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Fabella Syndrome: A Typical Case of Misdiagnosis and Discussion

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Abstract

Background: Fabella is a natural occurring sesamoid bone, cartilage or a mixture of both that is usually located at the posterolateral corner (PLC) of the knee [1]. Recently the PLC of the knee has been extensively investigated because it is a common site of injuries and diseases [2] [3]. The complexity of PLC anatomy needs to be fully understood because the fabella could be missed diagnosis as an osteochondral defect, osteochondritis dissecans (OCD), calcific tendinitis, or foreign body. We present a case report of fabella syndrome triggered by trauma and also performed a review of literature for the various diagnoses that might be confused with fabella syndrome. **Case presentation:** A 29-year-old, Sudanese male presented to the trauma center in King Khalid Hospital in KSA, complaining of pain and partial swelling in his left knee joint due to trauma. Fabella was detected in the posterior lateral corner (PLC) of the knee joint embedded in the lateral head of the gastrocnemius muscle. All other pathological conditions were excluded. **Conclusion:** Fabella is sesamoid bone with variable size, found in the PLC. Commonly if present it causes periodic pain especially in the fully extended knee or it remains asymptomatic. Trauma, surgery, sports or heavy extreme activities may trigger the pain of asymptomatic fabella. Clinicians should consider that pain in the PLC of the knee can result from the presence of the fabella in a condition called fabella syndrome.

Keywords

Fabella Syndrome, Sesamoid Bone, Osteochondral Defect, Osteochondritis Dissecans, Calcific Tendinitis, Foreign Body

1. Introduction

Among the human body joints, the knee is the largest most, superficial and complicated joint. It takes place between the condyles of the femur proximally and the tibial plateau distally. It has been classified as a hinge type of synovial joint allowing flexion and extension; even so, the gliding, rolling and with rotation about a vertical axis movements are possible with little degrees [4]. The stability factors of knee joint are composed of 28 unique static and dynamic stabilizers (ligaments, tendons, meniscal structures, and strong muscles) [5] [6]. Recently the posterior-lateral corner (PLC) of the knee has been commonly investigated because of its importance in knee stability and considered as a common side of injuries and diseases [2] [3]. The complexity of PCL anatomy needs to fully understand because it can contribute to the misdiagnosis for orthopedic surgeons [4] [7]. The static components of PLC are the fibular collateral, fabellofibular and popliteofibular ligaments, and posterolateral capsule, whereas the dynamic components are the tendons of the popliteus, biceps femoris, lateral head of gastrocnemius and iliotibial tract; that together provide lateral knee stability [8].

PLC is a common side of injuries and abnormal condition such as fabella syndrome, osteochondral defect, osteochondritis dissecans, calcific tendinitis, and foreign body. All of these conditions will be reviewed briefly in this study.

The current study aimed as well to report an unfamiliar morphology of posterior lateral corner of the knee (fabella syndrome) and its differential diagnosis in order to avoid misdiagnosis in such case.

2. Case Report

A 29-year-old, Sudanese male presented to the trauma center in King Khalid Hospital in KSA, complain from pain and partial swelling in his left knee joint due to falling down trauma.

Physical examination of the patient showed a partial swelling with normal popliteal fossa. On palpation temperature was normal in the region and there was no tenderness around the knee joint. A general screen of the patient's gait revealed no significant abnormalities. Changing position from sitting to standing and tolerance to either position was painless. The patient was asked if he has any similar symptoms before the trauma and the answer was no. Instability tests showed negative results and there were no abnormalities upon examination of distal neurovascular status.

Although he visited two physicians during this time, the problem still re-

mained due to misdiagnoses.

Eventually in the hospital, after a precise examination, X-ray showed a fabella in close topographical relation to the posterior lateral femoral condyle embedded in the lateral head of gastrocnemius muscle (Figure 1). This result was confirmed by MRI findings as seen in Figure 2.

