

# Prevalence of the Fabella and Determination of the Fabella Index

## Prevalencia de la Fabela y Determinación del Índice Fabelar

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**SUMMARY:** The fabella is a bony anatomical variable, which in humans is located posterior to the lateral condyle of the femur, in the tendinous portion of the lateral head of the gastrocnemius muscle. Its prevalence rate has been reported in different populations, ranging from 3% to 86%. This study aimed to create an index that classifies the fabella according to its dimensions, determine the prevalence of the fabella in the Colombian population, and identify possible differences according to the fabella index (FI), sex, age, laterality, and degree of fabellar degeneration. A retrospective study used 93 lateral knee radiographs belonging to Colombian individuals. A fabella index was established to classify fabellae into longifabellar, medifabellar, and equifabellar, and radiological classification was used to identify the degree of fabellar degeneration (DFD). The prevalence of fabella was 36.30 %, and this variant was associated with the individual's sex, with male subjects having 2.66 times the probability of presenting fabella. A higher prevalence of medifabellar fabellae (57.60 %) was observed, followed by longifabellar (24.20 %) and equifabellar (18.20 %). There was a positive and moderate correlation between the DFD and age. We consider that larger fabellae can cause entrapment of the common fibular nerve, compression of the popliteal artery, and tear of the medial meniscus, so the FI becomes relevant in clinical practice, providing information on the type of fabella and its associated pathological manifestations. This study introduces a novel fabella index and investigates the frequency of fabella in the Colombian population. The findings of this study will serve as a reference for future research and contribute to the field of knee orthopedics and surgery in this population.

**KEYWORDS:** Anatomy; Fabella; Fabella index; Prevalence; Radiology.

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## INTRODUCTION

Sesamoid bones are short and often recognized as spheroid or ovoid. They develop in the thickness of certain tendons closely related to joint surfaces or where tendons curve sharply around bone surfaces (Olave *et al.*, 2014). The fabella stands out among the sesamoid bones; it is a bony structure initially described by Andres Vesalius in the 16th century (Diaz, 2004), named for its similarity to a fava bean.

In humans, the fabella is located behind the lateral condyle of the femur, in the tendinous portion of the lateral head of the gastrocnemius muscle (Sarin *et al.*, 1999). This bone is attached through the fabellofibular ligament to the apex of the fibular head and to the superior margin of the lateral meniscus by a second bundle of fibers that separates from the main bundle of the fabellofibular ligament (Hauser *et al.*, 2015). Its prevalence rate has been reported in different populations, ranging from 3 % to 86 % (Minowa

*et al.*, 2004; Silva *et al.*, 2010; Corvalan *et al.*, 2018; Ortega & Olave, 2018). Its presence has been associated with chondromalacia and osteoarthritis (Adedigba *et al.*, 2021); likewise, its dimensions and shape are parameters implicated in common fibular nerve entrapment neuropathy (Patel *et al.*, 2013; Lin *et al.*, 2023), popliteal artery compression (Ando *et al.*, 2017), and medial meniscus tear (Zhong *et al.*, 2022). Despite the above, there is no classification for the fabella according to its dimensions, and we have not found studies reporting the presence of this sesamoid bone in Colombian individuals. Therefore, our objective was to determine the prevalence of the fabella in this population and create an index that classifies the fabella according to its dimensions and identify possible differences according to the fabella index (FI), sex, age, laterality, and degree of fabella degeneration. Creating a FI and understanding its prevalence in Colombian

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individuals is valuable for healthcare providers, as it enables precise and efficient medical treatment, minimizing the risk of misdiagnosis and optimizing the management of symptoms and injuries.

## MATERIAL AND METHOD

A retrospective analysis was conducted using 93 lateral knee radiographs, with 47 taken from the left and 46 from the right. These radiographs belonged to 91 Colombian individuals, with 89 individuals having unilateral radiographs and 2 having bilateral radiographs. The radiographs were taken between October 2020 and July 2023. The study comprised participants of both genders, with 44 males and 47 females. The ages of the individuals ranged from 11 to 77 years, and they were classified by age groups: adolescents (11 to 18 years), young people (19 to 26 years), adults (27 to 59 years), and older adults (60 to 77 years).



Fig.1. Lateral radiograph of the knee, showing the craniocaudal (CCD) and anteroposterior (APD) diameters.

