European Review for Medical and Pharmacological Sciences 2023; 27: 9085-9090

# The morphology of cyamella and its prevalence in Turkish society

F. AKSU[1], R.F. AKKOC[1], P. GUNDOGAN BOZDAG[2]

[1]Department of Anatomy, Faculty of Medicine, Firat University, Elazig, Turkey
[2]Department of Radiology, Elazig Fethi Sekin City Hospital, Health Science University, Elazig Campus, Elazig, Turkey

**Abstract. – OBJECTIVE: The aim of this study is to determine the prevalence and morphometry of cyamella, one of the sesamoid bones around the knee joint.**

**PATIENTS AND METHODS: In this retrospective study, a total of 9,500 plain/digital radiographs of 6,500 patients over the age of 18 who applied to Elazig Fethi Sekin City Hospital between January 2021 and January 2022 were examined.**

**RESULTS: Examinations revealed cyamella in a total of 76 (0.8%) knees in the direct X-ray images of 49 (0.75%) patients. Eighteen (36.74%) of the patients with the presence of cyamella were males, and 31 (63.26%) were females. The mean age of the patients with cyamella was 50.9±12.9. Twenty-seven (55.1%) of the 49 cyamella were bilateral; seven (14.3%) were in the right knee, and 15 (30.6%) were in the left knee. The comparison of cyamella sizes between genders revealed a statistically significant difference in the transverse measurements only ($p$=0.015) in the right knee, while a statistically significant difference was found in all 3 parameters ($p$=0.032 for thickness; $p$=0.04 for transverse; $p$=0.026 for length) in the left knee.**

**CONCLUSIONS: We believe that sufficient knowledge regarding the prevalence and distribution of cyamella in patients presenting with the complaint of knee pain and its differentiation from fabella, another sesamoid bone in the same region, as well as other anatomical structures, will aid an early and accurate diagnosis.**

*Key Words:*
Cyamella, Direct X-ray, Sesamoid Bone, Knee Joint.

## Introduction

Sesamoid bones are accessory ossicles found in tendons and muscles. The main function of the sesamoid bones is to facilitate the physiological motion of the tendon. Sesamoid bones may make pseudo-articular connections with their neighboring bones. In the case of destruction of these articulations, they may be a cause of considerable pain and rupture of the tendon[1-3]. Generally, some sesamoid bones found in primates and other animals are embryologically more common in the fetus in humans, fusing with skeletal growth and bone maturation during development[4,5]. One of the sesamoid bones found in the lower extremities is the "cyamella". Cyamella is a sesamoid bone located proximal to the popliteal muscle, also known as "popliteal fabella", "fabella distalis", or "sesamoideum genu inferius laterale"[6-9]. Cyamella, enclosed by an external cortical shell, is composed of trabecular bone. As in other sesamoid bones, genetic effects play a role in the formation of cyamella, whereas environmental stimuli exert a large effect on cyamella ossification[10]. The cyamella may be located at the lateral aspect of the knee, within the sulcus popliteus of the femur, at the head of the proximal tibia, or between the tibia and the caput fibula[7-9]. Cyamella may vary in size. Its function is not fully defined. Fabella, another sesamoid bone, is a sesamoid bone that should be clearly distinguished in pathologies such as calcification, osteophyte, osteochondromatosis, and popliteal tendon avulsion[4,11,12]. Cyamella and fabella are sesamoid bones found in the same region. However, they are associated with different muscles with different motions. Cyamella is associated with the popliteus muscle, which flexes and internally rotates the leg. Fabella and is also associated with the gastrocnemius muscle, which flexes the foot[2,10].

Cyamella cause atypical knee pain such as cyamella syndrome, posterior knee pain, chondromalacia, and n. peroneus communis palsy. Besides, discoid meniscus, rheumatoid nodules, iliotibial band friction, biceps femoris tendon, semitendinosus and gracilis tendons, popliteus tendon, and symptomatic cyamella should be considered in the differential diagnosis of snapping knee cases[13-22]. Posterior knee pain following symptomatic

*Corresponding Author:* Ramazan Fazil Akkoc, Ph.D; e-mail: ramazan_fazil@hotmail.com

cyamella may lead to further immobility and progression of knee joint flexion contracture[23].

