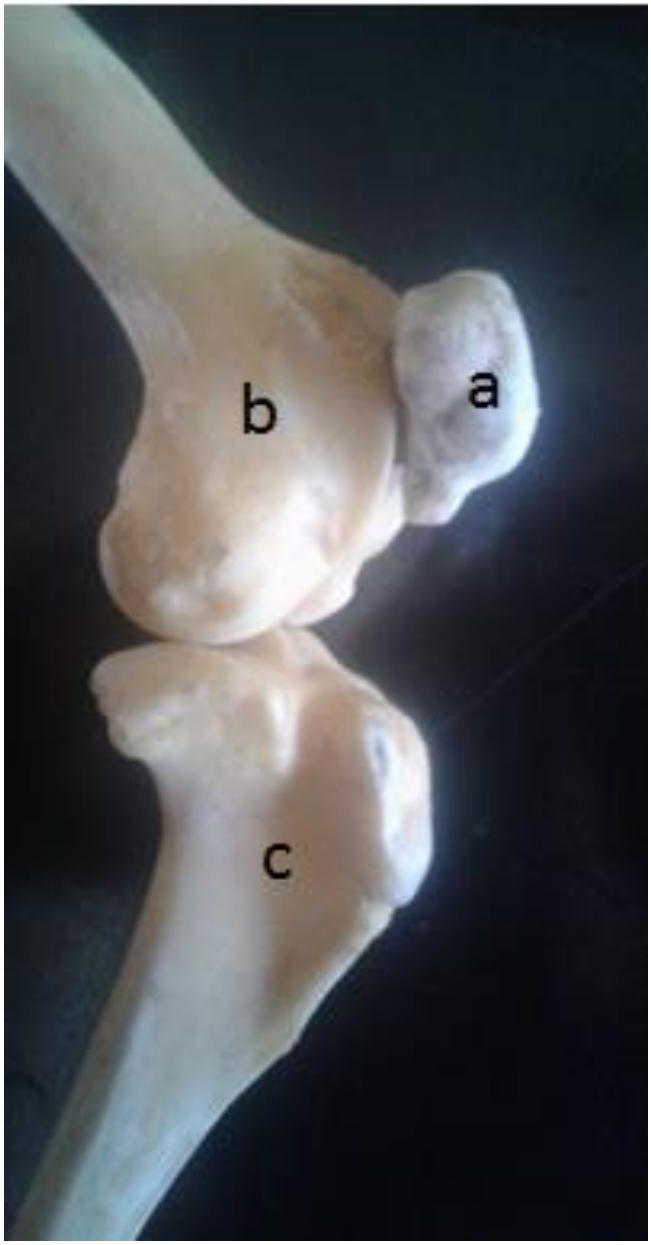

Figure 1: Picture showing: (a) patella, (b) distal extremity of femur, (c) tibia.

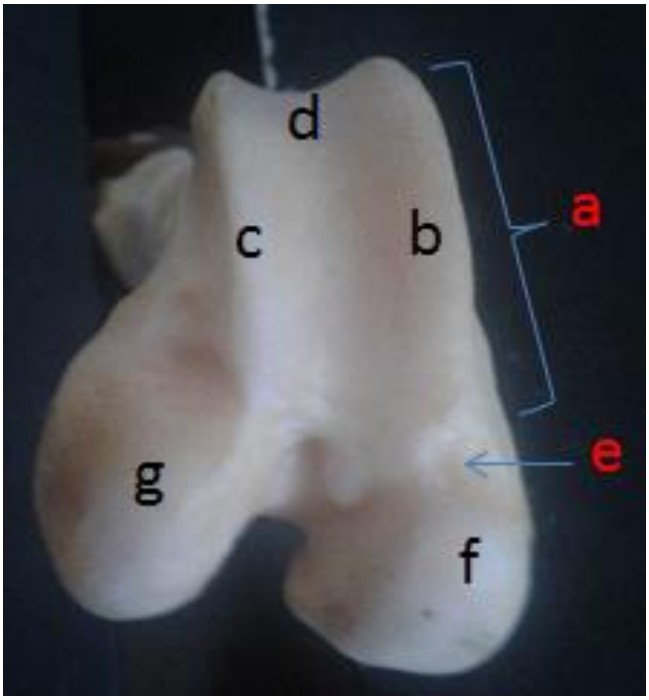

Figure 2: Picture shows distal extremity of femur: (a) trochlea of femur, (b) lateral ridge, (c) medial ridge d-groove between two ridges, (e) extensor fossa, (f) lateral condyle g-Medial Condyle.

