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Early arthroscopic debridement of posterior cruciate ligament calcification after symptom presentation led to immediate recovery: a case report

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Abstract

Background We report a rare case of posterior cruciate ligament (PCL) calcification, which has only been reported in two case studies on PubMed.

Case presentation A 71-year-old man developed left popliteal pain in the morning without any history of trauma and the pain became severe that night. On the following day, he presented to our department. The patient could not flex his left knee at all due to pain and swelling. CT and MRI scans showed calcification behind the PCL with mild osteoarthritic changes and accumulation of synovial fluid in the joint. Synovial fluid analysis did not reveal any crystals. Blood tests at first admission showed inflammation, hyperglycemia, and low blood uric acid levels. Although the patient's knee joint was injected with steroids, his symptoms did not improve. Thus, we performed arthroscopic surgery two days after symptoms had appeared. Intraoperatively, we observed a white, soft tissue in the synovial membrane behind the PCL. Part of this tissue was collected for histological analysis, which revealed sparse fibers with calcium deposits. Immediately after surgery, the patient's symptoms were completely gone. Afterward, the patient remained asymptomatic one month after surgery.

Conclusion This is the first reported case of debridement of PCL calcification and ossification that was performed soon after symptoms appeared. In addition, we demonstrated that early debridement led to complete recovery.

Keywords Posterior cruciate ligament, Calcification, Arthroscopic surgery, Metabolic disorder

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Background

Knee ligament calcification is rare but calcification of vessel walls and the rotator cuff is commonly observed. Patients with calcification in the articulation experience severe pain even at rest and often cannot sleep due to the pain. The literature in PubMed includes several reports of medial collateral ligament (MCL) calcification in the knee ligament [1, 2] and a few reports of anterior cruciate ligament (ACL) calcification [3–5]. However, there is only one report of posterior cruciate ligament (PCL) calcification [6] and one report of PCL ossification [7]. In these two cases, arthroscopic debridement was performed more than a year after symptoms had appeared. Herein, we report a patient in whom arthroscopic debridement of calcium deposits was performed two days after symptoms had appeared.

Case presentation

A 71-year-old man was admitted to our outpatient clinic and complained that he had been experiencing left popliteal pain since the day before. His symptoms appeared in the morning and acutely got worse that night without any history of trauma. The pain was severe even during rest, and the patient was not able to sleep. On the following day, he presented to our department. His past medical history included diagnoses of diabetes and hyperlipidemia. He had not experienced any fever since the symptoms first appeared, but the popliteal fossa was observed to be tender. The patient's knee was swollen and had a positive ballottement test. The skin of the knee had a normal temperature and did not exhibit any redness. However, the patient could not flex his knee at all (0 degrees of flexion) and he could not walk because of the pain.

Blood tests at first admission showed that the white blood cell count was 9700 /μL, the CRP level was 1.45 mg/dL, the glucose level was 202 mg/dL, hemoglobin A1c was 7.4%, and the uric acid level was 2.4 mg/dL. X-rays revealed a high-density mass within the intercondylar notch (Fig. 1). Multi-planar computed tomography (CT) showed a mass with heterogeneous density behind the PCL (Fig. 2A). Magnetic resonance imaging (MRI) showed the mass behind the PCL with mild osteoarthritic changes, accumulation of synovial fluid in the articulation, and inflammation of the synovial membrane in the popliteal fossa (Fig. 2B). Synovial fluid was collected, and its analysis did not reveal any crystals.