The presence of cyamella can be detected by various modalities such as direct radiography, computed tomography, and magnetic resonance imaging[12].

There are no studies conducted on the prevalence and distribution of cyamella in the Turkish population, except for case reports. The present study aims to determine the prevalence, distribution, gender differences, and morphometric characteristics of cyamella in the Turkish population. Thus, we believe that our study will aid in the early and accurate diagnosis as well as the differential diagnosis of various pathological conditions caused by cyamella.

## Patients and Methods

### Participants and Radiographic Images Examination

In this retrospective study, a total of 9,500 plain/digital radiographs of 6,500 patients over the age of 18 who applied to Elazig Fethi Sekin City Hospital between January 2021 and January 2022 were examined. Patients undergoing direct X-rays of the knee joint with a film-focus distance of 100-120 cm were evaluated retrospectively (Figure 1). Those undergoing surgery on the distal femur, proximal tibia, and proximal fibula, those who had fractures or fissures in the same region, had knee joint pathology, had a direct X-ray of the knee joint, and had poor image quality were excluded from the study (2,184 plain/digital radiographs were excluded from the study) (Figure 2).

### Statistical Analysis

IBM SPSS Statistics Version 22.0 (IBM Corp., Armonk, NY, USA) package software was used for statistical analysis of the data. The data were presented as frequency (percentage) and median (min-max). The Mann-Whitney U test was used for continuous variables that did not show a normal distribution between two independent groups, whereas the Kruskal-Wallis test was used for more than two independent groups. Categorical variables were analyzed with Pearson's Chi-square test, and the corresponding *p*-value was obtained. The statistical significance level was accepted as 0.05 in all tests.

## Results

In the present study, direct radiograph images of 6,500 people taken between January 2021 and January 2022 were examined. Examinations revealed cyamella in a total of 76 (0.8%) knees in the direct X-ray images of 49 (0.75%) patients. Eighteen (36.74%) of the patients with cyamella were males, and 31 (63.26%) were females. The mean age of the patients with cyamella was 50.9±12.9. Twenty-seven (55.1%) of the 49 cyamella were bilateral; seven (14.3%) were in the right knee, and 15 (30.6%) were in the left knee.

