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Morphological Characterization and Preparation of Knee Joint Porcino, Verisimilitude and Contributions as Alternative Material for Teaching Human Anatomy

Mauricio Ferraz De Arruda

[1]Physiotherapist, PhD in Bioscience and Biotechnology Morphology sub area Professor of the Anatomy in the Municipal Institute of Higher Education IMES-Catanduva-Brazil
zigomaticoah@ig.com.br

Gustavo Salomão

[2]Biologist Graduate in
The Municipal Institute of Higher Education IMES-Catanduva-Brazil

Abstract: *The teaching of human anatomy, temporal this moment passes by legislative and methodological modification, thus it is increasingly common to use plastic parts to simulate various body parts. Many team not bringing the quality and / or similarity to the natural ones. Thus in our study brings to the specific topic of the knee, a very complex and with many nuances to be displayed and stored, linked to the use of new methodologies and alternative teaching materials for this part. We can create various methods to improve this teaching, the use of anatomical parts similar to human animals, with the proposed this study using the porcine knee. Our work showed that were there 15 similar structures in the comparison between human and porcine knee*

Keywords: *Teaching, anatomy, knee, human, porcine.*

1. INTRODUCTION

Currently are found difficulties in order to improve the learning of anatomical structures for various reasons, one of them is the difficulty in memorizing anatomical terminology since most of the terms derived from Latin and Greek, as well as the inadequate preparation of the anatomical parts, preventing the close observation, and hindering the learning process [1].

There is also the matter of the teaching material (cadaveric and / or plastic components) being, for the most part, inadequate for the number of students, is mostly what we aim in this work where inadequate training of students by the difficulty of getting close parts ideal hinder meaningful learning of concepts of discipline [2].

Therefore, it is of fundamental importance to search for innovative methods to facilitate the apprehension of knowledge by students [3].

Currently, educational institutions seek methods and innovations in teaching to meet the difficulty of student learning, seeking thereby ensure high quality training of creative and critical professionals [3]. In order to prevent students from areas health pass through the discipline of human anatomy with a form of mechanical learning, we must work determine the relationship between the teacher, the students and the educational material [2].

This study will address the knee anatomy and constituent structures of this joint in order to characterize the structural equalities informed in literature one porcine model was dissected in order to demonstrate the feasibility of its use as part of laboratory practical teaching [2].

So the knee was the body structure of choice due to poor market parts that simulate this joint and, for surely is one of the most important parts of our body, through it takes mobility and stability to the lower limbs [2].

It is probably the most complicated joint in the human body. This ought to its function related directly to their bone structure, its integrated muscle activity and its restricted and accurate ligamentous structures, second [4].

We say that studies in animal models are great choices, but these choices are based on some considerations: proper analogy, transferability of information, genetic uniformity in the samples, knowledge of the biological properties, cost and availability, generalization of the results, easy adaptation to manipulation experimental, ecological consideration and ethical and social implications [5].

Thus it is urgent the importance of new methodologies deputy alternative materials for the teaching of anatomy in practical profile.

2. LITERATURE REVIEW

2.1. Morphological and Functional Aspects of the Human Knee Joint

The knee joint is formed by the distal femur, proximal tibia and patella; if this is divided into three compartments; medial tibiofemoral, patellofemoral lateral and anterior tibiofemoral [6].

The articular surfaces of the knee joint are characterized by their large size and all its complicated and incongruous ways. The femur leans medially to the knee, while almost vertical tibia is located [7].

The proximal medial epicondyle are prominences and lateral to the condyles, the medial is more prominent than the lateral. Gives rise to precisely the distal medial epicondyle, the deep medial ligament; and proximal to the medial fits the adductor magnus. The lateral epicondyle arises is where the lateral collateral ligament and epicondyle distally such, the lateral condyle engaging serves originating from the popliteus muscle [6].

The condyles are not identical, the major anterior-posterior axis are not parallel, but divergent backward; the internal condyle also differs more than the outward and is narrower [8]

The wider the sesamoid bone is the patella tendon and is implatada quadriceps muscle; It has a distal pole and the proximal extreito, triangular. The thicker articular surface is divided into greater lateral facet, lower medial and facetal vertical ridge [6].

The strong fibrous capsule superiorly is fixed to the femur, proximal to the joint immediate margins of the condyles and also the intercondylar notch later. [7].