A FI was established based on its craniocaudal diameter (CCD) and anteroposterior diameter (APD) (Fig. 1) through the following function:

$$\frac{\text{Craniocaudal diameter}}{\text{Anteroposterior diameter}} \times 100$$

According to the FI, fabellae with a FI less than or equal to 50 were classified as longifabellar, those with a FI greater than 50 and less than 70 as medifabellar, and those with a FI greater than or equal to 70 as equifabellar (Fig. 2). In addition to this index, radiological classification was used established by Hou *et al.* (2019) to identify the degree of fabellar degeneration (DFG), with degree 0 (d0) being: a normal fabella with a triangular or oval shape; 1st degree (d1): sclerotic fabella with subchondral sclerosis of the anterior surface; 2nd degree (d2): sclerotic fabella with osteophyte formation; and 3rd degree (d3): huge fabella (length greater than 2 cm) with large osteophyte formation.

**Statistical analysis.** Data analysis was performed using the SPSS 26 software (SPSS Inc., Chicago, IL, USA). Categorical variables were analyzed using the chi-squared test and Fisher's exact test for those with smaller sample sizes. To calculate the occurrence of events in which there was an association between variables, the odds ratio (OR) and 95% confidence intervals were calculated. Spearman's nonparametric correlation test was used for the correlational analyses. For all tests, statistical significance was considered at  $p < 0.05$ .

## RESULTS

The presence of the fabella was assessed per individual and not per knee; thus, of the total cases (91 individuals), the overall prevalence of fabella was 36.30 % (33), of which 63.60 % (21) were male, and 36.40 % (12) were female. It was found that this anatomical variant was

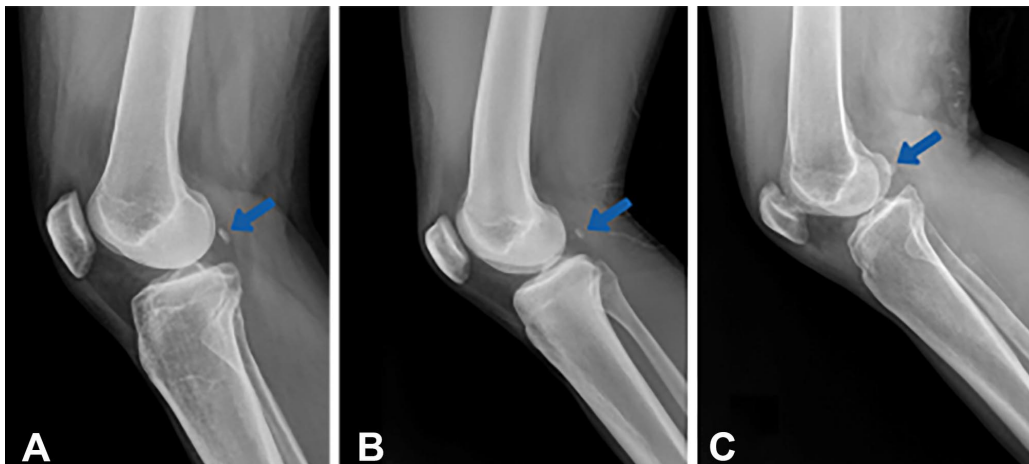


Fig.2. Fabellae according to FI a) longifabellar  $FI \leq 50$  b) medifabellar  $50 < FI < 70$ , and c) equifabellar  $FI \geq 70$ .

associated with the individual's sex ( $p < 0.05$ ); male subjects were also 2.66 times more likely to have the fabella than female subjects.

The fabella was visualized bilaterally in one individual, while unilaterally, this bone was located on 32 occasions, of which 16 were in the left knee and 16 in the right knee, so its presence was not associated with laterality ( $p > 0.05$ ).

Among the age groups, it was observed that this structure was present more frequently in adults at 18.68 % (17), followed by young people at 9.89 % (9), adolescents at 4.40 % (4), and finally, older adults at 3.30 % (3). However, no association was found between the occurrence of fabella and age group ( $p > 0.05$ ).

Regarding the FI, a higher prevalence of medifabellar fabellae was found (57.60 %), followed by longifabellar (24.20 %) and equifabellar (18.20 %). No association ( $p > 0.05$ ) was found between the FI and parameters such as sex or age group.