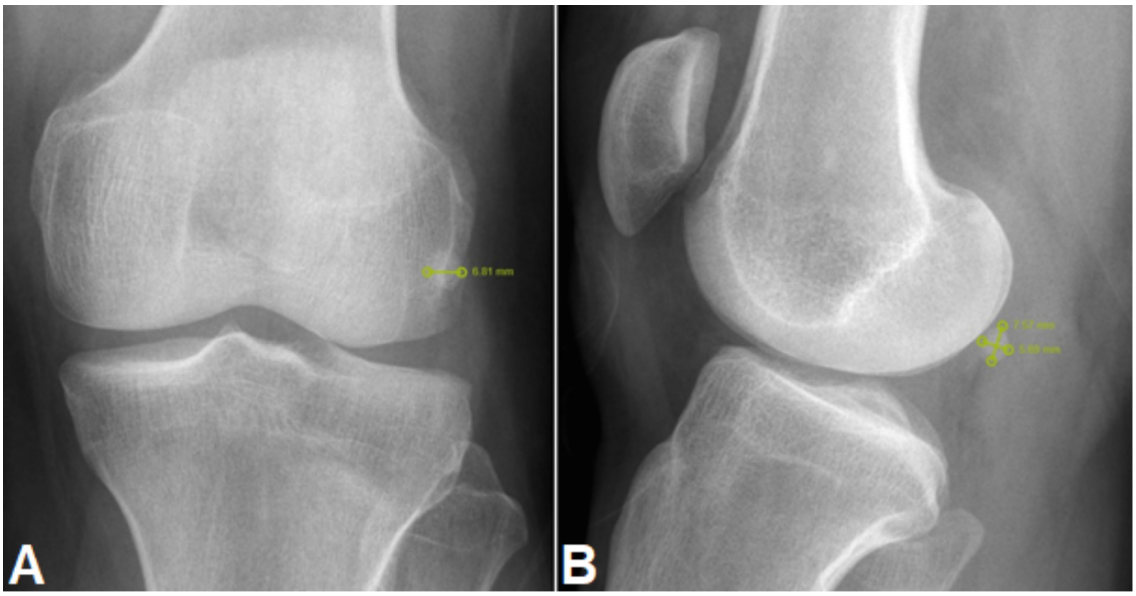


**Figure 1.** Morphometric measurements on direct X-rays. **A**, Anteroposterior X-ray. **B**, Lateral X-ray.

**Table I.** 3-way measurements of unilateral cyamella.

| | | Median (mm) | Min-Max (mm) | Std deviation |
|---|---|---|---|---|
| Right | AP (thickness) | 4.40 | 2.60-5.70 | 1.34660 |
| | Transverse (width) | 3.40 | 1.80-6.00 | 1.63881 |
| | Length | 6.30 | 3.10-10.00 | 2.16795 |
| Left | AP (thickness) | 3.70 | 2.10-6.00 | 0.97897 |
| | Transverse (width) | 4.20 | 2.30-6.20 | 1.12914 |
| | Length | 6.00 | 3.30-9.80 | 2.02466 |

AP (thickness), transverse (width), and length measurements of cyamella were obtained in mm. The dimensions of cyamella found only in the right or left knee are presented in Table I, while the dimensions of bilateral cyamella are presented in Table II.

The comparison of cyamella sizes between genders revealed a statistically significant difference in the transverse measurements only ($p$=0.015) in the right knee, while a statistically significant difference was found in all 3 parameters ($p$=0.032 for

