

## Morphological Analysis of the Fabella in Brazilians

### Análisis Morfológico de la Fabela en Brasileños

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**SUMMARY:** Among the present's sesamoids in the human body, the fabella can be found in the posterior part of the knee in low incidence. This report is quite controverted in the classic anatomical literature as well as its constitution. Its fixation is on the tendon of the gastrocnemius lateralis, close to its origin, in the posterior part of condilus femoralis lateralis. However, when its occurs, generally induces in the knee the absence of arcuate ligament with the presence of fabellofibular ligament. The prevalence is larger in male individuals. Few studies discuss the histology of the fabella. Some authors suggest that the fabella basically formed by bone tissue and others describe it as a fibrocartilaginous. The aim of this study is to analyze the incidence of the fabella, its histological structure and its association with presence or absence of fabellofibular ligaments through macro and microscopic study. Sixty-two Brazilian's knees were dissected and the fabella was found in two diferent specimens. The tissue had been removed and fixed in 4% formaldehyde for microscopic evaluation. The fabella is a sesamoid bone that appears on knee in a small frequency in Brazilians. Its presence provokes absence of the arcuate ligament and the presence of the fabellofibular ligament. The histological study demonstrated bone tissues on its constitution without osteoclasts.

**KEY WORDS:** Sesamoid bones; Morphology; Anatomy; Knee joint.

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### INTRODUCTION

The sesamoid bones (l. sesame grain) are structures inside the tendons or in periarticular areas (Debiérre, 1890; Testut, 1927; Goldberg & Nathan, 1987; DiDio, 2002). They are more frequent in hands and feet fingers near the phalanxes (Goldberg & Nathan) and the most common is the patella. In humans, we can find about 46 sesamoid bones (Sarin *et al.*, 1999). On knee joint we can find the fabella (l. grano). Its placed inside the tendon of the gastrocnemius lateralis muscle, in posterior part of the condilus femoralis lateralis (Gray, 1977; Miaskiewicz & Partyka, 1984). Its incidence is controverse for classic anatomic authors. His existence provokes anatomical alterations in the posterior-lateral compartment of the knee. One of the structural changes is the presence of the fabellofibular ligament is the form of short collateral ligament (Kim *et al.*, 1997).

The arcuate and fabellofibular ligaments are

structures that contribute with the stabilization of knee joint (Maynard *et al.*, 1996), together with the tendon of the popliteus muscle (Pasque *et al.*, 2003). Besides, the posterior-lateral compartment of the knee still possesses another stabilizer, the popliteo fibular ligament (Ishigooka *et al.*, 2004). Biomechanical studies award those ligaments an important function in the stabilization during the rotatory movements of the knee (Maynard *et al.*). There are few histological data about fabellar structure (Minowa *et al.*, 2004). Gardner *et al.* (1970) describes it with fibrocartilaginous constitution. Llorca (1963) states that it is formed by bone tissue and that its prevalence is larger in men.

During the last decades investigation models tried to elucidate the occurrence of sesamoid bones (Sarin *et al.*) as well as studies of anatomy of the posterior-lateral compartment of the knee, through the dissection and

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images (LaPrade *et al.*, 2000; Munshi *et al.*, 2003; Haims *et al.*, 2000). Based on these evidences including structural changes on knee with the presence of the fabella, and absence of reports about fabella in Brazilians, the aim of this study is analyze the fabella macro and microscopic in Brazilian's.

## MATERIAL AND METHOD

Sixty-four knees of Brazilian corpses were analyzed, in individuals aged between 38 and 78 years old (average of 58.5 years) from three Universities of Rio de Janeiro. All the specimens were fixed in formaldehyde 10%, without defined mortis cause, without traumas, congenital malformations or postural shunting. The same dissection technique were used in all especimes and plans were obeyed, sixty-two knees had been selected. All selected knees had been access by its posterior surface, withdrawal of the skin, subcutaneous screen, until the exposition of the popliteus muscle, muscular settings of the hamstrings and heads of the gastrocnemius lateralis and medialis.

After visual and palpatory evaluation of the lateral head of the gastrocnêmius, during the mesoscopic dissection of the hollow popliteus with magnifying glass of 4x of increase. The knee capsule was dissected by posterior surface in order to verify the presence of the arcuate ligament and the fabellofibular ligament, observing the relations of the gastrocnemius lateralis tendon with condilus femoralis to confirm fabella's presence.