The fibrous capsule is reinforced five ligaments; patella, fibular collateral and medial collateral; oblique popliteal and arcuate popliteal [7].

The lateral ligaments strengthen the joint capsule on both sides, internal and external; providing lateral stability when the knee is in extension [8]

The cruciate ligaments consist of dense connective tissue, oriented with symmetry and surrounded by a vascular synovial envelope. They are composed of collagen fibrils that combine to form larger fibers [6].

When you open the knee joint by the anterior approach, the cruciate ligaments are at the center of the joint, especially in the intercondylar notch. The first to appear is the anterior cruciate ligament, which is the longest and most exposed to trauma; behind is the posterior cruciate ligament, is what persists in partial ruptures [8]

Anterior cruciate ligament (ACL); it has a femoral fixation circular segment-shaped in the medial surface of the lateral femoral condyle; passing anteriorly, medially and distally inserting the tibia. It consists of two beams, beam medial anterior and posterolateral side, so-called tibial fasteners; a size measuring 38 mm in length, 11 mm width and 5 mm thickness. The primary function is to prevent the anterior displacement of the tibia and also hyperextension of the knee; is the secondary resistance to varus tendon and internal rotation to the tibia on the femur [6].

Posterior cruciate ligament (PCL); it has its origin in the medial femoral condyle and inserts later down to the posterior cortical surface of the tibia. Some authors have tried to write two or three beams to this ligament, but this anatomical description is not well supported and not clinical application behaves [9].

When the flexed knee ligament that is essential for stabilizing the femur [7].

The meniscus also part of the structure of the knee; They are two fibrocartilaginous disc-shaped crescent, are among the femoral condyles and tibial plateaus. They appear around the 45th day and are clearly defined in the eighth week of development [6].

The medial meniscus is C-shaped and wider than previous later. Its anterior horn part is fixed on the anterior cruciate ligament and the posterior horn part is fixed on the posterior cruciate ligament, has firmly to the deep surface of the tibial collateral ligament. The lateral meniscus is substantially circular and smaller than the medial. The meniscofemoral ligament unites this meniscus to the posterior cruciate ligament and the femoral condyle [7].

Fibrocartilage tissue are formed hydrated and its weight has in its composition approximately 75% water; the solid components are 90% collagen and from 2% to 3% proteoglycans [6].

The knee joint has the first degree of freedom constrained by XX` transverse axis, around which perform flexion-extension movements in the sagittal plane. Contained in a frontal plane horizontally through the femoral condyles [8]

The second degree of freedom is the rotation around the axis YY`da leg, with the knee flexed. This rotation becomes impossible in length; thus the axis of the leg is intertwined with the mechanical axis. We say that the flexion-extension is the main movement of a knee [8]

Extension is a movement away from the rear face of the rear leg thigh, there is no absolute extent, so the reference position the lower member is in a state of maximum elongation [8]

The bending is approaching the back of the leg to the back of the thigh. We have absolute bending from the position reference and a relative bending from any position in flexion. We can also speak of active flexion, it reaches 120 ° if the hip is extended; and passive flexion, reaches an amplitude of 160 ° and leaves with the heel contact the buttock [8]

The leg rotation around the longitudinal axis; It can only be carried out with the knee bent, as it extended the blockade called joint connects the tibia and the femur. Our internal rotation is the one that leads to tiptoe in and intervenes with great importance in the foot abduction movement. The external rotation leads to tiptoe out and is also involved in this movement of abduction [8]

The longitudinal rotational movements of the knee is flexed only occur when. To the extent that rotation is impossible, as is the tension of the cross and lateral ligaments. When the extended knee cruciate ligaments prevent the occurrence of the internal rotation; LCAE is contracted in the rotation and internal stretches on the outside, the external LCPI is stretched and contracted in the inner [8]

The main degree of freedom of the knee is in flexion-extension, corresponding to the transverse axis. It is conditioned by the trochlear joint; the femur lower end surfaces are a pulley, which has a similar shape with a train double landing aircraft; both condyles form the two joint faces of the pulley and are the landing gear wheels and pulley throat is represented by the neck of the femoral trochlea and behind the intercondylar notch [8]

Extension and hyperextension the anterior cruciate external're tense when long and is one of the brakes in hyperextension so, both the cruciate ligaments and by the side of the knee rotational stability in extension can occur, it is assured [8]