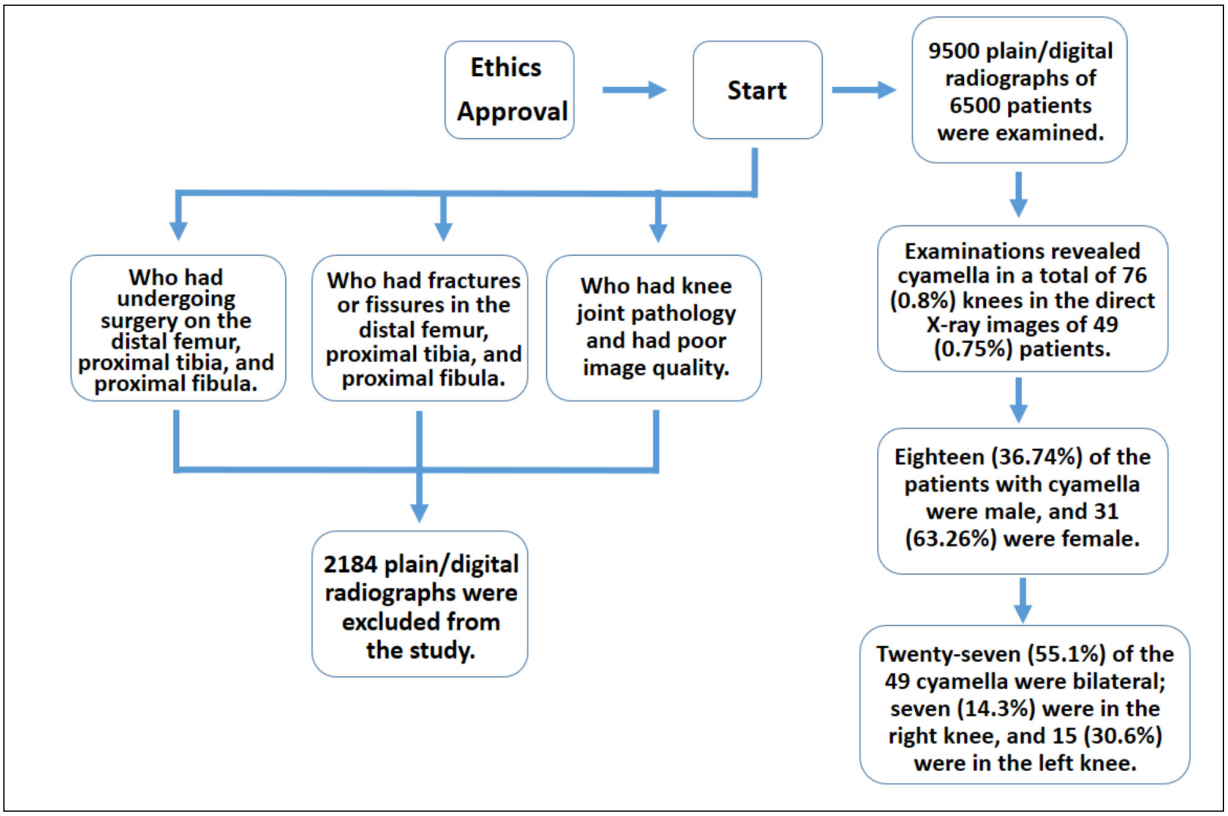


**Figure 2.** Flow diagram.

**Table II.** 3-way measurements of bilateral cyamella.

| | | Median (mm) | Min-Max (mm) | Std deviation |
|---|---|---|---|---|
| Right | AP (thickness) | 5.00 | 2.0-7.2 | 1.3215 |
| | Transverse (width) | 5.00 | 3.0-8.3 | 1.4716 |
| | Length | 7.00 | 3.2-10.0 | 1.6887 |
| Left | AP (thickness) | 5.20 | 1.7-8.9 | 1.7231 |
| | Transverse (width) | 4.90 | 2.8-8.8 | 1.6791 |
| | Length | 7.00 | 3.5-12.0 | 2.0566 |

**Table III.** Dimensions of cyamella by gender and plane.

| | | Male Median (min-max) | Std deviation | Female Median (min-max) | Std deviation | *p*-value |
|---|---|---|---|---|---|---|
| Right | AP (thickness) | 5.30 (2.0-7.2) | 1.5537 | 5.00 (2.5-6.2) | 1.1344 | 0.430 |
| | Transverse (width) | 6.00 (2.9-8.3) | 1.7298 | 4.50 (1.8-7.2) | 1.2111 | 0.015* |
| | Length | 7.00 (3.8-10.0) | 1.8043 | 6.60 (3.1-10.0) | 1.7290 | 0.286 |
| Left | AP (thickness) | 5.70 (2.5-8.9) | 1.7701 | 4.50 (1.7-6.8) | 1.2903 | 0.032* |
| | Transverse (width) | 6.00 (2.8-8.8) | 1.6047 | 4.20 (2.3-8.3) | 1.2998 | 0.004* |
| | Length | 8.10 (3.5-12.0) | 2.1943 | 6.15 (3.3-9.8) | 1.7410 | 0.026* |

*a statistically significant difference is observed between male and female ($p<0.05$)

AP (thickness); $p=0.04$ for transverse; $p=0.026$ for length) in the left knee. Cyamella size measurements according to gender and plane are presented in Table III.

A total of 76 cyamella detected in 49 individuals were all determined as Class I. They were localized lateral to the condylus lateralis of the femur, near the border of the popliteal tendon, and often within the popliteal sulcus.

## Discussion

Cyamella is one of the sesamoid bones found in the lower extremities. It may be located on the lateral side of the knee, in the sulcus popliteus of the femur, at the tip of the proximal tibia, or between the tibia and the caput fibula. Available literature[10] shows that environmental stimuli exert a greater effect on cyamella ossification, although genetic factors play a role in the formation of cyamella. Existing studies[8,24] on cyamella with total knee images report the prevalence of cyamella in a range of 0.57% to 2.70%. In this study, the prevalence of cyamella was determined to be 0.75% (49 people) according to the number of patients, while it was found to be 0.8% (76 knees) according to the total number of knees. When examining the cyamella, it should be carefully distinguished from the fabella, another sesamoid bone in the same region, because although they are located in close proximity, they are associated with muscle groups and tendons with different functions. Misdiagnosis of two sesamoid bones innately affects the prevalence.

In this study, direct radiography images of individuals over the age of 18 were examined, revealing that the youngest patient with cyamella was 21 years old and the oldest 72 years old. In the literature[24,25], the youngest person with cyamella was reported to be 14 years old, whereas the oldest person was 95 years old.

