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Mini Review

The Role of the Transverse Ligament of Knee Joint in the Formation of Meniscus Geometry

Ivantsou AU[1]*, Tsydzik IS[2] and Ivantsou UA[3]

[1]Department of Normal Anatomy Grodno State Medical University, Republic of Belarus

[2]Grodno Regional Clinical Cardiology Center, Republic of Belarus

[3]Department of Traumatology, Grodno State Medical University, Republic of Belaruse

***Corresponding Author:** Ivantsou AU, Department of Normal Anatomy Grodno State Medical University, Republic of Belarus.

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Abstract

In the presented article the variety of forms of the knee joint menisci is considered. The most common forms of menisci were determined, depending on the features of fixation of the anterior horns.

Keywords: Knee; Meniscus; Children; Geometry

Introduction

According to different authors, the incidence of meniscus injuries in children ranges the incidence of meniscus injuries in children ranges from 0.15 to 36.7% of all knee injuries. Menisci provide an important role in maintaining body weight, carrying and distributing stress, and ensuring knee stability. Damage to the menisci is accompanied by adverse changes in joint function, leading to pain, impaired movement, instability. The destruction and absence of menisci (or most of them) promotes the progression of degenerative-dystrophic processes in previously intact joint elements, leads to the rapid development of deforming osteoarthritis and long-term disability [1,2].

The biomechanics of the knee joint is responsible for the distribution of the load, so when the knee is in full flexion, the lateral meniscus transfers 100% of the load in the lateral knee, while the medial meniscus transfers approximately 50% of the medial load [3]. Observations of various degrees of destruction of the cartilage of the condyles of the femur and tibia after total and subtotal removal of the menisci show the important role of the meniscus in stressing the knee joint. Partial meniscectomy leads to a loss of 12% of the contact surface, subtotal - 46%, and total - 75%.

To ensure the conformity of the articular surfaces, it is necessary not only to maintain the size and overall shape of the meniscus, it is also important to maintain the curvature of the meniscus surfaces. The concave femoral surface of the meniscus plays a key role in ensuring congruence with the femur and is an important geometric variable in the formation of the resulting forces during the transfer of axial load and radial displacement of the meniscus, as well as the concomitant stretching in the meniscus material. Likewise, the slight concavity of the tibial surface of the meniscus and its change from anterior to posterior regions is important for the resultant forces and tension in the joint [4,5].

The complexity of the geometry of the meniscus makes it necessary to study in detail not only the variety of meniscus shapes, but

also to assess the shapes of the menisci with various options for fixing the anterior horns.

The aim of our study was to study the peculiarities of the geometry of the menisci of the knee joint of newborn children with various options for fixing the anterior horns.

The material for our study was 30 preparations of knee joints of fetuses and newborns, without pathology of the musculoskeletal system from the collection of the Department of Human Anatomy. The study was approved by the Research Ethics Committee.

The studies were performed in the physiological position of the lower extremities. Preliminarily, the skin and subcutaneous fatty tissue were removed and the joint cavity was dissected with an incision around the patella from above and from the sides. Prior to this, the patellar and lateral ligaments were identified if possible, and attention was paid to the shape and degree of development of the intraarticular ligaments, menisci, and articular surfaces of the knee joint. To determine the morphometric parameters and geometric shapes of the meniscus, the distance between the horns, anteroposterior size, width, and height of individual parts of the meniscus were measured using a caliper morphometric method. The obtained data were recorded in protocols indicating the variants of anatomical structure, their morphometric features, and individual sketches with photographs of the preparations were performed. The study has a descriptive character comparative statistical parameters and reliability were not determined. Only the percentage of cases from the total sample was determined.

Research results. Anatomical dissection and detailed preparation of the structures of the knee joint allowed us to establish the presence of the transverse ligament in 15 cases (50%) (Figure 1).