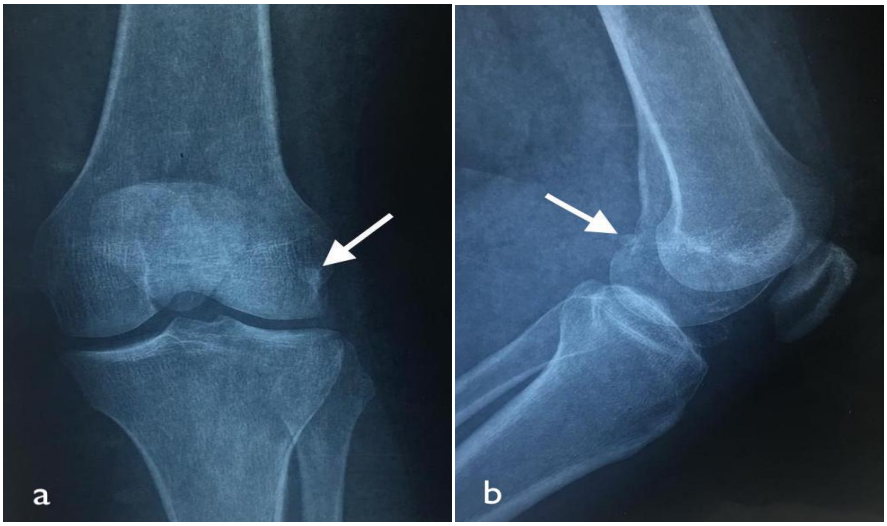

Figure 1. (a) Anteroposterior (AP), (b) Lateral view of plane radiograph showing fabella (arrows) located on the dorsal aspect of the lateral femural condyle.

Figure 2. MRI showing: a sagittal plane of knee joint at the lateral condyle of the femur. Arrow indicates the fabella associated with lateral head of gastrocnemius muscle.

3. Discussion

Flabella is a small sesamoid bone found commonly in the lateral head of gastrocnemius muscle [1], but few studies reported that it can be found in the medial head [9] [10]. It is believed that the fabella is associated with the distal part of the short head of biceps femoris tendon [11] [12]. Also, it had been reported in the knee of the dogs, cats, and rabbits [13] [14].

Researchers were varied about the time of development of the fabella. Some authors noticed that it appeared at the age of 10 years and remains unossified until the age of 12 - 15 [15]. And some of them reported that it first appeared in the second trimester around 15th week of gestation [16]. fabella was developed when the plantaris and lateral head of gastrocnemius were entirely separated, but not when both muscles converge to a single belly [17]. The presence of fabella is widely variable. **Table 1** demonstrates the prevalence of fabella on the previous studies including different ethnic groups [18].

Fabella could be pure osseous, cartilaginous or mixed in nature, forming its own joint with lateral condyle of the femur posteriorly [18] [19]. It has a variable size ranging from a very small dot with a 2.2 mm in diameter [19] [20] to large size measured 15 × 8 × 9 mm [21] 13 mm × 10 mm [22]. It's larger in male than the female, which supports the theory of biomechanical role of fabella [11] [12]. Authors believe that the fabella is involved in the stability of the posterolateral aspect of the knee [23].

The functions of sesamoid are to protect the tendon of muscle from being damaged by friction, change the direction of the puling muscles and helping muscles in action [24]. During the transition from the quadrupedal posture to the bipedal, the fabella seemly starts to disappear, because the standing position in bipedal need more stability and less rotation [25] [26] so that the fabella variable absent and it classified as retrogressive anatomical that lost it function with an upright position in human.

Table 1. Prevalence of the fabella in the different ethnic groups.

Author	Year	Prevalence %	Ethnic group
Yu *et al.*	1996	19.0	Caucasian American
Sarin *et al.*	1999	31.3	Caucasian America
Raheem *et al.*	2007	9.1	Caucasian Irish
Tim *et al.*	2010	3.1	Caucasian Brazilian
Phukubye and Oyedele	2011	23.5	Caucasian and African
Piyawinijwong *et al.*	2012	50.5	Asian Thailand
Tabira *et al.*	2012	68.6	Asian Japanese
Zeng *et al.*	2012	86.9	Asian Chinese
Chew *et al.*	2014	31.25	Asian, Singapore
O.F. Egerci *et al*	2016	22.8	Caucasian Turkish

Asymptomatic fabella remains silence until it has been detected by accident in routine lateral knee radiograph. And this was accepted as normal anatomy without any complain pathology in knee that may confuse radiologist with other pathological conditions [27] [28] like osteophytes in osteoarthritis or intrameniscal calcifications.