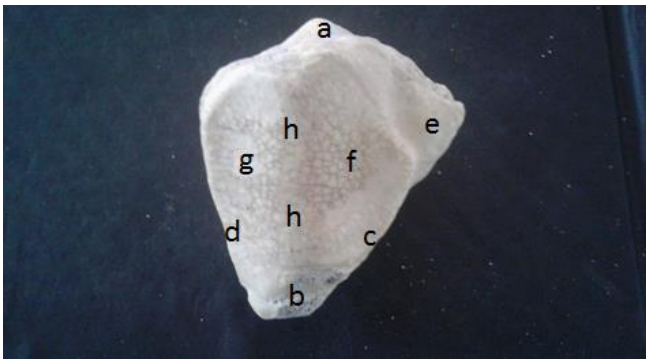

Figure 3: Articular surface of patella: (a) base of the patella, (b) apex of the patella, (c) medial ridge, (d) lateral ridge, (e) ossifying fibrocartilage, (f) medial articular surface, (g) lateral part of the articular surface, (h) middle ridge.

The medial and lateral femoral-patellar ligaments

Fibrous bands that strengthen the articular capsule from both sides. The medial femoral-patellar ligament (Figure 4) appeared somewhat distinct and was fan-shaped, with its wide part located anteriorly to the patella. It comes from the eminence on medial epicondyle of femur proximal and posterior to the medial collateral ligament. The ligament diverges in the proximal and anterior direction to terminate at the patellar medial border, the parapatellar fibro-cartilage connected to the medial part of the patella's anterior surface, and the distal to medial tuberosity. The lateral femoral-patellar ligament (Figure 5) appeared thin and indistinguishable from fibrous layer of articular capsule. It is represented by a narrow band arising from an eminence located on the lateral femoral epicondyle proximal and posteriorly from lateral collateral ligament of stifle joint. The ligament passes in an oblique anteriority direction to be attached in the middle of lateral border of patella.

Figure 4: Distal extremity of femur showing medial femoral-patellar ligament.

Figure 5: Distal extremity of the femur showing the lateral femoral-patellar ligament.

Patellar ligaments

are three ligaments in the form of bands that attach patella to the tibial tuberosity. They are insertion tendons of the quadriceps femoris muscle and the femoralis biceps muscle. The medial ligament of the patella (Figure 6) comes from the medial part of the anterior patellar surface, ventrally to the medial femoral-patellar ligament, which is partially covered by this ligament and then passes distally to attached in the medial surface from the proximal end of the tibia and posteriorly to the tibial tuberosity. The middle patellar ligament (Figure 7) is long, strong, thick, and broadband that extends from the anterior patellar surface and passes straight distally to the tibial tuberosity. The lateral ligament of patella

(Figure 8) appeared indistinct and completely fused with insertion tendon of the biceps femoris muscle that comes from the distal half of the lateral border of patella toward the lateral surface of the tibial tuberosity.

Figure 6: Distal extremity of the femur showing the medial patellar ligament.

Figure 7: Distal extremity of the femur showing middle ligament of patell.

Figure 8: Distal extremity of the femur showing the lateral patellar ligament.