The fabella found had been removed, analyzed, and kept in formaldehyde 4%. All the specimens had been absorbed in paraffin using the histologic routine procedures, and then made series cuts of 20 mm. The histological material had been colored with Hematoxilina-eosine (HE) e Tricomie of Gomori and Masson and analyzed. All materials, microscopic, macroscopic and mesoscopic were archived and photographed.

## RESULTS

Two fabellas were found (01 right / 01 left) corresponding to 3.1 % of the sample. Macroscopically all of the knees with fabella had absence of the arcuate ligament and presence of the fabellofibular ligament (Figs. 1 and 2). Under this ligament it was possible to find the tendon of the popliteus muscle. In these knees other anatomical variations in the posterior part were not found.

The macroscopic analysis of the fabellas revealed in the dorsal part the presence of capsular articulate fibers covering them. In the ventral part an articular facet for the condilus femoralis lateralis was found. In the distal portion of the fabella (Fig.2) was found the point of fixation of the fabellofibular ligament addressed to the head of the fibula.

With elliptic aspect, they presented their largest diameters varying between 1.3cm to 1.6cm slightly concave in the dorsal part and convex in the ventral part. The borders smoothly irregular projections, structurally made of bone tissues (Fig. 3, 4, 5 and 6). There was a absence of osteoclasts on its constitution in all the materials studied (Figs. 3, 4, 5, 6).

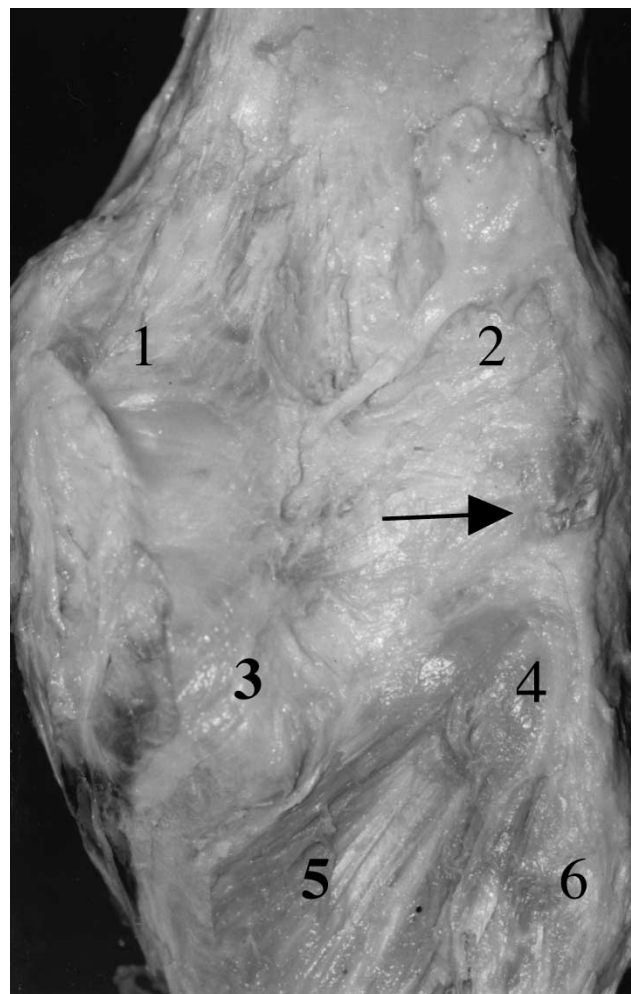


Fig. 1. Posterior view of the knee. 1 and 2. Condilus femoralis lateralis and medialis, respectively; 3. Oblique popliteus ligament. 4. Lig. fabellofibular; 5. Popliteus muscle; 6. Head of the fibula; black arrow - fabella.