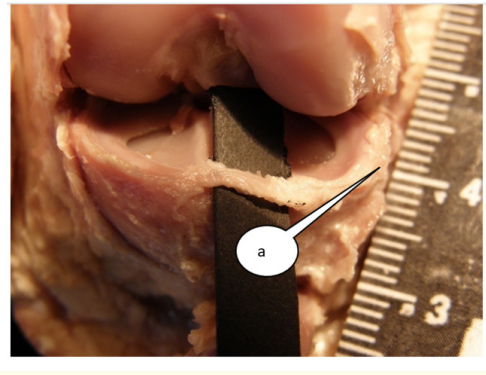

Figure 1: Transvers ligament.

a - transvers ligament and in 15 cases (50%) the transverse ligament was absent (Figure 2).

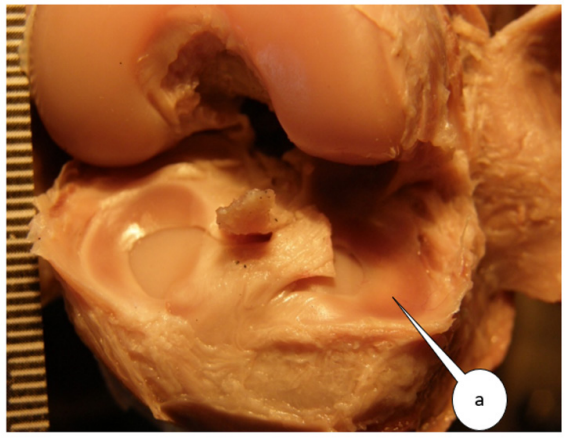

Figure 2: Absence of transverse ligament.

a - anterior horns are not connected by the transverse ligament and the anterior horns were fixed using bundles of the meniscotibial ligaments. In the course of our studies, we found that in all cases of the presence of a transverse ligament and in its absence, the distance between the horns at the medial meniscus significantly exceeds the same dimensions in the lateral one, which once again confirms the position that the shape of the medial meniscus is more crescent (reminds crescent), while the shape of the lateral meniscus is closer to discoid (or annular) (Figure 3).

Figure 3: Anatomy of the meniscus.

However, the shaped relationships between the individual parts of the menisci are quite variable and form complex meniscus ensembles of the knee joint. Having systematized the forms of the menisci during fixation of the anterior horns with the transverse ligament, we found that the most common variant (7 cases (23.3%) was the relationship of the menisci in which the sizes of the posterior horn prevailed over the sizes of the body and the anterior horn, and all sizes of the lateral the meniscus prevailed over the size of the medial meniscus (Figure 4).

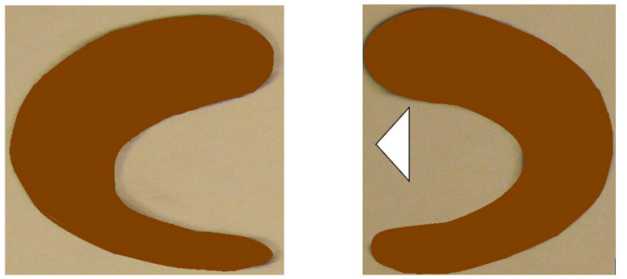

Figure 4: the most common variant of the meniscus forms.

In 2 cases (6.7%) the sizes of the posterior horn prevailed over the sizes of the body and anterior horn, while the sizes of the body and posterior horn were larger in the medial meniscus than in the lateral (Figure 5).

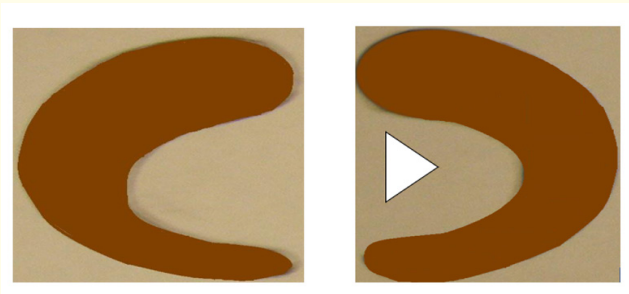

Figure 5: The second version of the meniscus forms.