In the radiological classification for fabellar degeneration, g0 predominated with 57.6 % (19) of the fabellae, followed by g1 with 30.30 % (10), g2 with 9.1 % (3), and g3 with 1.10 % (1). The DFD were not significantly different between sexes ( $p > 0.05$ ). However, a positive and moderate correlation was found between DFD and age ( $r = 0.392$  and  $p < 0.05$ ), which means that, as the age increased, so did the DFD by the fabella.

**DISCUSSION**

The prevalence of the fabella in the Colombian population was 36.30%, a frequency that differs from that reported in the literature, as shown in Table I. However, according to the occurrence rates reported from 1875 to 2019 in the work of Berthaume *et al.* (2019), the frequency obtained in our study is within the percentages reported for this anatomical variant.

The presence of the fabella contributes to the protection of the tendon of the lateral head of the

gastrocnemius muscle and increases the efficiency of this muscle (Hou *et al.*, 2019); hence, sesamoid bones develop in regions where intense mechanical stimuli, such as pressure, friction, or tension, are experienced. This would explain the difference of up to 40.55% between the Colombian and Asian populations, given that, among Asian customs, there is kneeling and squatting to perform common tasks, exerting constant pressure against the lateral femoral condyle (Chew *et al.*, 2014). Thus, we consider that the prevalence of the fabella will vary depending on the study population, their customs and lifestyle, aspects that would explain the discrepancy between our results and those reported in the literature.

Özbay *et al.* (2022), in their study of 504 Turkish individuals, found no significant differences between sex and presence of the fabella; however, our study suggests that the development of the fabella is sex-dependent, as do reports by Ortega & Olave (2018), where male sex associations were identified for this anatomical variant. Furthermore, our observations were supported by the calculated OR, which determined that this bone structure was 2.66 times more likely to develop in males than females. Given this, we have found no literature to compare our results.

The unilateral presence of the fabella was predominant in our study, yet despite this, no significant differences were found between laterality and fabellar presence. These results can be explained by directional asymmetry, which, according to Lijewski *et al.* (2021), is governed by genetic and especially mechanical factors, such as work and physical activity. Therefore, the functional preference of a limb may result in a morphological asymmetry in the level of the triceps surae muscle, subjecting the tendon of the lateral head of the gastrocnemius muscle to greater tension or friction, promoting the appearance of the fabella.

Jin *et al.* (2017) made an interesting observation on longitudinal sections of lower limbs, corresponding to 8 fetuses of 15 to 18 weeks, where they observed in 5 of 8 fetuses, the presence of a cartilaginous fabella embedded in a fibrous band that served as a common origin for the plantaris muscle and the lateral head of the gastrocnemius

Table I. Presence of fabellar in different populations.

Author	Year	Country	Number of neck	Number of fabellas	Tasa of prevalence (%)
De Maeseneer <i>et</i>	2001	Belgium	122	32	26.23
Minowa <i>et al.</i>	2004	Japan	212	182	85.85
Lencina	2007	Argentina	217	45	20.74
Silva <i>et al.</i>	2010	Brazil	62	2	3.22
Jin <i>et al.</i>	2017	Türkiye	1000	190	19.00
Ortega & Olave	2018	Chili	400	125	31.25

muscle. This suggests that age does not determine the presence of the fabella; however, its ossification is age-dependent. According to Özbay *et al.* (2022), ossification of the fabella occurs in the first decade of life. Taking this statement into account, our research methodology allowed us to identify all the fabellae in the study sample, given that the age of the individuals ranged from 11 to 77 years. Along the same lines, in our findings, there was no association between the presence of a fabella and established age groups, observations similar to those reported in 357 (754 knees) of African subjects, where the prevalence of a fabella increased up to age 60, decreased abruptly after age 60, and then increased again at age 80, according to an age range from 3 to 97 years (Adedigba *et al.*, 2021). The relationship between the prevalence of a fabella and age remains controversial. Hou *et al.* (2019) reported a significant association between these parameters, observing a higher prevalence of fabella with increasing age; their study included 1359 knee radiographs belonging to 1150 patients, ranging in age from 21 months to 86 years. The differences observed in our study are likely due to sample size limitations within the different age groups.