In this study, it was found that gender did not affect the localization (right or left) of cyamella ($p=0.172$), which is also consistent with the literature. The results of this study show that the prevalence of bilateral and unilateral cyamella is almost equal. Consistent with the literature, the existing equality in the present study suggests that environmental factors are more prominent in the formation of cyamella. In the available literature, an examination of the formation of cyamella in terms of genetic factors reveals that bilateral symmetrical cyamella is associated with the effect of genetic factors. In this study, the localization of all cyamella, including not only bilateral but also unilateral, was determined as Class I. We believe that genetic factors, such as environmental factors, also play a role in total symmetry among this population, which we examined retrospectively[10].

The review of the available literature[24,26] shows that cyamella size can range from very small (0.3*0.4*0.8 mm) to gigantic measurements (22*17*15 mm). Both the minimum and maximum values of the cyamella sizes obtained in this study in all 3 planes are within the range of literature results. Although larger cyamella are mostly reported in the literature[12,24], cyamella size is observed to be less than 1,000 $mm^3$. In the present study, cyamella size is consistent with the literature (min=18.564 $mm^3$, max=844.8 $mm^3$).

### Limitations

The study is limited to 9,500 direct radiograph images of 6,500 people who applied to Elazig Fethi Sekin City Hospital.

## Conclusions

Cyamella, whose function is not fully elucidated, is generally asymptomatic when detected. Cyamella are equally likely to be found in both sexes, on one or both knees, on the right or left knee. Although

evidence exists that environmental factors are more effective than genetic factors in the development of cyamella, its bilateral and symmetrical presence, and the same location, as in this study, suggest that genetic factors also play a significant role. The cyamella should be distinguished from other sesamoid bones (Fabella) in the clinic due to its location. Due to its size, it should be taken into consideration in the differential diagnosis and should not be mistaken for avulsion fractures. The knee joint is characterized by bony structures, neurovascular structures, various anatomical variations of muscles and tendons, and sesamoid bones. We are of the opinion that if the anatomists and clinicians examining the region know the related variational anatomical structures adequately, they will be able to diagnose and treat associated pathologies more efficiently.

### Conflict of Interest
The authors declare that they have no conflict of interests.

### Funding
The authors declare that there was no funding associated with this data.

### Ethics Approval
The use of imaging data in this study was reviewed and approved by the Fırat University Non-Interventional Research Ethics Committee (dated 12.01.2023, session number 2023/01-21). The study was conducted in accordance with the principles of the Declaration of Helsinki.

### Informed Consent
Not applicable due to the retrospective nature of the study.

### Availability of Data and Materials
The data and materials generated/analyzed in the present study are available from the corresponding author upon request.

### Authors' Contributions
F.A. and R.F.A. designed the study and wrote the manuscript. P.G.B. gathered the data. All authors read, provided feedback and approved the final version of the manuscript.

### ORCID ID
Feyza Aksu: 0000-0001-8595-0010
Ramazan Fazıl Akkoc: 0000-0002-0559-8932
Pınar Gundogan Bozdag: 0000-0002-7303-5832