Of particular interest are 2 cases (6.7%) in which, in the medial meniscus, the dimensions of the posterior horn prevailed over the dimensions of the body and anterior horn, and in the lateral meniscus, the dimensions of the posterior horn were larger than the dimensions of the anterior horn, and the dimensions of which, in turn, exceeded the dimensions of the body (Figure 6).

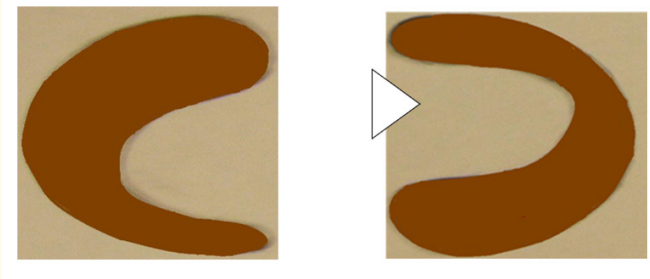

Figure 6: The third version of the meniscus forms.

In each (13.3%) of the remaining four cases, there were different relationships between the parts of the menisci.

In the first case, in the medial meniscus, the dimensions of the posterior horn prevailed over the sizes of the body and the anterior horn, while at the same time, in the lateral meniscus, the maximum dimensions were observed in the body of the meniscus, and the posterior horn was larger than the anterior horn. The sizes of all parts of the medial meniscus in this case were larger than those of the lateral (Figure 7).

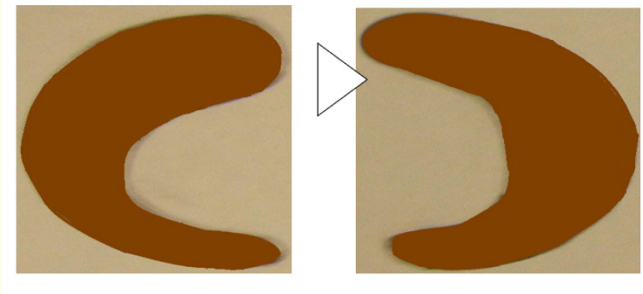

Figure 7: The first case of the rare meniscus forms.

In the second case, in the medial meniscus, the maximum dimensions were observed in the anterior horn with a predominance

over the size of the body and the small posterior horn, and in the lateral meniscus, the dimensions of the anterior horn were equal to the size of the body with predominance over the dimensions of the posterior horn. The sizes of all parts of the medial meniscus in this case were larger than those of the lateral (Figure 8).

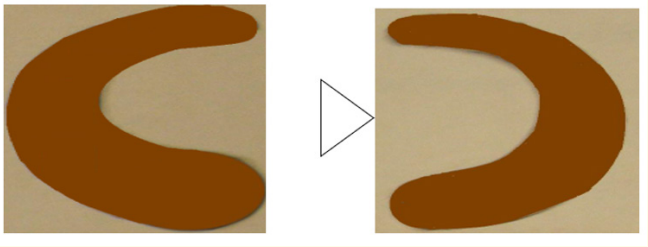

Figure 8: The second case of the rare meniscus forms.

In the third case, in the medial meniscus, body dimensions prevailed over the dimensions of the posterior horn, and its dimensions were larger than the dimensions of the anterior horn, in the lateral meniscus, on the contrary, the body dimensions prevailed over the dimensions of the anterior horn, and its dimensions were larger than the dimensions of the posterior horn. When comparing the lateral and medial menisci, it turned out that the anterior horn and body were large in the lateral meniscus, and the posterior horn in the medial (Figure 9).