3.1. Fabella Syndrome

Fabella Syndrome describes traditionally posterolateral knee pain, occurring due to biomechanical pressure of the fabella against the lateral femoral condyle. Given its rarity, its diagnosis is often overlooked [29]. Fabella leads to many pathological conditions such as fabella syndrome and common fibular nerve palsy [30]. Also the presence of the fabella increases risk of osteoarthritis in the knee joint [31]. Due to its close anatomical association, authors believe that it may cause compression of popliteal artery [30] [32] or peroneal nerve at PLC of the knee [33] [34].

Pain at the posterior lateral part of the knee; which is augmented by full joint extension, is defined as fabella syndrome [35]. Authors referred this painful syndrome as the osteoarthritis [24] [36], degenerative arthritis and various deformity [37], dislocations [38], fracture [39] [40], and chondromalacia of the fabella [1] [28].

Absence of the fabella is a normal anatomical variation, clinicians and radiologist should know about the morphological features, position, and incidence of this bone. The fabella detected by different modalities of radiography such as X-ray, US, and MRI or by the cadaveric dissection.

3.2. Osteochondral Defect

Osteochondral defect is a common serious problem from which a large number of people around the world suffer [41]. About 63% of knees had been associated with chondral damage when investigated by means of arthroscopy, the full-thickness chondral lesion had been found in about 5% of cases [42]. The chondral lesion is the most common musculoskeletal defect that usually affects old age individuals [43]. Damage affecting chondral and bony part of the joint is called osteochondral defect, when solely articular cartilage is affected the term chondral injury or defect is usually applied [44] [45]. Articular cartilage damage may found isolated, but associated tissues are always involved [46]. Severity and progression of an osteochondral defect are largely affected by many factors such as weight, age, physical activity and genetic background of the individual [41] articular cartilage is avascular therefore it is the capability for regeneration are confined [47] [48]. Hyaline cartilage replaced by fibrocartilage as the joint subject to osteochondral defect, this change leads to joint's deformation and immobility [49]. Osteochondral and even chondral damage can develop into osteoarthritis [50]. Osteoarthritis is a common complication of traumatic injuries that causes joint defects and disabilities [51]. According to the clinical findings joint injuries commonly in-

volve articular cartilage, supporting tissues and capsule which cause joint degeneration [51]. Chondromalacia, chondral and osteochondral fractures, chondrosis, chondral flaps and osteochondritis dissecans are types of articular cartilage lesion [52].

Data revealed that trauma is the most common cause of the articular cartilage damage and osteochondral deformities [53] [54]. The traumatic lesion is due to either direct stroke or contortion. Ligaments laceration is usually associated with traumatic injuries [52]. Etiology of the osteochondral lesions is also due to other causes rather than trauma such as metabolic defects, ischemia, joint degenerative disease, thromboembolism, corticosteroids or inflammatory diseases [45] [54].

Ankle and knee are the common joints that prone to the osteochondral injuries. Knee is the most frequently affected [44] [54] [55]. Femoral condyles are most common part of the knee impaired by osteochondral lesion and almost 58% of cases affect the medial femoral condyles [56]. In the ankle the talar dome is the frequent site of lesion [54].

Osteochondral injuries are always associated with pain, swelling, joint instability and dysfunction [57] [58] [59] [60]. Joints injuries disturb daily activities and joints immobility is common complication [61].

There are many imaging modalities used to diagnose chondral and osteochondral lesions, plain radiograph, CT, MRI and ultrasonography [59] [62] [63]. Plain radiograph doesn't give a complete image of the lesion [64]. A Plain radiograph is useful to diagnose a fracture, subchondral cyst, osteochondral fragments and displaced osteochondral bodies [59]. To demonstrate articular cartilage surface using computerized tomography arthrography is the best choice, magnetic resonance is imaging technique through which demonstration of all tissue can be achieved (**Figure 3**) [59]. The US is used for assessment of both chondral and subchondral tissue components [62].

Figure 3. MRI showing: (a) Coronal plane of large osteochondral defect at the medial condyle of the femur; (b) Sagittal plane [65].