femoral- tibial articular surface

The femoral-tibial articulation in Awassi sheep is created between the two femoral condyles, the proximal extremity of tibia, and menisci between them (Figure 9). The femoral condyles appeared slightly oblique in direction (Figure 10). Compared to the medial condyle, the lateral one was wider and larger, and its articular surface was more curved than that of the medial condyle. The medial condyle is confluent distally with the trochlear medial ridge, while the lateral one is separated from the lateral ridge by extensor fossa. In addition, the articular surface of lateral condyle presents the popliteal fossa from which the oblique tendon of the popliteal muscle arises. Two articular eminences, the medial and lateral condyles, are located on the proximal end of the tibia. (Figure 11), Each has an articular surface that resembles a saddle to allow for articulation with the appropriate femoral condyle and meniscus. Medial condyle was more extended and larger than lateral condyle on caudal surface of the proximal extremity of the tibia. The lateral condyle's lateral surface contains the articular facet of the head of the fibula. The inter-condylar eminence or spine of the tibia is slightly oblique and consists of two parts, a large and high medial part, while the lateral part is small and low, and these two parts are separated from each other by a deep and narrow nonarticular fossa from which the cranial cruciate ligament arises. There were intercondyloid fossae cranially as well as caudally to inter-condyloid eminence. The caudal one is larger and deep and to which attaches the caudal ligament of medial meiscus. At the same time, the cranial fossa is represented by a small shallow nonarticular depression separated cranially by the lateral part of the intercondyloid spine of the tibia where the lateral meniscus's cranial ligament was attached (Figure 11). Cranial to the medial part of the tibia's intercondyloid spine, the medial meniscus's cranial ligament is attached to a small prominence. The popliteal notch separates the two condyles of the tibia caudally, from which, in the medial part, there was a prominent tubercle to attach the caudal cruciate ligament. The tuberosity of the tibia has an oblique surface directed craniodistally. The middle patellar ligament covers it entirely (Figure 11).

The medial and lateral menisci (Figure 12) are crescentic plates of fibrocartilage that correspond to the femoral as well as the tibial articular surface. The lateral meniscus (Figure 13) does not cover caudal part of the lateral-tibial condyle, which was the site of attachment of the origin tendon of the popliteal muscle. Each meniscus has a proximal deep concave surface corresponding to the femoral condyle and a convex distal surface corresponding to the tibial condyle. The lateral border of each meniscus is very thick and convex, while the medial border is very thin and concave. Meniscal ligaments connected the cranial and caudal extremities of meniscal cartilage to the tibia at cranial and caudal to the tibial spine.

Meniscal ligaments

The cranial meniscotibial ligament connects each meniscus cranially to the tibia. The lateral one is longer and wider than the medial one. It runs from the lateral meniscus's cranial extremity to attach to the intercondyloid spine's

cranial fossa, while the medial one is shorter and thinner than the lateral one. It runs from cranial extremity of the medial meniscus to attach the eminence to cranial fossa and the cranial part of the tibial spine. In addition, the medial meniscal cartilage is connected to the tibia by the caudal meniscotibial ligament, which extends from the caudal extremity of the meniscus to caudal fossa caudal to the spine of the tibia. The lateral meniscus is attached to the femur by the meniscofemoral ligament (Figure 13). This ligament is represented by a thick, short, and flat band extended in an oblique path from the lateral meniscus' caudal extremity toward a facet in the caudomedial part of femoral inter-condyloid fossa proximal to medial condyle (Figure 10).

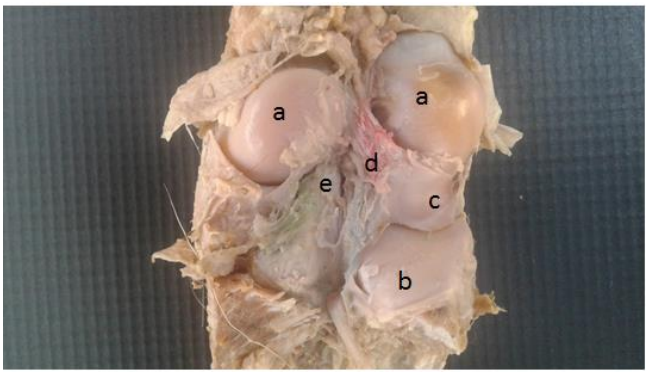

Figure 9: Picture showing the structure of the femoral-tibial joint: (a) femoral condyles, (b) tibial proximal, (c) meniscus, (d) meniscofemoral ligament, (e) caudal cruciate ligament.

