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## **Bilateral double-layered patella in a patient with advanced knee osteoarthritis**

Running title: Bilateral double-layered patella

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### **Abstract**

Double layered patella (DLP) is a rare anomaly of the patella that may go undiagnosed, especially in patients with progressive knee dysfunction and early degenerative changes. Clinical symptoms such as motion-dependent pain and anterior knee pain most typically occur in adolescents or young adults, however, gradually increasing pain and early generalized degenerative changes have also been seen in patients over 40 years old. Diagnosis of DLP could be difficult, especially in cases with coexisting arthrosis. DLP is considered to be pathognomonic for the diagnosis of multiple epiphyseal dysplasia (MED) and usually coexists with other anomalies seen in this syndrome, such as hip dysplasia. In extremely rare cases, DLP can occur as a solitary disorder. The prevalence of such cases, however, is unknown, and they could be easily misdiagnosed. Computed tomography (CT) and magnetic resonance imaging (MRI) are the most sensitive radiological methods used in DLP diagnosis. This case report presents a case of a bilateral DLP incidentally found in a 47-year old patient with advanced arthritis referred for arthroplasty because of increasing symptoms of knee joint failure with no other abnormalities recorded. An important goal of our case study is to raise the awareness of this abnormality with radiologists and orthopedic surgeons.

**Key words: bilateral double-layered patella, osteoarthritis**

## **INTRODUCTION**

Medical literature reports only a few cases of double layered patella (DLP). DLP is considered to be pathognomonic for the diagnosis of multiple epiphyseal dysplasia (MED) [7].

Early onset of clinical symptoms, such as increasing anterior knee pain and motion-dependent pain are characteristic of young patients; however, dysfunction as well as early, generalized degenerative changes have also been seen in patients over 40 years old with no history of trauma [10]. Because there are therapeutic implications to distinguishing DLP from other causes of knee failure in non-traumatic painful patients, imaging findings should be used to guide differential diagnosis.

This case report presents a case of a incidentally found bilateral DLP in a 47-year old patient with advanced arthritis referred for arthroplasty because of increasing symptoms of knee joint failure with no other abnormalities recorded.

## **CASE REPORT**

The patient (M.G.), aged 47, was referred from a county health center to the Orthopedic Clinic of the Medical University in Lublin, Poland, with increasing symptoms of knee dysfunction and pain. On physical examination, the patient felt severe pain in both knees during movement and physical effort, especially the left knee, with a slight contracture in flexion and motor impairment of the LLE resulting in abnormal gait. The patient had not been diagnosed previously for these complaints. Physical examination also revealed a limited range of motion of 0 to 100 degrees of flexion for the right knee and 0 to 70 degrees for the left knee. The patient reported pain in both compartments in the area of the joint space. AP and lateral view radiographs of both knees showed advanced arthritis, with more advanced lesions in the left knee. In lateral views two separated, parallel segments of both patellas were found (Fig.1). The patient was referred for arthroplasty of the left knee. Computed tomography (CT) was performed a month later to assess bone structure. CT scans confirmed the presence of advanced degenerative changes in both knees and coexisting bilateral double-layered patella (Fig.2). Additionally, several small segments were detected in the upper outer quadrant of the superficial surface of the left knee patella (Fig.2 B and D). During the arthroplasty, patellar

segments were removed or fused. The articular surfaces of the distal femur and proximal tibia were replaced with a prosthesis. Osteophytes that had formed on the patella and the edges of both bones were reduced. Following surgery, the patient underwent standard postoperative rehabilitation. Despite reminders, the patient never reported for follow-up.

## DISCUSSION

The patella, being the largest sesamoid bone in the human body, serves as an anatomic pulley (trochlea) for the quadriceps tendon. One of the most common patellar abnormalities is multipartite patella, which occurs in 0.2–6% of the population. A bipartite patella is the most prevalent form of this condition [12]. The partition is most often considered to be the consequence of a failed fusion of patellar ossification centers, but, other causes, such as trauma, tendon pulling on the patella, or insufficient vascular supply have also been proposed in the literature [11]. Available classifications of multipartite patella do not include a double-layered patella (DLP) [9]. DLP is currently considered to be pathognomonic for the diagnosis of multiple epiphyseal dysplasia (MED), but single cases of this anomaly without coexistence of MED have also been described [1,7]. The dominant form of MED occurs in 0.01% of the population, but the prevalence of the recessive form is unknown [1]. It has been suggested that mutations in the COMP, DTDST, MATN3, COL9A1, COL9A2, and COL9A3 MED genes may be responsible for the occurrence of MED, while mutations in the DTDST and COL9A2 genes have been shown to coexist with the DLP phenotype [1,5,10].

It is extremely difficult to estimate the prevalence of solitary DLP, because until now only a few cases have been reported in the literature available to the authors. First described by Buttner in 1925, DLP is an anomaly in which there are two patellar segments separated by a coronal septum: an anterior segment which is embedded in the quadriceps femoris tendon and patellar tendons, and a posterior segment, which forms the articulating surface for the femur [7]. It is thought that DLP is bilateral in up to 40% of patients [3]. The interface between the two segments is cartilaginous [4,7]. Apart from complete DLPs, partial DLPs have also been described in the literature, often in association with fracture [5]. A partial DLP can also occur in patients without MED [3].

DLP is sometimes asymptomatic, but it can also cause a variety of clinical problems. Clinical symptoms such as motion-dependent pain and anterior knee pain, clicking, locking or patellar dislocation most typically occur in adolescents or young adults [4,7]; however,

gradually increasing pain and early, generalized degenerative changes have also been seen in patients over 40 years old [10]. A delayed and painful movement of the posterior patellar segment that has no tendinous insertions, which causes painful snapping of the patella has also been reported [4]. DLP can be suspected based on clinical examination, especially in patients with a history of MED [7]. The diagnosis is confirmed following imaging (X-ray, CT or MRI scans)[8]. CT and MRI are the only modalities that enable precise morphological evaluation of both patellar segments. As a method that allows to perform multiplanar and 3D reconstructions, CT is an important preoperative tool. The layers can also be seen in ultrasound images, because the posterior segment is not entirely covered by the anterior segment.

Because DLP is a very rare abnormality, no standard treatment has been established so far. This means that therapeutic interventions are individually tailored to the patients' needs. Surgery has been performed in symptomatic patients both with and without a history of trauma. Resection of the posterior segment was proposed previously [2], however, more recent work describes a good clinical outcome in patients who have undergone a surgery involving decortication of the separated bone segments and fixation using multiple stabilizing elements [4,5] or a single screw [6]. Patients who are referred for surgery may need a more extensive evaluation, including CT scanning, as CT scans can be used for planning treatment and printing 3D models of the patella.

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**Figure 1** Lateral X-ray views of double-layered patella; **A.** Right patella (white arrow); **B.** Left (white arrow), additional separated segment in upper part of left patella (red arrow).

**Figure 2.** Computed tomography scans reconstructions; **A.** Axial view of right knee; **B.** Axial view of left knee; **C.** 3D reconstruction of right patella; **D.** 3D reconstruction of left patella, multiple segments in upper part of anterior layer is seen (red arrows).