Although the patient's knee joint was injected with steroids, he was still in severe pain the next day. We performed arthroscopic surgery two days after symptoms had first appeared in order to conduct further examinations and initiate treatment. Since the pain was preventing the patient from sleeping at night, he wanted to be diagnosed and treated as soon as possible. Intraoperatively, a partial medial meniscus posterior root tear (MMPRT) that appeared to be old and degraded was found (Fig. 3A), the lateral tibia cartilage was observed to be fibrillated (Fig. 3B), and a white, soft toothpaste-like tissue was noted in the synovial membrane behind the PCL. A minimal portion of the synovial membrane of the PCL was removed and the calcification was pushed out to retain as much of the PCL as possible. The MMPRT was not treated since the medial meniscus posterior root did not show any instability. The majority of the unknown tissue behind the PCL broke apart in the synovial fluid, but a part of the tissue was collected for further histological analysis (Fig. 4A, B). H-E staining revealed sparse fibers and multi-nucleated giant cells within the tissue (Fig. 5A). Von-Kossa staining showed calcium deposits in most of the fibrous tissue (Fig. 5B).

The patient's symptoms were completely gone after surgery. He was allowed full range of motion and could walk without pain. A small amount of calcification was

Fig. 1 X-ray of the left knee. A high-density mass is present within the intercondylar notch (arrow)

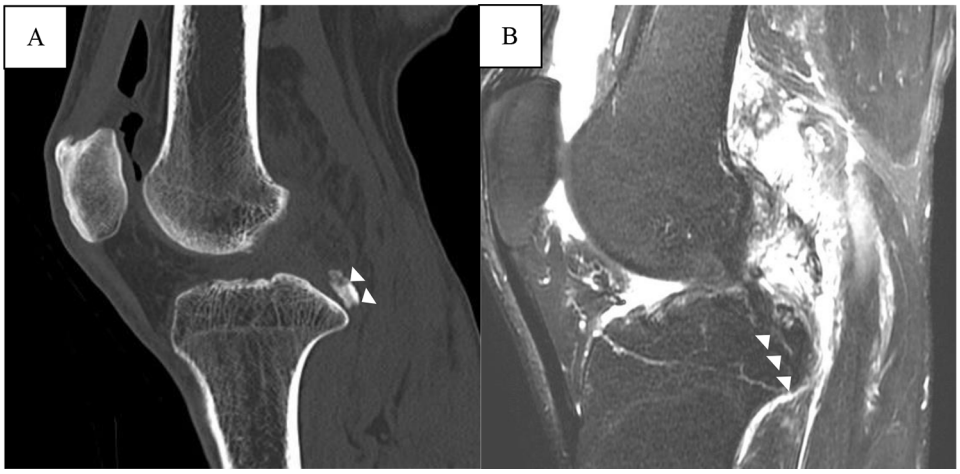

Fig. 2 Preoperative sagittal multi-planar CT (A: left) and T2-weighted sagittal MRI (B: right). (**A**): The mass with heterogeneous density behind the PCL (arrowheads). (**B**): The mass behind the PCL showing low signal intensity on T2-weighted image (arrowheads)

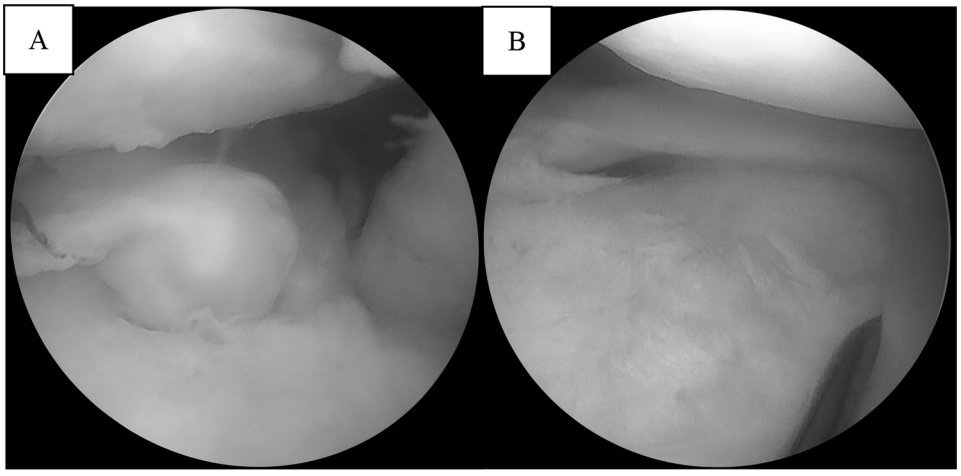

Fig. 3 Intraoperative arthroscopic photos. (**A**: left): Partial medial meniscus posterior root tear (MMPRT). (**B**: right): Fibrillated lateral tibia cartilage

