CASE REPORT

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Sesamoid bone of the medial collateral ligament of the knee joint

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SUMMARY

The variable occurrence of the sesamoid bones supports the theory stating that the development and evolution of these bones are controlled through the interaction between intrinsic genetic factors and extrinsic stimuli. In the present article we report a sesamoid bone at the medial collateral ligament of the knee joint, a newly discovered finding in human and veterinary medicine.

Key words: Sesamoid – MCL – Knee – Fabella – Cyamella

INTRODUCTION

New structural anatomical discoveries are not so often encountered. However, their potential occurrence should be kept in mind, which can eventually help in a better understanding of patients' symptoms and subsequently improve the management plan. In this article we will present a newly encountered anatomical structure in the knee joint. Sesamoid bones are small bones embedded in certain tendons, most commonly encountered in the hands and feet. Their occurrence is variable in multiple anatomical regions of the human body except for the patella. In the knee joint, there are multiple known sesamoid bones including the sesamoid bones patella, fabella and cyamella.

The current article describes a new sesamoid bone at the medial collateral ligament which has not been previously reported in human or veterinary medicine with thorough discussion of the anatomical relations and the exclusion of other possibilities.

This article supports the theory stating that the development and evolution of the sesamoid bones are controlled through the interaction between intrinsic genetic factors and extrinsic epigenetic stimuli, which can explain their variable occurrence.

CASE REPORT

We present a case of a 51-year-old female patient, who presented with mild pain at the medial aspect of the left knee. No trauma has been reported. An unenhanced spiral CT-Scan was performed with 2 mm thickness, 120 kvp and 100 mAs, which showed preserved articulation of the knee joint with neither joint effusion, nor narrowing of the joint space nor articulating cortical irregularities (Fig. 1). Mild subchondral sclerosis was depicted at the medial tibial plateau as a sign of early osteoarthritis. At the region of the superficial layer of the medial collateral ligament (MCL), there was a well-defined, oval-shaped osseous structure, measured 8x7x13 mm (antero-posterior x transverse x cranio-caudal dimensions, respectively). This structure was located within the superficial layer of the MCL, and its superior margin measured 2 cm caudal to the ligament attachment at the medial femoral epicondyle (Fig. 1). Sequential images in coronal reconstruction from anterior to posterior direction showed intact outline of the superficial layer of the MCL with a preserved underlying fatty planes and subsequent proximal thickening enclosing the osseous structure (Fig. 2). The meniscotibial portion of the deep layer of the MCL detected just distal to the edge of the cortex of the medial tibial plateau (Fig. 3), while the meniscofemoral portion could not be adequately addressed. This structure showed a rim of uniform

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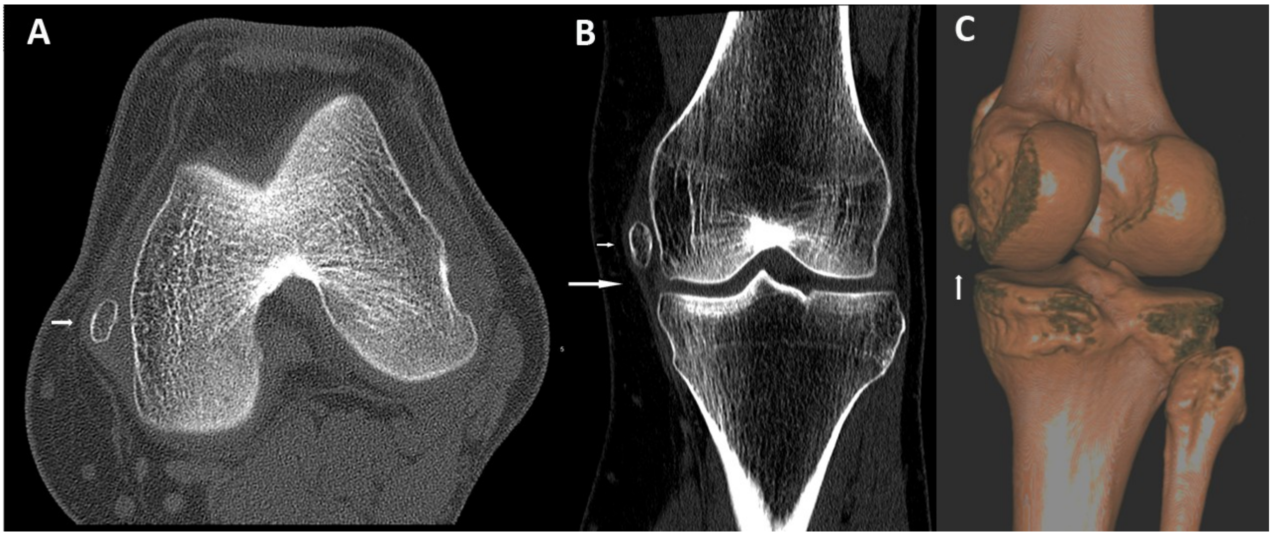