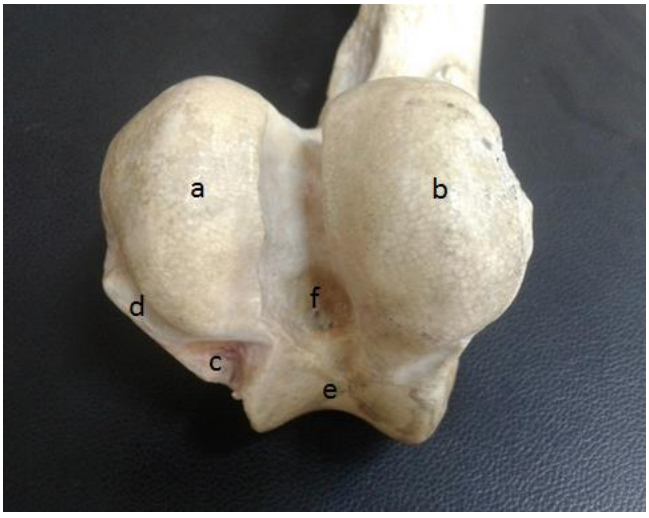

Figure 10: Distal extremity of the femur show: (a) lateral condyle, (b) medial condyle, (c) extensor fossa, (d) popliteal fossa, (e) trochlea of the femur, (f) intercondylar fossa.

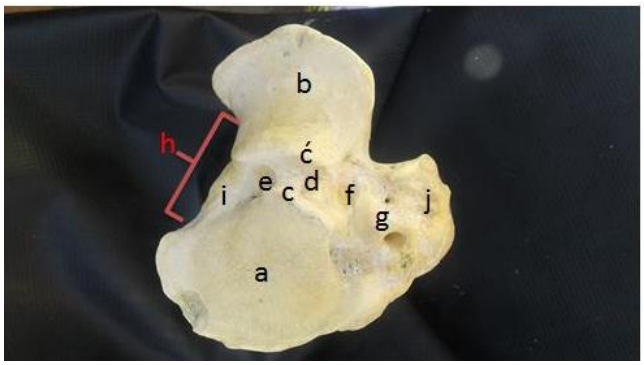

Figure 11: Picture showing the proximal extremity of the tibia: (a) medial condyle, (b) lateral condyle, (c) tibial spine, (d) nonarticular fossa, (e) caudal intercondylar fossa, (f) cranial intercondylar fossa (g) small eminence of the cranio medial meniscus ligament attachment (h) popliteal notch (i) tubercle of caudal cruciate ligament attachment (j) tibial tuberosity.

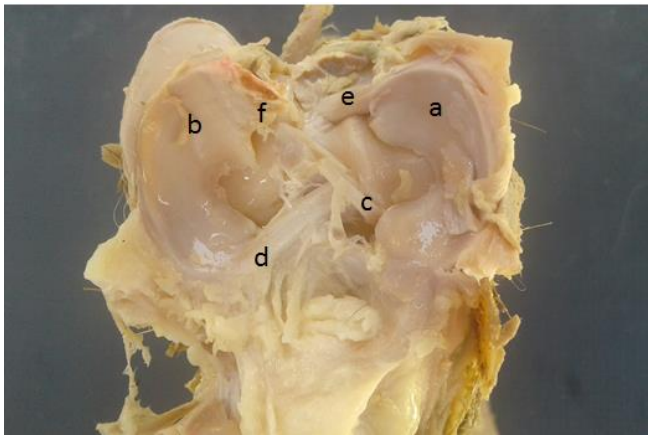

Figure 12: Picture showing medial meniescus: (b) lateral meniescus (c)cranial medial meiscus ligament (d) cranial lateral menscus ligament (e) caudal medial meniscus ligament (f) Part of the meniscofemoral ligament.

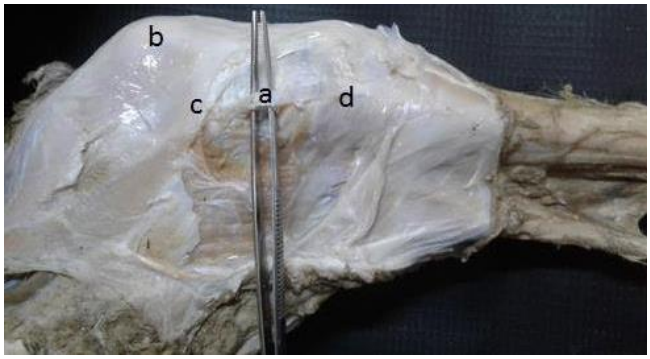

Figure 13: Picture showing: (a) medial collateral ligament (b) patella (c) femur (d) tibia.