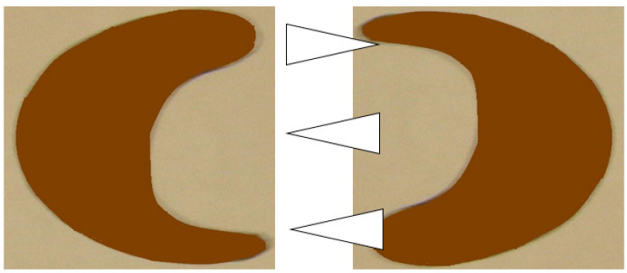

Figure 9: The third case of the rare meniscus forms.

In the fourth case, in the medial meniscus, the dimensions of the posterior horn prevailed over the dimensions of the body and anterior horn, while in the lateral meniscus, the maximum dimensions were observed in the body of the meniscus, and the posterior horn was larger than the anterior horn. A similar variant was described in the first case, but the difference lies in the fact that when comparing the lateral and medial menisci, it turned out that the anterior horn and body were large in the lateral meniscus, and the posterior horn in the medial (Figure 10).

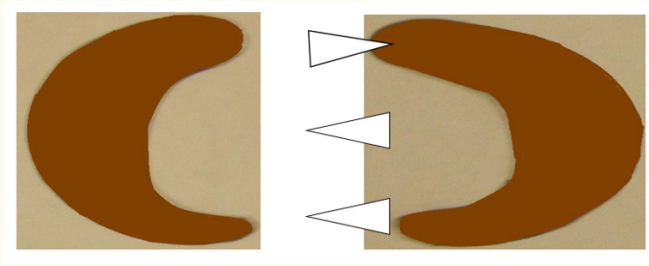

Figure 10: The fourth case of the rare meniscus forms.

In the course of systematization of the meniscus shapes in the absence of fixation of the anterior horns of the menisci by the transverse ligament, we established the following options. So the most common variant (8 cases (26.7%)) was the relationship of the menisci in which the dimensions of the posterior horn of the medial meniscus prevailed over the size of the body and the anterior horn (Figure 11).

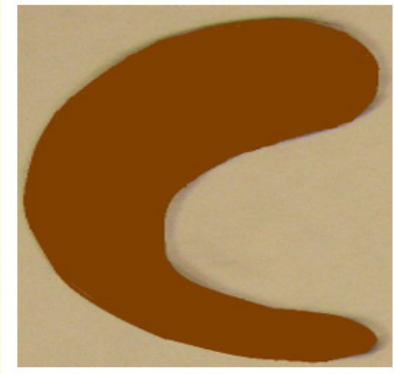

Figure 11: The first version of the meniscus forms without transvers ligament.

while this form of the lateral meniscus was found in 5 cases (16.7%), in one case (3.3%) the size of the posterior horn was equal to the size of the body with predominance over the size of the anterior horn (Figure 12).

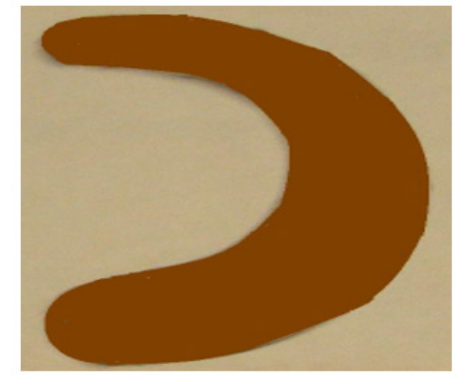

Figure 12: The second version of the meniscus forms without transvers ligament.

in one case (3.3%) the size of the body was less than the size of the posterior and anterior horns (Figure 13),

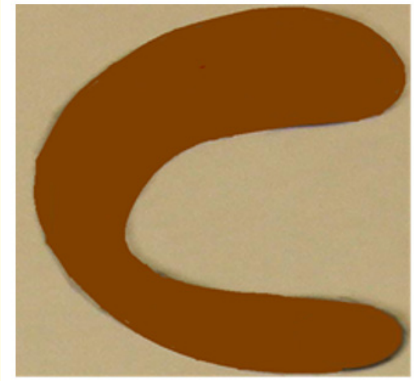

Figure 13: The third version of the meniscus forms without transvers ligament.

in one case (3, 3%), the body dimensions were larger than the dimensions of the posterior and anterior horns (Figure 14).