2.2. Morphological and Functional Aspects of the Porcine Knee

The porcine diartrodial is a knee joint, has joint capsule, synovial membrane and synovial fluid. Sub-patellofemoral joint is a knee joint that communicates with the medial and lateral joint femorotibias, the trochlea, at its distal end; we can also say that both the medial side as through an intercondylar space called, communicate [10]

Patellofemoral capsule is greatly enhanced because it is constituted by groups linked to the collateral ligaments and sagittal synovial fold extends cruciate ligament. It consists of a strong patellar ligament in his distal part has a purse and a small transverse ligament connects the cranial face of the meniscus [11]

The patellar ligament only, the patella, the extensor groove of the tibia and the collateral ligaments are palpable references knee. The medial surface of the tibia may be accompanied, from the knee to the distal end [10]

The pig anterior cruciate ligament consists of two distinct parts separated by the anterior tibial ligament lateral areas previously tibial fixation. On entering the anteromedial portion of the LCA, we have the tibialis anterior ligament of the medial meniscus [12]

The origin of the anteromedial portion of the LCA, begins in the posterior-proximal part of the femur and its place is above the tibia. Its postero portion originates from the anterior distal femur and inserts on the back of the tibia anterior intercondylar area [12]

Except for side fibers, on the anteromedial portion of LCA regarding their attachment points the rest can be seen best with the knee in extension. When the joint moves from full extension to 25° flexion, lateral fibers are strained, but in anterior proximal part of the origin of the fiber becomes less tense as it is the most extreme bending position. Most of the remaining fiber is strained in extension, some are tense and very few flexion joint at intermediate positions [12]

We have also a guide beam in the posterior cruciate ligament, consisting of side fibers. Most of its fibers are strained in maximum flexion, some in intermediate positions near the maximum flexion and full extension. We can say that the ACL's main function is to contain the extension and the posterior cruciate ligament restricting flexion [12]

Each knee has two meniscus, medial and lateral. The medial have in your same way an open half-moon (35mm diameter front-rear, in humans) and occupies approximately 60% of the surface of the medial tibial plateau. The side is in form a "C" being in it's smaller than the medial diameter [13].

The medial and lateral meniscus are connected via transverse ligament present in dogs and pigs [14]. The top of the meniscus is concave in shape and consequently allows a good contact area with the condyles of the femur and the lower part is flat to better accommodate the tibial [13].

3. PURPOSE

Characterized morphologically and prepare a porcine knee joint, as an alternative material for teaching human anatomy.

Determine the similarity between the bone structures of the human knee joint and porcine

Determine the similarity between the ligaments of the human knee joint and porcine

4. MATERIALS AND METHODS

4.1. Materials

- Formaldehyde 10%
- Tweezers mouse tooth
-Cable For Scalpel No. 4
-Lâmina Scalpel to number 4
Latex -gloves to Embramac mark procedure.

5. PROCEDURES

5.1. Procedures Theoretical Preparation

12 books found in different libraries have been read as follows: Municipal Library Catanduva-SP, UNESP / Araçatuba-SP library, library UNIP / Sao Jose do Rio Preto, IMES Catanduva-SP library.

7 were read articles and 2 theses from various locations and databases to study as Scielo and MEDLINE.

5.2. Procedures Manufacturing Practice

The porcine knee was obtained in butchers, kept in 10% formalin dissected for four months, several pieces were tested to achieve the successful outcome.

Made in the laboratory of IMES Catanduva-SP, where the lower Pig members were transported packed by plastic bags and left in freezer to be frozen. After thawing started dissection, leaving intact only the main parts of the knee for comparison.

The dissection was carried through scalpel blade used at 45 ° degrees for each cut, always using forceps known as rat tooth to remove excess and unnecessary parts. Much meat is removed and all the fat useless.

Finally the excess was clean, thereby obtaining only the study knee parts. After dissecting the entire piece was again in 10% formalin, it may be used in various statements.

6. RESULTS

The results show the detection very similaridad the human knee of the porcine knee following structures:

Femoral medial condyle, Lateral femoral condyle, Capsule knee joint, patella; Ligament side if fibular originating from the lateral epicondyle of the femur and inserting the head of the fibula;

Tibial collateral ligament originating from the medial femoral epicondyle and the medial tibial insertion;

Medial meniscus, lateral meniscus;

Anterior cruciate ligament originating from the lateral femoral condyle and insert the anterior intercondylar area;

Posterior cruciate ligament originating from the femoral medial condyle and insert the posterior intercondylar area;

Patellar ligament originating from the patella and insertion into the tibial tuberosity;

Greasy ligament;

Ligament to the femoral meniscal;

Tibial plateaus, Tibial tuberosity

Many of the aforementioned structures can be observed in Figures below.