3.3. Osteochondritis Dissecans of the Knee

Osteochondritis dissecans (OCD) is a separation of articular cartilage and underlying bone separate from the specific joint, due to a plane of cleavage through underneath bone (**Figure 4** & **Figure 5**) [65]. König (1881) was first to describe Osteochondritis dissecans, He thought that a fragment separate as a result of dissecting inflammation followed necrosis caused by trauma [66]. Untreated OCD to the weight bearing bone may develop a degenerative joint disease [67]. According to the skeletal maturity of the patients, OCD is classified into juvenile and adult entities with open and close epiphyseal cartilage plates respectively [68] [69]. Among different joints including wrist, elbow, ankle, and hip, Knee is the commonest site for OCD [70] being engaged to approximately 75% of the cases, whereas, medial femoral condyle is the primarily affected site having more than 85% of the cases [67].

The clinical presentation is usually associated with nonspecific symptoms [71], including vague knee pain that is aggravated by certain activity like climbing stairs and may cause activity-related swelling and stiffness. Unstable lesions

Figure 4. Anteroposterior plane radiograph showing an osteochondritis dissecans lesion [70].

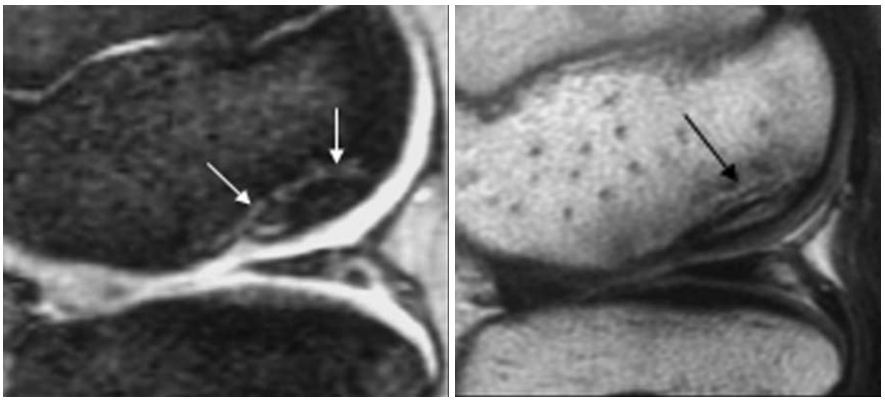

Figure 5. Echo MRI showing a rim of high signal intensity surrounding the osteochondritis dissecans lesion (arrows) [70].

usually marked by physical symptoms such as locking or feeling of loose fragment [72] [73]. OCD of the knee is becoming increasingly more frequent in children, adolescent and young adult and is thought to be, due to earlier and increasingly sports endeavors [74] [75]. Despite much speculation, the etiology of OCD remains unclear [76]. A variety of theories have been suggested regarding the cause of OCD, including three main areas; trauma, vascular and genetic [74]. Microscopically, absent of the bone necrosis favour defects in the ossification centers, rather than ischaemia in the distal part of femur [67]. The diagnosis of OCD depends on patient data, physical examination, and radiographic appearance. MRI is considered as the best imaging modality for early detection of lesion [77].

Literature, classified OCD lesions as: grade 1, normal articular cartilage. These asymptomatic lesions and usually found accidentally during another index surgery; grade 2, fragmentation *in situ*. The overlying cartilage may look normal, but can feel soft to probing and can be indented more easily when compared to the surrounding normal cartilage; grade 3, partial detachment which can cause mechanical symptoms due to micro-motion of the fragment; and grade 4, is designated to an unstable lesion with complete detachment, loose body present, causing pain and mechanical symptoms [78] [79].

3.4. Calcific Tendinitis

Calcific tendinitis is also included in the differential diagnoses of fabella syndrome. In contrast to the posterolateral knee pain experienced in fabella syndrome, calcific tendinitis causes anterior knee pain [80]. It is atypical pain if experienced posterolateral aspect of the knee joint. Calcific tendinitis refers to a painful musculoskeletal disorder characterized by macroscopic calcium deposits in any tendon of rotator cuff [81] [82]. Calcium deposits can be single or multiple and may be found in subacromial bursa. These calcium deposits are composed of a crystalline calcium phosphate called as "hydroxyapatite". It is different from dystrophic calcification, which develops at the edges or at the insertion site of non-viable and poorly vascularized or degenerative tendons. Calcific tendinitis affects 3% - 20% of the population; especially the adults whose age is 30 - 50 years. The most common rotator cuff involved in calcific tendinitis is supraspinatus followed by infraspinatus, teres minor, and subscapularis tendons. Remember, calcific tendinitis can affect any joint, but typically involves shoulder and hip joints. In the knee joint, patellar and quadriceps tendinitis are common [80] [83].