Fig 1. (**A**): Axial CT-scan shows oval-shaped bony structure at the medial aspect of the knee at the level of the medial femoral condyle at the MCL with a peripheral uniform cortex and internal fat density with osseous trabeculations (arrow). (**B**): Coronal CT-scan shows oval-shaped bony structure (small arrow) at the medial aspect of the knee within the MCL (large arrow) with a peripheral uniform cortex and internal fat density with osseous trabeculations. The proximal attachment of the MCL at the medial femoral epicondyle is intact. (**C**): Posterior view 3D-reconstruction CT-scan shows oval-shaped bony structure at the medial aspect of the knee (arrow).

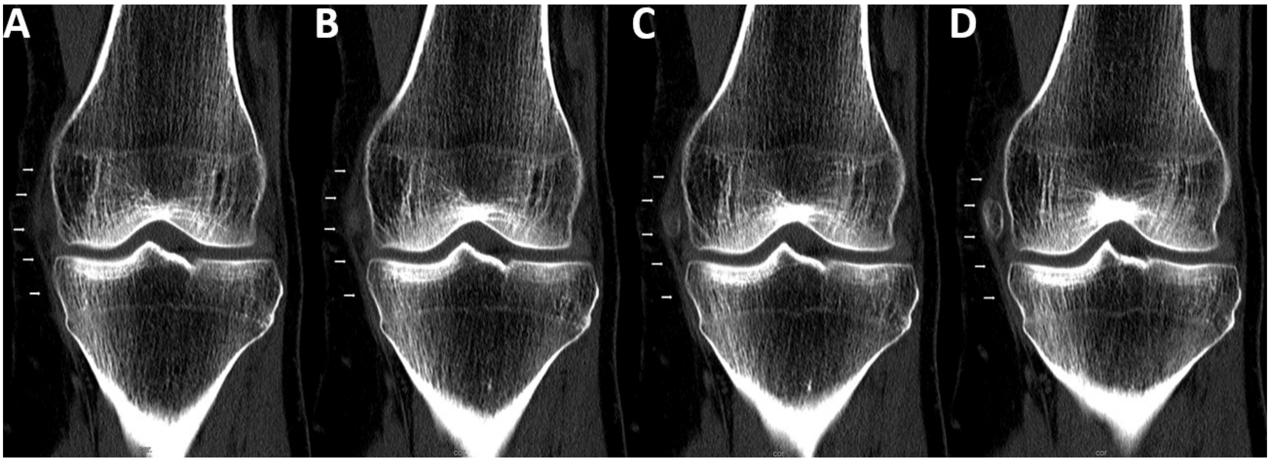

Fig 2. Series of coronal reconstruction CT-scan of the MCL from anterior to posterior, shows intact outline of the superficial layer of the MCL anterior to the sesamoid bone (**A**) and representing the progressive thickening of its proximal portion to enclose sesamoid bone (**B-D**).

smooth peripheral cortex, and internal trabecular bone. The intervening distance between this structure and the adjacent cortex of the medial femoral condyle equaled 2 mm. There were neither cortical irregularities nor new bone formation at the site of origin of the superficial layer of the MCL at the medial femoral epicondyle, nor bony defect, nor fracture at the adjacent osseous structures.

DISCUSSION

In this article, we delineate a newly discovered sesamoid at the MCL of the knee joint. We will clarify our diagnosis based on a literature review in human and veterinary medicine. We suggest referring to it as the Albtoush bone.