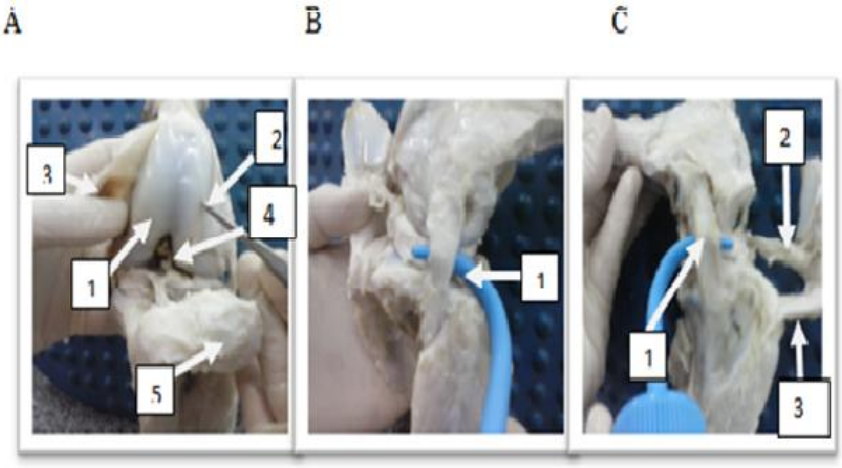

Fig1. *(A) porcine knee in front view, where it is observed through white arrows identification of the lateral femoral condyle A1, A2 femoral medial condyle articular capsule, A3, A4 anterior cruciate ligament, patella A5; (B) a side view observed in the tibial collateral ligament in B1 and (C) Medial view observing the fibular collateral ligament C1, fatty ligament and patellar ligament C2 C3.*

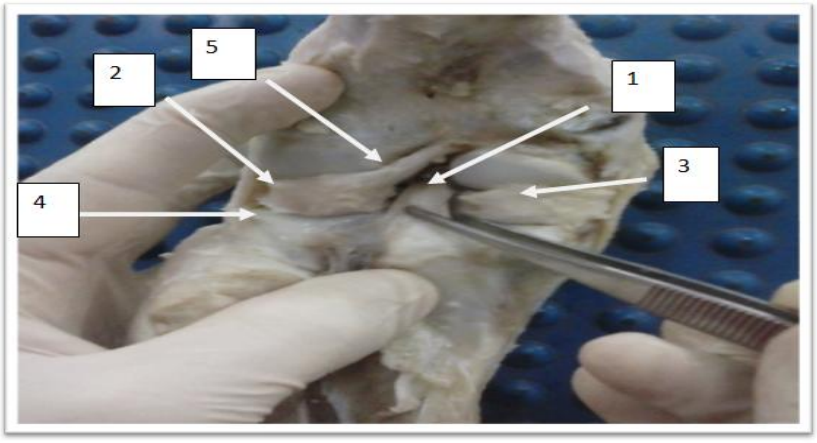

Fig2. *Porcine knee rear view, which is observed through the white arrows identify the posterior cruciate ligament 1, 2 lateral meniscus, medial meniscus 3, 4 tibia plateaus and femoral ligament meniscus 5.*

7. DISCUSSION

The teaching of anatomy undergoes numerous changes in various contexts whether they are legal or didactic. Teaching materials (plastic parts) most often are not understood, so we aim in this work a satisfactory training of students, improving learning in various concepts of discipline [2].

Currently, educational institutions can not own bodies, seek new methods to try to address the difficulty of student learning, and seeking higher quality training [3].

Our work meets the others, as Silva (2012)[15], which through research related to alternative materials for teaching anatomy, proposed new ways, using anatomical animal parts, specifically pig organs.

In his report he used two pieces of pork purchased at butcher; heart, leaving blood vessels, arteries and coronary veins, the inner region of the heart and also the atrioventricular valves and lungs and can show all the air conducting channel from the primary bronchi to the bronchioles, leaving alveolar part covered by pleura in some regions of the lung.