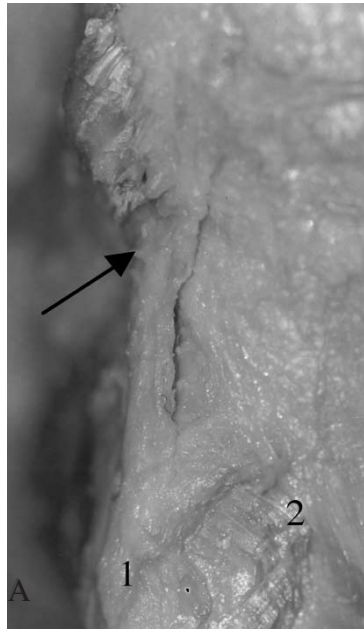


Fig. 2. Lateral, posterior face of knee. Arrow Fabellofibular ligament. 1. Head of the fibula; 2. Popliteo muscle.

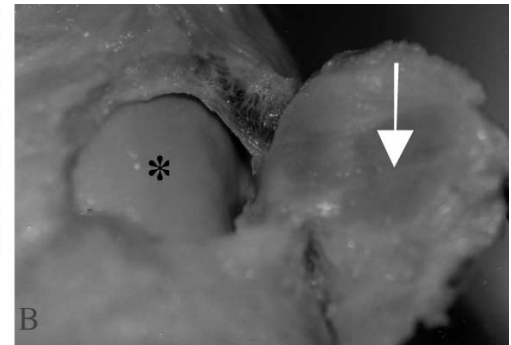
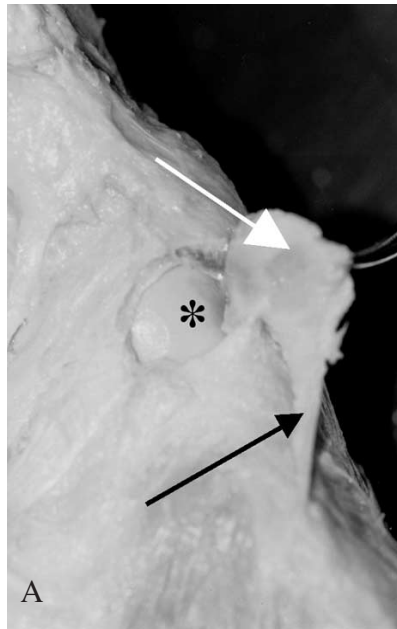


Fig. 3b. Articular facet of the fabella (white arrow); articular surface with the lateral condyle of the femur (\*).

Fig. 3a. Partial section of the articular capsule, articular facet of the fabella (white arrow) in its articular surface with the lateral condyle of the femur (\*) Inferior Fabellofibular Ligament stretched (black arrow).

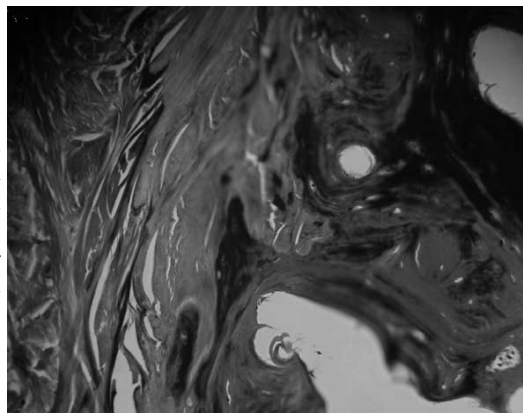


Fig. 4. Cortical with osteon in periosteum formation with inserts in form of circumferences. In two perpendicular plans - 100 x. (Technique of Gomori).

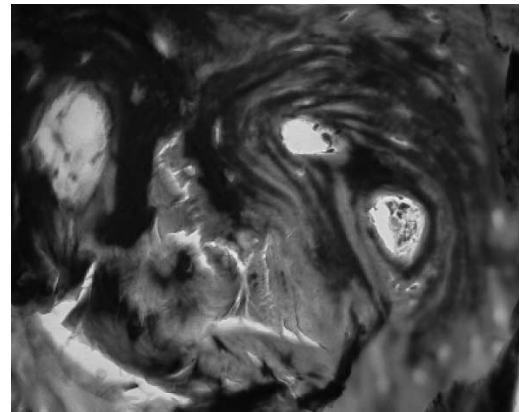


Fig. 5. Cortical with osteon in development and fibers imbeded at the osteal matrix - 400x (Technique of Gomori).