Articular capsule

The fibrous layer was connected to the femur and tibia's condyle edges. The meniscus's and cruciate ligaments' convex borders are thin cranially and are represented only by the synovial layer, while they are much stronger caudally where the oblique tendon of the popliteal muscle strengthens them. The articular capsule is related to the medial and lateral femurotibial ligaments. There are two synovial sacs with minimal communication observed between them in between the cruciate ligaments.

Ligaments

There are four ligaments, two collateral, and two cruciate. The medial collateral ligament (Figure 14) is a long, narrow, and thick band that extends from a depression on the femoral medial epicondyle distal to the attachment of the medial femur patella ligament. It passes straightly to be attached on the most caudal part of the inner surface of the tibia about 4 cm distal to the tibial inner condyle's edge.

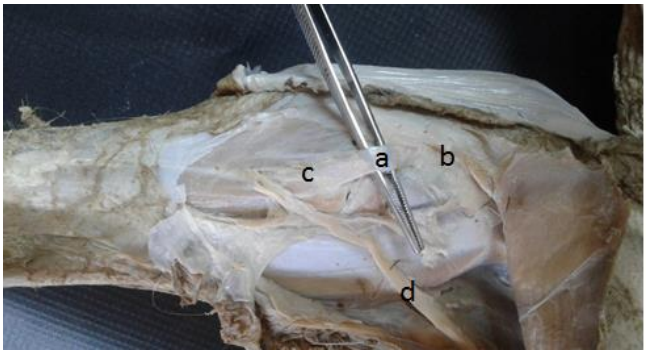

Figure 14: Distal extremity of femur showing: (a) lateral collateral ligament, (b) femur, (c) tibia, (d) sciatic nerve.

Discussion

Two major joints comprise the stifle joint anatomically, the femurotibial and femuropatellar joints. Condyles of femur,tibia as well as medial and lateral meniscie come together to create the femur-tibial articulation. The femur's trochlea and the patella's articular surface come together to construct the femuropatellar articulation (8,9). This result agreed with our observation in Awassi sheep that the knee joint is one of the complex joints, where more than one particular surface participates in its formation, and it consists of the articular surfaces of the femoral-patellar and femoral-tibial bones.

The external fibrous capsul as well as the inner synovial joint capsules comprised articular capsule, whereas outer one surrounded the femuropatellar and femurotibial joint sacs (10); our results agreed with the results mentioned above about the articular joint capsule. The articular surface of the patellofemoral capsule in Awassi sheep was thin and broad, where its fibrous sheet connects to the edge of the articular surfaces. It is strengthened laterally by a lateral patellar ligament partially fused with it, while medially, it is connected to a fibrous layer of the medial patella-femoral ligament. Medial and lateral femoro-patellar ligament existed skinny bands, as components of the fibrous joint capsule, running from the patellar medial and lateral borders to the medial and lateral sesamoid bones, respectively, at gastrocnemius muscle insertions (11).

Our results partially agree with what the researcher mentioned in the fact that there is a medial patellofemoral ligament and a lateral patellofemoral ligament, as the two ligaments connect to the patella. However, the difference is in the connection of the other end, where El-Bably and Noor (11) found the connection in the sesamoid bones at gastrocnemius muscle insertions. The difference is due to the difference in the type of animal under study. The Patellar ligaments are three bands that associate the patella with the tibia's tuberosity. Our findings approved those mentioned by Shigue *et al.* (12) in deer. Elbably and Noor (8), in their study on a red fox, said that the medial and lateral seasamoid bone, the medial and lateral femoral condyls located between the inter-condyloid fossa, the medial and lateral menescii, in addition to lateral and medial tibial condyles disconnected by the inter-condyloid eminance construct the femorotibial articulation, the observation of researcher like our results except there is no sesamoid bone in the stifle joint in sheep. Findings of current study were similar to that cited by Fathi *et al.* (13), who cited that the femoral medial condyle was inferior and lesser than the lateral one. Also, it was oblique in direction. The extensor fossa was situated between the lateral ridge of the femur's trochlea and the lateral condyle. The condyles of the tibia also were medial as well as lateral. These condyles have minimal contact with the femur's condyles since they were not designed to fit there. The existence of the menisci offset this adaption. The inter-condylar eminence separates the two tibial condyles into medial and lateral parts. The medial part appeared higher than lateral part. Lateral condyle appeared greater than medial one. The inter-condyloid eminence has two fossae that were cranial and caudal to it (14).