The study with real pieces arouse interest and ease in conducting practical classes without laboratories nor the use of sophisticated equipment. Emphasizing our work in the sample as they really are the posterior and anterior cruciate ligaments, these parts that are quite damaged, with greater learning of each student through real parts.

This study corroborates Mello 2009 [16] May used porcine knee doing a training in surgical techniques, this knee Landrace, coming from a refrigerator slaughter of animals for human consumption. The doctor and president of the Campinas Knee Group, Dr. Wilson Mello said that "is very similar to human knee porcine and much better training in biological artificial knee that."

This shows that our study may further various parts of the knee, because the knee is porcine very similar to human meniscus, various ligaments, patella and many other structures; They are easier to be viewed in real knee than plastic parts.

The anatomical comparative study demonstrates knee similarities between tetrapods, thus indicates the ancient origin, demonstrating the adaptability of these joints [9].

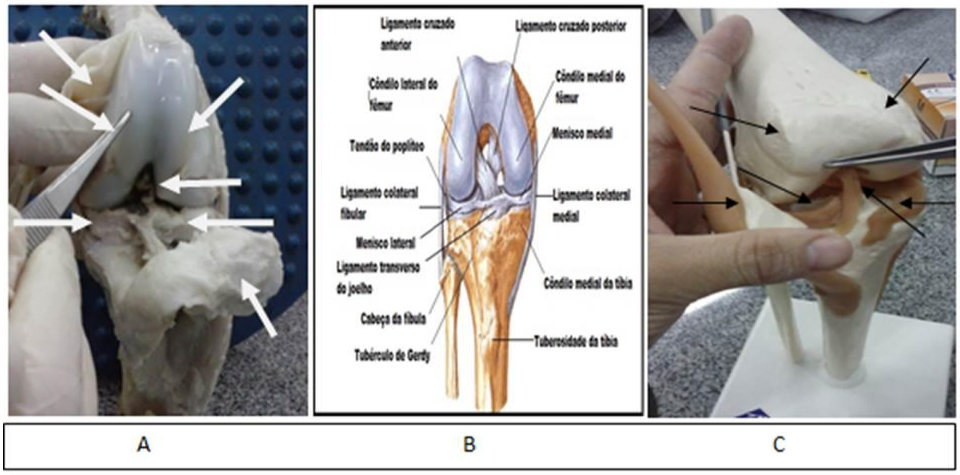

Fig3. *We can observe and make comparisons of the actual piece in A, the pig with the figure of book B and the plastic part C.*

Source: Adapted from Own and NETTER 2000.

8. CONCLUSION

We conclude that the anterior and posterior cruciate cruciate ligaments, the medial femoral condyle and lateral, the patella, the fibular and tibial collateral collateral ligaments, the medial and lateral meniscus, the patellar ligament, the fat ligament, the capsule of the knee joint, the ligament meniscus femoral, tibial plateaus and the tuberosity of the tibia showed anatomical likelihood and can be used for the anatomy of discipline since proved often more reliable than current plastic parts that do not show much the actual shape of each of the knee.

In comparison we also find parts that do not appear in commonly used plastic parts, and the joint capsule of the knee and the fat ligament. The ligament femoral meniscal lying in the plastic part,

however loose.

We note some important parts in the porcine knee that can be addressed in future studies as the peroneal muscles, very similar to the veins and arteries of the human knee.

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AUTHORS' BIOGRAPHY

Mauricio Ferraz de Arruda is Bachelor in Physiotherapy from the University Center of Araraquara, Master from the Faculty of Pharmaceutical Sciences of Araraquara Julio de Mesquita Filho- UNESP, Doctor from the Faculty of Pharmaceutical Sciences of Araraquara, Julio de Mesquita Filho-UNESP in Biosciences and Biotechnology sub -Area Capes (Morphology) Update on Rheumatology from the School of Ribeirão Preto Medical FMRP. Researcher in the field of musculoskeletal tissue injury and repair. Professor of disciplines, Anatomy, Physiology, Radiology, Biomechanics, Prosthesis and Orthosis from the IMES Catanduva. Effective member (SBA) Brazilian Society of Anatomy. Lecturer in orthopedic imaging area.

Gustavo Salomão is Graduate in Biology from the IMES Catanduva., Professor of Anatomy discipline in the technical college CEME