'Sesamoid bone' is a well-known terminology, which was defined by Galen to describe the small bones of the hands and feet due to their similarity to the sesame seeds (*Sesamum Indicum*) (Wood, 1984). Sesamoid bones run within tendons, which pass in proximity to bony prominences (Sarin et al., 1999), and are commonly encountered in certain regions in the body, mostly hands and feet, occurring in a variable manner except for the Patella. Their function is related to protection of the tendon as well as contributing to the gliding mechanism.

Sesamoid bones can be classified in two types, depending on their location. In type A, the bone is located adjacent to the articulation and is incorporated in the joint capsule (i.e., patella and the hallucis and pollicis sesamoids). In Type B, the sesamoid bone is located at sites where tendons are

Fig 3. Coronal reconstruction CT-scan showed the meniscotibial portion of the deep layer of the MCL (short arrow) medial to the body of the medial meniscus (star). Fatty plane inferior to the sesamoid bone (dot) intervenes between the deep layer and superficial layer of the MCL (long arrow).

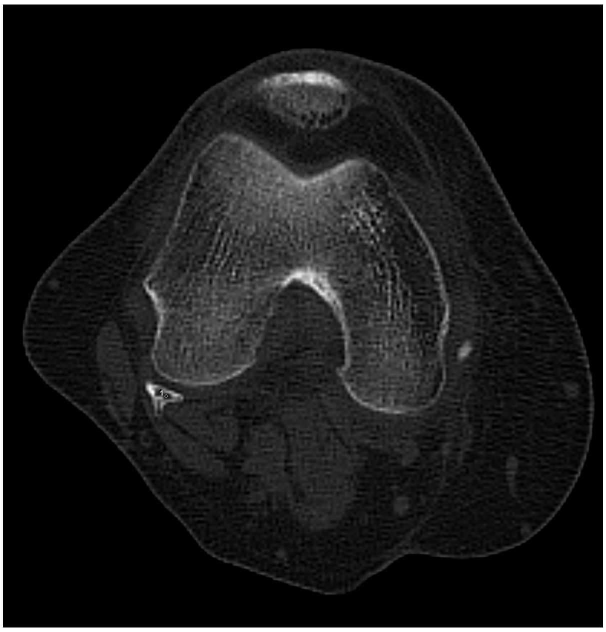

Fig 4. Axial CT-scan shows Fabella at the lateral head of gastrocnemius tendon, with peripheral cortex and internal fat density. The central average density (1) measures -171 HU.

angled, showing a curved course around bony surfaces, and these sesamoid bones are separated from the underlying bone by a synovial bursa (e.g.- Sesamoid of the peroneus longus tendon) (Resnick et al., 1977).

The development and evolution of the sesamoid bones is controlled through the interaction between intrinsic genetic factors and extrinsic epigenetic stimuli (Sarin et al., 1999) and has been described to begin as cartilaginous nodules that undergo endochondral ossification.

These bones can be involved in many pathologies such as fracture, dislocation, osteomyelitis, septic arthritis, osteoarthritis and crystal deposition, as well as benign and malignant bone tumours (Unni, 1996; Singh et al., 2009). Also certain sesamoid bones can be a source of pain, such as the fabella (Driessen et al., 2014). Possible mechanism of pain in Fabella Syndrome, according to Zipple et al. (2003), includes compression on adjacent structures such as fabellafibular ligament, gastrocnemius tendon, femoral condyle, posterior capsule, and common fibular nerve. Sesamoid bones show surrounding cortex, fatty medulla cavity (Fig. 4) and associated with articular cartilage at the side articulating with a nearby bone such as at the metacarpal condyles forming the sub-sesamoid joint (Goldberg, 1987).

The developmental theory of the sesamoid bones was assumed to be similar to the knee meniscal ossicles, which are supposed to originate from vestigial structures that grow progressively following birth (Ganey et al., 1994). However, that was argued against by the temporal observations of the development of meniscal ossicles (Mohankumar et al., 2014).

In the human knee, there are multiple well-known sesamoid bones including patella, fabella and the rarely reported cyamella. The patella is a constant sesamoid bone embedded at the quadriceps tendon, and its absence is related to certain diseases and syndromes (Letts, 1991). According to Caffey (1978) the age ranges of initiating the patellar ossification are 32-76 months in boys and 20-40 months in girls. The fabella is a non-constantly seen sesamoid bone at the lateral head of gastrocnemius tendon (Fig. 4), which ossifies at approximately 12 years of age (Flecker, 1942). A study showed that the incidence of the fabella is 31.25% in an Asian population (Chew et al., 2014). In a minority, the fabella can also be seen at the medial head of gastrocnemius tendon.