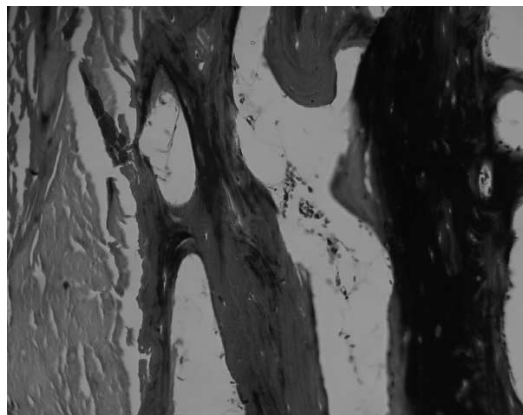


Fig.6. Cortical with osteon cut longitudinally, gaps well vascularized, quiescent endosteum. Fibrous Periosteum-100x. (Technique of Gomori).

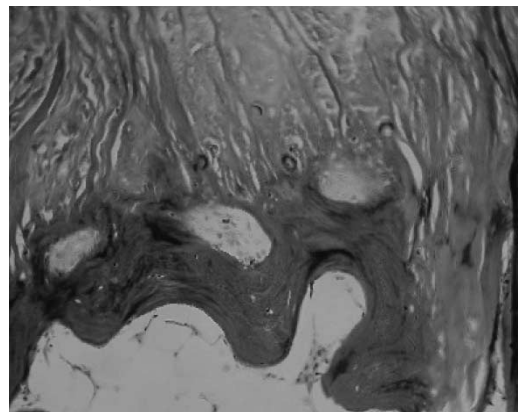


Fig.7. Cortical with ligamentous inserts (fabellofibular ligament) perpendicularly parallel, in permeation with chondrocytes and vision of wide adipose myeloid gaps - 100x (Gomori's Technique).

**DISCUSSION**

The search for elucidation the mysteries of formation and frequency of the sesamoid bones has been promoting the activity of many researchers (Sarin, 1999). There are two theoretical propositions for the development of those bones, a functional and other phylogenetic (Goldberg & Nathan; Sarin *et al.*, 1999). The functional theory has a support in the biomechanical aspect, where those bones are described as pulleys, reducing the friction of the tendons and potentiating the muscular handspike (Carey, 1927; Kaplan, 1965; Holladay *et al.*, 1990; Hosseini & Hogg, 1991). The phylogenetic suggests genetic intrinsic factors developed during the evolutionary process that can be the key for the development of sesamoid bones (Sarin *et al.*). They appear in the womb period. Initially cartilaginous they can calcify or not after the birth depending on the kind of activity done by the individual, that is, a "biomechanics-embryological" origin (Testut).

The presence of the fabella is also discussed in the literature and associated to clinical facts like as: Fabellar pain syndrome; fabellar chondromalacia (Duncan & Dahm, 2003) and articular block (Weiner *et al.*, 2007; Larson & Becker, 1993; Stamatoukou, 2002; Duncan & Dahm). Due to its location in the posterior-lateral part of the knee, the fabella relations can affect the common fibular nerve (Takebe & Hirohata, 1981). During decades, the presence of the fabella has been stimulating researchers to correlate its presence with disturbances in the skeletal system mainly with the primary arthrosis on knee (Pritchett, 1984; Sarin *et al.*). Macroscopically, there is a consensus that the fabella is present in the head of the lateral gastrocnemius although in rare case it was found in the medial gastrocnemius (Gardner *et al.*, 1975; Testut). The fabella is not mentioned in most of the classic texts (Table I). Gardner *et al.* (1975) mentions besides the description of the fabella, the anatomical

variations provoked on knee. Affirms that the fabella provokes absence of the arcuate popliteo ligament. However, new data were studied with the size of the fabella and the thickness of the fabellofibular ligament. Studies show that how biggest is the fabella, more thickest is the fabellofibular ligament (Seebacher *et al.*, 1982). Nowadays serious articles show that not always there is absence of the arcuate popliteo ligament (Table I). According to Minowa *et al.* of the 29 knees with fabella, 12 had arcuate ligament very defined.