This result agreed with our findings, where proxiemal extremity of the tibia presents medial as well as lateral condyles. Each has to some degree, a saddle-shaped articular surface used for articulation with the compatible femoral condyle and meniscus. The menisci, which recompense for the incongruence of the articular surfaces, are each semilunar and wedge-shaped in section with concave proximal and slightly convex distal surfaces. Each is protected by ligaments that run between its cranial and caudal extremities and the central nonarticular area of the proximal extremity of the tibia. The lateral meniscus was also attached caudally to the femoral intercondylar fossa (15). This result agreed with our results. The cranial and caudal cruciate ligaments are fundamental in the femoral intercondyloid fossa between the two synovial sacs of the femorotibial joint.

The anterior cruciate ligament is oriented to the caudal direction and dismisses in the lateral wall of the femur's intercondyloid fossa. The caudal cruciate ligament runs proximally and is cranially medially to cranial cruciate ligament to terminate in the anterior part of the femur's inter-condyloid fossa (16). This result is agreed with our observation. The cruciate ligaments are two strong bands which are existed fundamentally in the femoral intercondyloid fossa between the paired synovial sacs. During the last decade, Numerous animals were admitted to hospital for various clinical reasons, and among these clinical cases, a sizable percentage had knee joint fractures (17,18). The caudally cruciate ligament is longer and lies medially to the cranial one. It arises from a prominent tubercle on the medial surface of the tibial popliteal notch. From its origin, the caudal cruciate ligament was directed proximally and cranially to be inserted in a depression situated in most cranial part of the femoral intercondyloid fossa. The cranial cruciate ligament was shorter than the posterior one. It arises from the intercondyloid fossa (central fossa) on the tibial spine and extends proximo-caudally to be attached to the horizontal wall of the femoral inter-condyloid fossa, these findings came in agreement with Hifny *et al.* (16).

This work concluded that fibrous sheet of articular capsule is connected around the edges of condyles of femur and tibia, and the articular capsule is attached to the medial and lateral tibiofemoral ligaments. There are two vesicular sacs with a simple connection between the cruciate ligaments. Severe joint lesions led to a high frequency of leg weakness, but this relationship was not absolute, indicating the joint lesions are not the only cause of leg weakness (19). Etterlin *et al.* (20) hypothesized that the increased magnitude and diversity of biomechanical stress experienced by free-range pigs promotes the development of osteochondrosis. Large animal models of osteoarthritis are a necessary testing ground for FDA approval of human medicine applications. Sheep models have advantages over other available large animals, but development and progression of osteoarthritis in sheep is exceedingly slow, which handicaps progress in development of potential treatments (21,22).

Conclusion

This study concluded that the fibrous sheet of the articular capsule is connected around the edge's condyles of femur and tibia, and the articular capsule is attached to the medial and lateral tibiofemoral ligaments. There are two vesicular sacs with a simple connection between the cruciate ligaments.

Acknowledgments

The authors gratefully acknowledge the cooperation and kind support of the management of the College of Veterinary Medicine, University of Mosul, Iraq.

Conflict of interest

The authors declare that there is no conflict of interest.