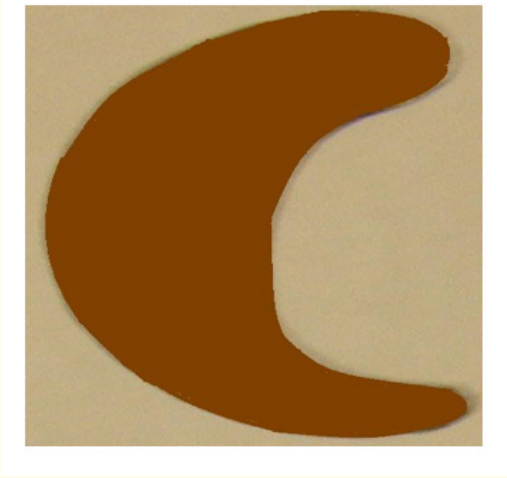

Figure 14: The fourth version of the meniscus forms without transvers ligament.

Moreover, all sizes of the lateral meniscus prevailed over the sizes of the medial meniscus. In three cases (9.9%), in the medial meniscus, the dimensions of the posterior horn dominated over the anterior horn, and the dimensions of the anterior horn dominated over the size of the body (Figure 15).

Figure 15: The fifth version of the meniscus forms without transvers ligament.

At the same time, in the lateral meniscus, in two cases (6.7%), the dimensions of the posterior horn were equal to the size of the body with a predominance of the size of the anterior horn (Figure 16),

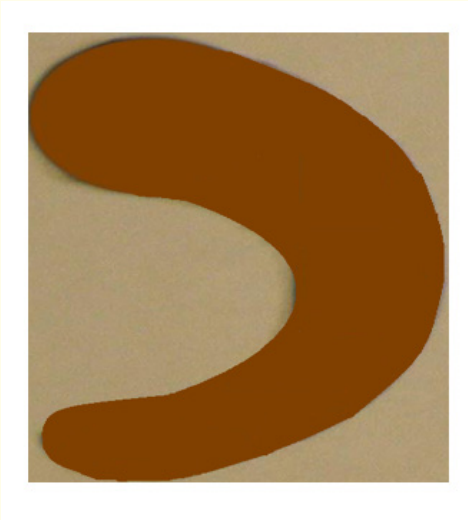

Figure 16: The sixth version of the meniscus forms without transvers ligament.

and in one case (3.3%) the sizes of the posterior horn were larger than the size of the body and the anterior horn.

In two cases, we established in the medial meniscus the predominance of body size over the size of the horns (6.7%) (Figure 17),

while the same meniscus shape was observed in similar lateral menisci. In one case (3.3%), the medial meniscus had the same size of the body and the posterior horn with a less pronounced anterior horn, while the lateral meniscus had the smallest sizes in the posterior horn, and the sizes of the anterior horn prevailed over the sizes of the meniscus (Figure 18).

In one case (3.3%), in the medial meniscus, the maximum dimensions were recorded in the posterior horn, and the dimensions of the anterior horn prevailed over the dimensions of the body, while the lateral meniscus had the smallest dimensions in the posterior horn, and the dimensions of the anterior horn prevailed over the dimensions of the meniscus (Figure 19).