## References

1) Rehmatullah N, McNair R, Sanchez-Ballester J. A cyamella causing popliteal tendonitis. Ann R Coll Surg Engl 2014; 96: 91E-93E.
2) Akkoc RF, Aksu F, Emre E, Sap O, Karatas A, Aydin S, Kavakli A, Ogeturk M. The morphology of fabella and its prevalence in Turkish society. Eur Rev Med Pharmacol Sci 2022; 26: 1164-1169.
3) Aksu F, Akkoc RF, Aydin S. Could the prevalence and distribution of os supratrochleare dorsale and patella cubiti be the key to accurate diagnosis? Indian J Orthop 2022; 56: 883-886.
4) Khanna V, Maldjian C. The cyamella, a lost sesamoid: Normal variant or posterolateral corner anomaly? Radiol Case Rep 2015; 9: e00031.
5) Akansel G, Inan N, Sarisoy HT, Anik Y, Akansel S. Popliteus muscle sesamoid bone (cyamella): appearance on radiographs, CT and MRI. Surg Radiol Anat 2006; 28: 642-645.
6) Gruber W. Monographie uber die aus wahren (hyalinischen) cartilagines praeformirten ossicula sesamoidea in den ursprungssehnen der kopfe des musculus gastrocnemius bei dem menschen und bei den saugetieren. Mem. de L'Acad, St. Petersbourg 1875. VII, serie.
7) Le Minor JM. Brief communication: the popliteal sesamoid bone (cyamella) in primates. Am J Phys Anthropol 1992; 87: 107-110.
8) Pearson K, Davin AG. On the sesamoids of the knee-joint. Part I Man Biometrika 1921a; 13: 133-175.
9) Slanina J. Fabella distalis: a new sesamoid bone. Radiol Clin 1956; 25: 274-277.
10) Berthaume MA, Bull AMJ. Cyamella (a popliteal sesamoid bone) prevalence: A systematic review, meta-analysis, and proposed classification system. Clin Anat 2021; 34: 810-820.
11) Jadhav SP, More SR, Riascos RF, Lemos DF, Swischuk LE. Comprehensive review of the anatomy, function, and imaging of the popliteus and associated pathologic conditions. Radiographics 2014; 34: 496-513.
12) Munk PL, Althathlol A, Rashid F, Malfair D. MR features of a giant cyamella in a patient with osteoarthritis: presentation, diagnosis and discussion. Skeletal Radiol 2009; 38: 69-92.
13) Date H, Hayakawa K, Nakagawa K, Yamada H. Snapping knee due to the biceps femoris tendon treated with repositioning of the anomalous tibial insertion. Knee Surg Sports Traumatol Arthrosc 2012; 20: 1581-1583.
14) Chen LX, Ao YF, Yu JK, Miao Y, Leung KK, Wang HJ, Lin L. Clinical features and prognosis of discoid medial meniscus. Knee Surg Sports Traumatol Arthrosc 2013; 21: 398-402.
15) Chu A, Ginat D, Terzakis J, Seneviratne A, Schneider KS. Chronic sarcoid arthritis presenting as an intra-articular knee mass. J Clin Rheumatol 2009; 15: 190-192.
16) Ilizaliturri JVM, Camacho-Galindo J. Endoscopic treatment of snapping hips, iliotibial band, and

iliopsoas tendon. Sports Med Arthrosc 2010; 18: 120-127.

17) Bernhardson AS, LaPrade RF. Snapping biceps femoris tendon treated with an anatomic repair. Knee Surg Sports Traumatol Arthrosc 2010; 18: 1110-1112.
18) von Dercks N, Theopold JD, Marquass B, Josten C, Hepp P. Snapping knee syndrome caused by semitendinosus and semimembranosus tendons. A case report. Knee 2016; 23: 1168-1171.
19) Krause DA, Stuart MJ. Snapping popliteus tendon in a 21-year-old female. J Orthop Sports Phys Ther 2008; 38: 191-195.
20) Mariani PP, Mauro CS, Margheritini F. Arthroscopic diagnosis of the snapping Popliteus tendon. Arthroscopy 2005; 21: 888-892.
21) Su S, Lu Y, Chen Y, Li Z. A symptomatic cyamella in the popliteus tendon causing snapping knee: a case report and literature review. BMC Musculoskelet Disord 2019; 20: 495.
22) Monti R, Martinese A, Bonadonna G, Rocco MP, Simonetti I, Arrigoni F, Palumbo P, Bruno F, Granata V, Fusco R, Splendiani A, Di Cesare E, Giovagnoni A, Grassi R, Miele V, Masciocchi C, Barile A. Degenerative and inflammatory musculoskeletal disorders: updates and hot topics in diagnostic and interventional imaging. Eur Rev Med Pharmacol Sci 2022; 26: 6958-6971.
23) Chen TW, Lin CW, Lee CL, Chen CH, Chen YJ, Lin TY, Huang MH. The efficacy of shock wave therapy in patients with knee osteoarthritis and popliteal cyamella. Kaohsiung J Med Sci 2014; 30: 362-370.
24) Corvalan C, Tang C, Robinson M. Fabella and cyamella of the human knee joint discovery by dissection and ultrasound examination. Eur J Anat 2018; 22: 103-109.
25) Dheer S, Silverberg C, Zoga AC, Morrison WB. A 14-yearold with lateral knee pain and locking. Skeletal Radiology 2012; 41: 1339-1340.
26) Duarte ML, Silva AQP, Alvarenga SB, Prado JLMA, Scoppetta LCD. Giant cyamella: a rare sesamoid bone. Radiol Bras 2017; 50: 270-271.