The cyamella, a sesamoid bone of the popliteus tendon, is a rare finding and rarely reported in humans, however, its incidence in certain nonhuman species has been studied. A study of 246 adult nonhuman primates belonging to 34 genera indicates that a popliteal sesamoid bone showed constant occurrence in Prosimii and Callitrichidae species, variable occurrence in Atelidae and Pongo and is usually absent in Gorilla. This bone is absent, or very rare, in Cebus, Cercopithecidae, Hylobatidae, Pan, and humans (Le Minor, 1992).

The MCL, where our newly described sesamoid bone was located, is composed of superficial and deep layers. The superficial one is 10-12 cm in length, and has one femoral and two tibial attachments. The femoral attachment is centred in a small depression slightly proximal and posterior to the centre of the medial epicondyle, with 26.8 mm average distance to the femoral joint line. The two tibial attachments include a proximal soft tissue and a distal bony attachment. The average distance from the tibial bony attachment to the tibial joint line is 61.2 mm. On the other hand, the deep layer of the MCL has distinct meniscofemoral and meniscotibial components. The former component attaches distal and deep to the femoral attachment of the superficial MCL, while the later component attaches just distal to the edge of the articular cartilage of the medial tibial plateau (Laprade et al., 2015).

Symptoms of MCL injury ranges from localised pain to knee instability depending on the severity of the ligamentous damage and the mechanism of injury. MRI scan is well-known to be a superior modality to delineate the ligamentous structures compared with CT scan, but unfortunately MRI was not done in the presented case due to loss follow-up.

The differential diagnosis for a calcified structure within the MCL includes Pellegrini-Stieda disease, calcific tendinitis, and ossifying tendinitis. Pellegrini-Stieda disease represents post-traumatic foci of amorphous calcification at the site of attachment of the medial collateral ligament, running along its proximal course in a curvilinear fashion, and accompanied by irregularities at the medial femoral epicondyle, as well as showing high uniform density with no internal fatty component (Fig. 5). In the case presented, it is clear that the proximal attachment of the superficial layer of the MCL showed no calcification, as the bony structure is 2 cm distal to the medial femoral epicondyle, without irregularities at the medial femoral epicondyle, and the structure was oval-shaped with cortex of uniform-thickness and internal fat density. Calcific tendinitis is similar to Pellegrini-Stieda disease in its (post-traumatic) nature, affecting most commonly the Supra- and Infraspinatus tendons, and it classically shows amorphous calcification with uniform density (Mansfield and Trezies, 2009; Kamawal et al., 2016). Ossifying tendinitis is a rarely reported type of tendinopathy, which is defined as post traumatic or post-surgery that shows chondral and myxoid tissues associated with bony metaplasia, and can be differentiated from the calcific tendinitis based on histopathological features (Merolla et al., 2015).

Fig 5. Coronal oblique CT-scan shows Pellegrini-Stieda lesion -same patient with fabella in Fig. 4- (arrow) that shows curvilinear outline along the proximal MCL and the intimate relation to the cortex of medial femoral epicondyle.

However, both these conditions show dense foci of calcifications on imaging with no internal fatty elements or trabecular bone. Other differentials such as a detached bone fragment due to fracture or osteochondral lesion were ruled out by the lack of osteochondral defect, fracture or history of knee trauma. Myositis ossificans as a differential diagnosis was ruled out as well by the fact that there is no muscular tissue deep to the superficial layer of the MCL that could explain the evolution of this osseous structure.

Based on the above mentioned differential diagnoses we diagnosed that the osseous structure within the MCL is most probably a sesamoid bone, which has not been described before.

Concluding, the Albtoush bone is a newly discovered sesamoid bone at the knee joint embedded within the MCL. Its existence supports the theory stating that development and evolution of the sesamoid bones is controlled through the interaction between intrinsic and extrinsic factors (Sarin et al., 1999). Patient symptoms may be linked to compression upon the adjacent structures, in a similar manner as pain associated with the presence of fabella (Zipple et al., 2003) or cyamellae (Benthien and Brunner, 2010), or be related to the associated thickening of the MCL mimicking symptoms of MCL tear.

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