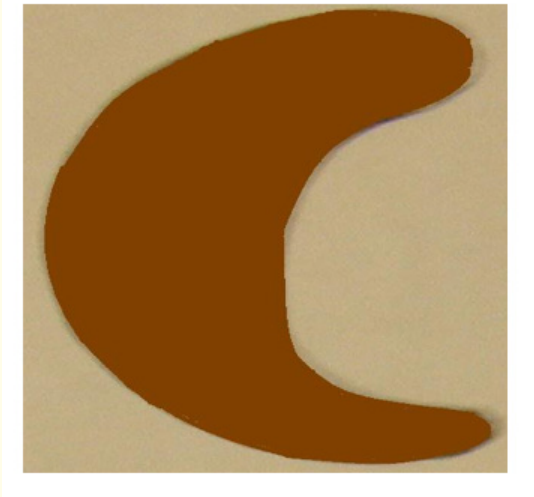

Figure 17: The seventh version of the meniscus forms without transvers ligament.

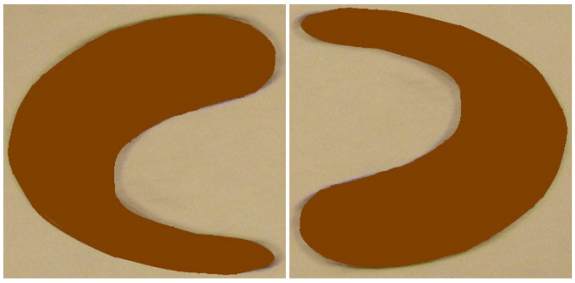

Figure 18: The eighth version of the meniscus forms without transvers ligament.

Discussion and Conclusions

The diversity, inconsistency, and multidirectional nature of the current data on the variant anatomy of the meniscus of the knee joint creates difficulties in the early detection, prediction of the course, and adequate treatment of children with injuries and dis-

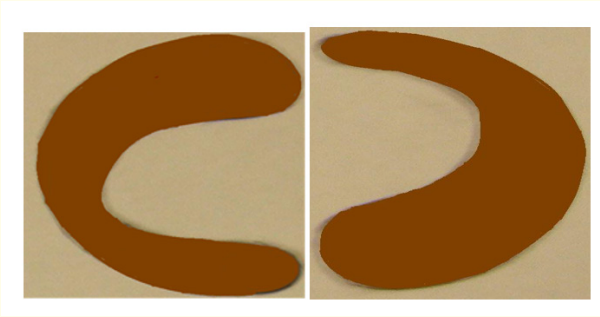

Figure 19: The ninth version of the meniscus forms without transvers ligament.

eases of this articulation. Despite the different shapes of the menisci, the transverse ligament provides reliable fixation of the anterior horns, allowing the knee joint to perform complex, but at the same time adequate biomechanics.

The peculiarities of the shape of the menisci and their fixation apparatus of variants play a key role in the biomechanics of the knee joint both in normal functioning and in pathology, forming a complex set of diagnostic symptoms from asymptomatic course to the presence of pain with a decrease in the amplitude of movements.

The results we have presented are quite interesting because they display rare forms of the meniscus complex and its relationship with the transverse ligament of the knee, which may pose certain difficulties in the radiological diagnosis of knee joint injuries.

We believe that the large width of the posterior horn of both menisci in newborn children causes a high frequency of injuries of this localization in older children when axial loads are encountered.

Bibliography

1. Turati M., *et al*. "Discoid meniscus in human fetuses: A systematic review". *Knee* 30 (2020): 205-213.

2. Schmitt A., *et al*. "Results with all-inside meniscal suture in pediatrics". *Orthopaedics and Traumatology: Surgery and Research* 102.2 (2015): 207-211.

3. Jung YB., *et al*. "Anomalous insertion of the medial menisci". *Arthroscopy*14.5 (1998): 505-507.

4. Walker PS and Erkman MJ. "The role of the menisci in force transmission across the knee". *Clinical Orthopaedics and Related Research* 109 (1975): 184-192.

5. Mariani PP., *et al*. "Anomalous insertion of anterior and posterior horns of medial meniscus. Case Report". *BMC Musculoskeletal Disorders* 22.1 (2021):823.

6. Sadigursky David., *et al*. "Anatomical variant of the meniscus related to posterior junction: a case report". *Journal of Medical Case Reports* 11 (2017): 1 351.