The exact pathogenesis of calcific tendinitis is yet to be revealed. However, recent literature on this condition reported that it is a cell-mediated process with four well-defined phases. These four phases of calcific tendinitis are formative, calcific, resorptive and reparative [84]. In the formative phase of calcific tendinitis, the tendons undergo a fibrocartilaginous transformation. In the calcific phase, calcification of the tendon occurs. Resorptive phase is painful and various

inflammatory reactions take place within the calcium deposits. In the last phase of calcific tendinitis, fibroblasts restore the normal texture of tendons. In contrast, other authors suggest that matrix vesicles and degeneration of tendons are responsible for calcific tendinitis [85].

Calcific tendinitis may be asymptomatic in one-third of the patients. In others, it is painful, accounting for 7% of patients with shoulder pain, especially when inflammatory processes are undergoing in the calcium deposits. Osseous changes and calcium deposits can be visualized well with regional radiographs, CT and MRI. The size of calcium deposits may range from millimeters to centimeters. Remember that an aggressive appearance on imaging films may confuse calcific tendinitis with infection or other diagnoses such as malignancies [86]. CT scan is the best modality to identify subtle osseous changes.

3.5. Foreign Body

Foreign body is referred to the substance or object that does not belong to the place where it is found [87]. Fabella might be taken as a foreign body in the knee joint. However, foreign body and fabella syndrome can be differentiated from each other by the shape and density of the object and also by the trauma history. History of trauma and wound of entry favors foreign body in the knee joint while bone-like density and advocates for sesamoid bone. In context with fabella syndrome, Driessen *et al*. [35] have demonstrated that foreign body can produce pain in the PLC of the knee joint. Foreign bodies in knee joints are rare. Authors reported an intraosseous metallic foreign body in the lateral [88] and medial [89] condyles of the femur associated with pain in the left knee. Low radiopaque objects are usually missed on imaging investigations. Therefore, accurate diagnostic protocol is required to detect these objects in order to avoid any pathological changes and complications. Thorns, wood, and sand are common foreign bodies get into the body during routine accidents.

Radiography is the first investigation performed in detection of any foreign body. However, the disadvantage of radiography is that it is unable to provide exact size of foreign body as it is a 2-dimensional imaging modality. Therefore, further investigation using ultrasonography, CT scan and MR imaging are required to determine the exact size of the foreign body [90]. Determination of size of foreign body and more details are necessary to plan a therapeutic intervention. High frequency US is a safe, cheap and useful imaging modality to detect radiolucent foreign bodies such as wood and sand objects [91]. MRI is not considered a primary imaging modality for the detection of unknown foreign bodies as it is expensive and not easily available everywhere. Additionally, it is difficult to visualize foreign bodies of plastic, iron, glass and sand due to artefacts related to body's composition, which may be encountered on MRI scan.

4. Conclusions

Fabella is a normal anatomical variant that may appear in PLC of the knee. It is

often miss diagnosed in radiography [28]. Moreover, its variable size and nature (bone, cartilage, or mixed) [18] [19] may lead to confusion in the diagnosis of fabella syndrome with the following: 1) Osteochondral defect when it appears like isolated cartilage. 2) Osteochondritis dissecans which, if it is mixed, appears like a fragment of cartilage with underlying bone. 3) Calcific tendinitis when calcium deposit and osseous changes occur. 4) Foreign body especially after wounds injury.

In general, all these conditions can be differentiated from fabella syndrome by taking proper patient history, focusing on the nature (type and site of the pain) and the history of trauma. Also, taking into consideration the size, density, shape, condition of the associated structures would assist in the diagnosis.

Many reports pointed to the presence of the fabella, even though it is not described in most of the anatomy books. The exact role of the fabella in the knee joint and the consequence of its presence remain unclear and need to be clarified with further studies. We recommend giving more attention to this anomaly and the way it may affect the patient's life style.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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Abbreviations

PLC: Posterolateral Corner
OCD: Osteochondritis Dissecans
CT: Computed Tomography
MRI: Magmatic Resonance Imaging