References

1. Alkass JE, Juma KH. Small ruminant breeds of Iraq [master's thesis]. Baghdad: Department of Animal Resources, College of Agriculture, University of Baghdad Abu-Ghraib, Iraq; 2005. 63-101 p. [available at]
2. Kayser F, Hontoir F, Clegg P, Kirschvink N, Dugdale A, Vandeweerd JM. Ultrasound anatomy of the normal stifle in the sheep. Anat Histol Embryol. 2018. DOI: 10.1111/ahe.12414
3. Martini L, Fini M, Giavaresi G, Giardino R. Sheep model in orthopedic research: a literature review. Comp Med. 2001 Aug;51(4):292-9. [available at]
4. König HE, Liebich HG. Veterinary anatomy of domestic mammals' textbook and color atlas. 7th ed. Stuttgart: CRC press; 2020. 268-275 p. DOI: 10.1055/b-007-167437
5. Little CB, Smith MM, Cake MA, Read RA, Murphy MJ, Barry FP. The OARSI histopathology initiative-recommendations for histological assessments of osteoarthritis in sheep and goats. Osteoarthr Cartil. 2010;232:345-349. DOI: 10.1016/j.joca.2010.04.016
6. Abumandour MA, Bassuoni NF, El-Gendy S, Karkoura A, El-Bakary R. Comparative morphological studies of the stifle menisci in donkeys, goats and dogs. J Morphol Sci. 2019;36(2):72-84. DOI: 10.1055/s-0039-1685487
7. Alhaso AA, Alhanosh AA. Anatomical measurement study of the pelvic bone in Alawasi ewe lambs and local black she goats lambs and its relationship to the age of sexual puberty. Ann Romanian Soc Cell Biol. 2021;25(6):8153-65. [available at]
8. González DB, Agudelo M. Comparison of macerations with dermestid larvae, potassium hydroxide and sodium hypochlorite in Wistar rat crania. Anat. 2019;13(3):149-154. [available at]
9. Burger C, Kabir K, Mueller M, Rangger C, Minor T, Tolba RH. Retropatellar chondromalacia associated with medial osteoarthritis after meniscus injury. One year of observations in sheep. Eur Surg Res. 2006;38(2):102-8. DOI: 10.1159/000093281
10. Supriya B, Chandrasekhara R, Jagapathi R. Anatomy of the femorotibial joint of stifle of buffalo calves (*Bubalus bubalis*). Buffalo Bull. 2016:35(4):541-548. [available at]
11. El-Bably SH, Noor NA. Anatomical, radiological, and magnetic resonance imaging on the normal stifle joint in red fox (*Vulpes vulpes*). Int J Anat Res 2017:5(4):60-69. DOI: 10.16965/ijar.2017.465
12. Shigue DA, Rahal SC, Schimming BC, Santos RR, Vulcano LC, Linardi JL, Teixeira CR. Evaluation of the marsh deer stifle joint by imaging studies and gross anatomy. Anat Histol Embryol. 2014;44:468-474. DOI: 10.1111/ahe.12162
13. Fathi N, Elbakary RA, Karkoura AA, El-Gendy SA, Abumandour MA. Advanced morphological and radiological studies on the stifle joint of Egyptian baladi goat (*Capra hircus*). Alex J Vet Sci. 2016:51(2):199-210. DOI: 10.5455/ajvs.239172
14. Dyce KM, Sack WO, Wensing CG. Textbook of veterinary anatomy. 4th ed. NY: CRC Press; 2010. 91-93 p. [available at]
15. Hifny A, Abdalla KH, Abdel Rahman YA, Aly K, Elhanbaly RA. Anatomical studies on the femorotibial joint in buffalo. J Basic Appl Sci Res. 2012;2(11):10930-10944. [available at]
16. Al-Mallah KH. Pathological study of the relation between the incidences of claws lesions and carpo-digital joint capsule lesions in front limbs of sheep slaughtered in Mosul. Iraqi J Vet Sci. 2021;35(4):693-697. DOI: 10.33899/ijvs.2021.127788.1530
17. Muhamad SA, Ali OJ, Abbas BT, Marif HF, Sleman RR, Ali BM, Raza DA, Ali HH, Ali GM. A retrospective study of fracture cases managed in the veterinary teaching hospital; 181 cases (2014-2018). Iraqi J Vet Sci. 2020;35(1):2020. DOI: 10.33899/ijvs.2020.126228.1266
18. Niles A. Genetic analysis of osteochondrosis and leg weakness in the Swedish pig progeny testing scheme. 1987;37(2):45-53. DOI: 10.1080/00015128709436552