There are a few reports on the fabella's histology. Texts of descriptive anatomy are not quite divergent about its constitution. During the last century, Testut stated that the fabella was fibrocartilaginous. However, Minowa *et al.* divided the fabella according to the texture and the histology. According to the texture, the exam was done by touching. This way, Minowa *et al.* characterized the sesamoid as "hard" and "elastic". According to the histological point of view, the fabella was classified about the predominant tissue. Of the 39 fabellas studied, 29 were made of bone tissue; 9 of fibrous tissue and 1 fibrocartilaginous. Following the criterion proposed by Minowa *et al.*, all the fabellas found were "hard", constituted of bone tissue without osteoclasts. The studies and the clinical reports in the posterior-lateral compartment are still "obscure" (Duncan & Dahm), mainly in the relationship between the fabella and the collateral fibular ligament. The investigation perspectives non-invasive can elucidate possible compromises in the collateral fibular, fabellofibular, popliteofibular ligaments (LaPrade *et al.*) and consequently to prove the instability in the area (Kim *et al.*; Haims *et al.*; Munshi *et al.*). The absence of osteoclasts told in this text is not mentioned in the world literature. This fact allows to state that the fabella is not susceptible to bone remodeling after its ossification.

Our results allow to state that the fabellas found have the same characteristics than those described in classic texts of macroscopic anatomy which come in the knee joint always

Table I. Registration about fabella, presence of the fabellofibular ligament (FFL) and absent arcuate ligament (AL).

Authors/ Year	N° of knees studied / Fabella	%	FFL	AL
Testut* (1927)	100 / 29	29	Present	Does not quote
Gray* (1977)	Doesn't related	----	Does not quote	Absent
Orts Llorca* (1962)	100 / 10	10	Present	Does not quote
Miaskiewicz ** (1982)	188 / 25	13,29		Does not quote
Terry & LaPrade* (1996)	30 / does not quote	----	Present	Present
Sarin* (1999)	112 / 35	31,25	Does not quote	Does not quote
Moore & Dalley (2001)	Doesn't related	3 - 5	Does not quote	Does not quote
Munshi * *** (2003)	7 / 4	57	Not identified	50% lateral 75% medial
Minowa * ****(2004)	212 / 182	85,84	Present	Does not quote

\*Anatomical dissection \*\*Radiological study \*\*\*RNM study \*\*\*\*Anatomical and histological studies.

in low frequency (Testut; Gardner *et al.*, 1970; Orts-Llorca, 1952) always including the presence of the fabello-fibular ligament (Gray). It has a hard constitution with bone without osteoclasts cells.

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**RESUMEN:** Entre los huesos sesamoideos que están presentes en el cuerpo humano, la fabela puede encontrarse en la cara posterior de la rodilla. Los reportes de su incidencia son bastante controvertidos en la literatura anatómica clásica, como también su constitución. Hay autores que mencionan a la fabela como tejido óseo, mientras otros la describen como una estructura fibrocartilaginosa. El sitio anatómico de ubicación es el tendón del gastrocnemio lateral, próximo de su origen, en la cara posterior del condilo femoral lateral. La prevalencia es más grande en individuos del sexo masculino. En presencia de este, se observa en rodilla la ausencia del ligamento poplíteo arqueado y la aparición del ligamento fabelo-fibular. Hay pocos trabajos que discuten la anatomía del compartimiento póstero-lateral de la rodilla con la Fabela, así como su constitución. Este trabajo tiene el propósito de analizar la incidencia de la fabela, su estructura histológica, asociándola con la presencia u ausencia de los ligamentos poplíteo arqueado y fabelo-fibular a través del estudio macro y microscópico. Fueron disecados sesenta y cuatro cadáveres, sin causa mortis definida. Después fueron disecados. La fabela cuando estuvo presente fue retirada y fijada en formaldehído al 4% para su evaluación microscópica. De las sesenta y dos rodillas estudiadas dos presentaron fabela. La primera tuvo 1,6 cm de diámetro, ligeramente cóncava en su cara en contacto con condilo femoral lateral, bordes poco irregulares. La segunda tuvo 1,3 cm de diámetro con las mismas características estructurales. La fabela es un hueso sesamoideo que surge en la rodilla con baja frecuencia. Su aparición se acompañó de la ausencia del ligamento poplíteo-oblicuo y la presencia del ligamento fabelo-fibular. El estudio histológico determinó tejido óseo en su constitución sin osteoclastos.

**PALABRAS CLAVE: Huesos sesamoideos; Morfología; Anatomía; Rodilla.**

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