The terms longifabellar, medifabellar, and equifabellar come from Latin and are formed by the prefixes longi- from longinquus (long, extensive), medi- from medius (central, middle), equ- from equabilis (equal, uniform); they share the same lexeme -fabella- diminutive of faba (bean), and the same suffix -ar (relative to, characteristic of). Thus, the FI shows the shape and dimensions of the fabella: the longifabellar type are thinner and very long fabellae, the equifabellar have a similar thickness and height, so they tend to be spherical, and the medifabellar are characterized by their thickness being less than their length; however, the discrepancy is smaller than in the longifabellar ones, so they are oval or triangular.

It has been reported that fabellae with larger dimensions cause common fibular nerve entrapment (Lin *et al.*, 2023) and popliteal artery entrapment (Suzuki *et al.*, 2019), larger sizes are characteristic of equifabellar fabellae, since in these fabellae the increase in CCD is proportional to the increase in the APD. Along the same lines, it has been determined that an increased risk of a medial meniscus tear is associated with fabellae where the APD is similar to the CCD (Zhong *et al.*, 2022), dimensions characteristic of medifabellar and equifabellar fabellae. Considering the above, the FI becomes relevant in clinical practice, as it provides information on the type of fabella and its associated pathological manifestations. Our results found no association of the FI with parameters such as sex and age group; consequently, since this is the first time a FI has been reported, our data could not be compared.

Pain in the posterolateral compartment of the knee may be exacerbated by the DFD due to this sesamoid bone. Therefore, the DFD can be assessed through a meticulous radiological evaluation, in addition to determining the presence of a fabella. In this context, our work included a scale for the DFD, where we noted that DFD was not associated with sex, but there was a correlation between DFD and age, similar observations to those made by Hou *et al.* (2019), with the highest DFD being suffered by those individuals who were older. Clinicians should consider these aspects before deciding on non-surgical treatment or excision of the fabella.

## CONCLUSION

The presence of the fabella in the human anatomy exhibits significant variations according to the population analyzed. Our study reveals that gender has a determining influence on their development. In addition, the FI accounts for fabella dimensions and is a possible predictor of pathology according to the corresponding fabella. This study is the first to document an FI and the frequency of the fabella in the Colombian population, which will serve as a reference for future research and contribute to the field of knee orthopedics and surgery in this population.

It is essential to increase the sample size, and it would be interesting to advance in studies where this FI is applied to individuals suffering from fabella-related pathologies.

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**RESUMEN:** La fabela es una variable anatómica ósea, que en humanos se localiza posterior al cóndilo lateral del fémur, en la porción tendinosa de la cabeza lateral del músculo gastrocnemio. Su tasa de prevalencia se ha reportado en diferentes poblaciones, cuyos valores oscilan entre 3 % y 86 %. El objetivo de este estudio fue crear un índice que clasifique la fabela según sus dimensiones, determinar la prevalencia de la fabela en población colombiana, así como identificar posibles diferencias en función del índice fabelar, sexo, edad, lateralidad y grado de degeneración de la fabela. Se desarrolló un estudio retrospectivo en el que se dio uso a 93 radiografías laterales de rodilla, pertenecientes a individuos colombianos. Se estableció un índice fabelar que clasificó las fabelas en longifabelares, medifabelares y equifabelares, además utilizamos la clasificación radiológica para identificar los grados de degeneración fabelar (GDF). La prevalencia de la fabela fue del 36,30 %, se encontró

asociación de esta variante al sexo del individuo, siendo los hombres quienes tuvieron 2,66 veces más probabilidades de presentar la fabela. Se observó mayor prevalencia de fabelas tipo medifabelar 57,60 %, seguido de tipo longifabelar 24,20 % y equifabelar 18,20 %. Hubo correlación positiva y moderada entre la edad y el grado de degeneración fabelar. Consideramos que las fabelas con mayores dimensiones podrían causar atrapamiento del nervio fibular común, compresión de la arteria poplítea y desgarro del menisco medial, por lo que el índice fabelar adquiere relevancia en la práctica clínica, al dar información del tipo de fabela y sus manifestaciones patológicas asociadas. El presente estudio es el primero en proponer un índice fabelar y la frecuencia de la fabela en población colombiana, por lo que servirá de referencia para futuras investigaciones, además de brindar un aporte al área traumatológica y quirúrgica de la rodilla en esta población.

**PALABRAS CLAVE: Anatomía; Fabela; Índice fabelar; Prevalencia; Radiología.**

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