دراسة تشريحية على مفصل الركبة في السلالة المحلية من الأغنام العواسية

عدنان علي حسو، عمار غانم الحائك و موفق جرجيس يوسف

فرع التشريح، كلية الطب البيطري، جامعة الموصل، الموصل، العراق

الخلاصة

هدف البحث الى دراسة مفصل الركبة والتعرف على الصفات المورفولوجية له في الأغنام العواسية في محافظة نينوى. استخدمت ١٠ عينات من مفصل ركبة الأغنام العواسية البالغة والسليمة ومن كلا الجنسين والتي تم إحضارها من مجزرة الموصل. وقد أظهرت دراستنا أن مفصل الركبة هو من المفاصل المركبة حيث يتكون من سطح تمفصلي فخذي -رضفي وسطح تمفصلي فخذي -قصبي. السطح التمفصلي فخذي -رضفي يتشكل بين بكرة عظم الفخذ المكونة من حيدين مائلين ومتوازيين حيث أن الحيد الأنسي يستمر مع اللقمة الأنسية لعظم الفخذ، أما الحيد الوحشي فانه يفصل عن اللقمة الوحشية بواسطة الحفرة الباسطة. أما الجزء الأخر من هذا السطح التمفصلي هو عظم الرضفة والذي يكون سطحه التمفصلي أصغر من السطح التمفصلي البكري. تكون الكبسولة المفصلية رقيقة وواسعة وهي عبارة عن طبقة ليفية تتصل وتقع حول حافة الأسطح التمفصلية والتي يتم تقويتها انسيا ووحشيا بواسطة الأربطة الفخذية -الرضفية الأنسية والوحشية. يحتوي المفصل الفخذي -الرضفي على الأربطة الفخذية-الرضفية الانسية والوحشية بالإضافة الى الأربطة الرضفية والتي تكون على شكل اشرطه تربط عظم الرضفة بعظم القصبة وهي الرباط الرضفي الأنسي والوحشي والرباط الرضفي الأوسط. السطح التمفصلي الفخذي -القصبي يتشكل بين لقمتي عظم الفخذ والطرف الداني من عظم القصبة والغضروف المفصلي المتداخل بينهما. الغضروف المفصلي الأنسي والوحشي عبارة عن صفائح هلالية الشكل من الغضروف الليفي والذي يتطابق مع السطح المفصلي الفخذي والسطح المفصلي القصبي. تتصل كل هلالة أماميا بالقصبة بواسطة الرباط الغضروفي المفصلي القصبي الأمامي، ويتصل الغضروف الهلالي الأنسي خلفيا بواسطة الرباط الغضروفي القصبي الخلفي ويتصل الغضروف الهلالي الوحشي خلفيا بعظم الفخذ بواسطة الرباط الغضروفي الفخذي. تلتصق الطبقة الليفية من الكبسولة المفصلية حول حواف لقمتي عظم الفخذ والقصبة وترتبط الكبسولة المفصلية بالأربطة الفخذية القصبية الأنسية والوحشية وهناك كيسان حويصليان زلاليان يوجد بينهما اتصال بسيط جدا يقعان بين الأربطة الصليبية. هناك أربعة أربطة في السطح التمفصلي الفخذي- القصبي هما الرباطان الجانبيان الأنسي والوحشي وكذلك الرباطان الصليبيان الأمامي والخلفي.

19. Etterlin PE, Ytrehus B, Lundeheim N, Heldmer E, Österberg J, Ekman S. Effects of free-range and confined housing on joint health in a herd of fattening pigs. BMC Vet Res. 2014;10:208. DOI: 10.1186/s12917-014-0208-5
20. Hill RJ, Mason HM, Yeip G, Merchant SS, Olsen AL, Stott RD, Van Wettere AJ, Bressel E, Mason JB. The influence of oblique angle forced exercising surgically destabilized stifle joints is synergistic with bone, but antagonistic with cartilage in an ovine model of osteoarthritis. Arthritis. 2017;2017:7481619. DOI: 10.1155/2017/7481619
21. Kuyinu EL, Narayanan G, Nair LS, Laurencin CT. Animal models of osteoarthritis: classification, update, and measurement of outcomes. J Orthop Surg Res. 2016;11:19. DOI: 10.1186/s13018-016-0346-5