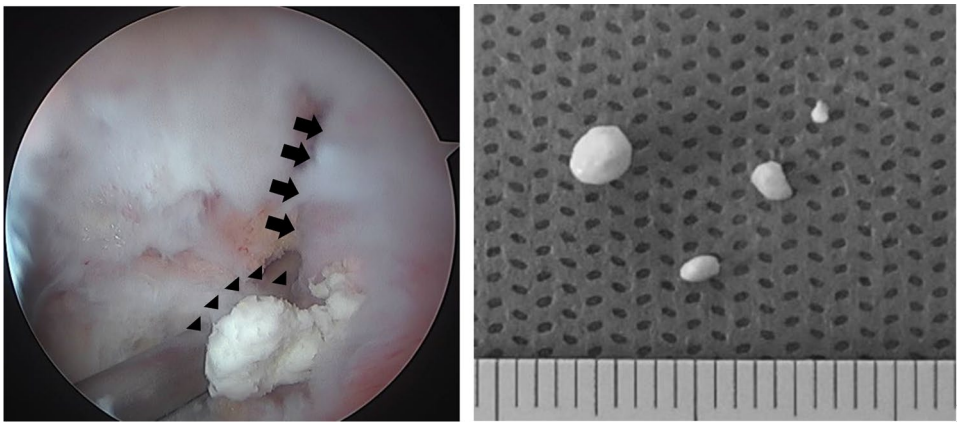

Fig. 4 Calcium deposits. (**A**: left): White, soft calcium deposits (arrowheads) behind the PCL (arrows) intraoperatively. (**B**: right): Collected calcium deposits

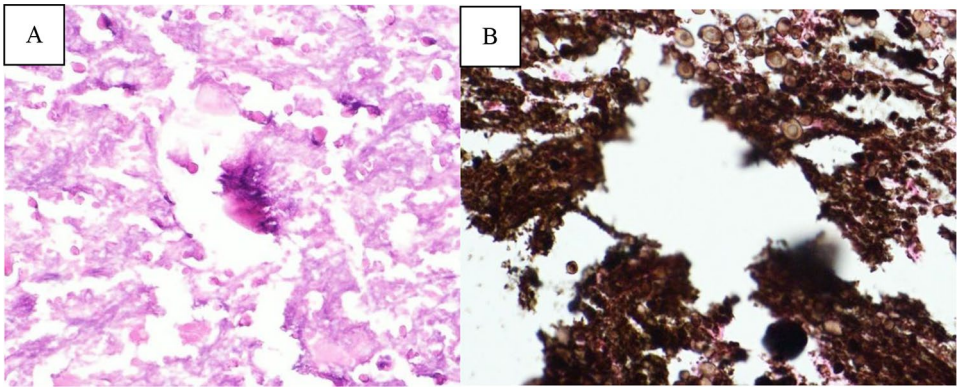

Fig. 5 Histological examination. (**A**: left): H-E staining revealed sparse fibers and multi-nucleated giant cells within the tissue. (**B**: right): Von-Kossa staining showed calcium deposits in the fibrous tissue (black staining)

Fig. 6 Postoperative CT scans

observed on postoperative CT scans (Fig. 6). One month later, X-rays with a posterior gravity sagging view showed no posterior sagging of the proximal tibia. The patient remains asymptomatic one month after surgery.

Discussion and conclusions

This is the first reported case of early debridement of PCL calcification and ossification that was performed soon after symptoms appeared. In addition, this procedure led to complete recovery. There is only one report of PCL calcification [6] and one report of PCL ossification [7] in the literature. In both cases, arthroscopic debridement was performed more than a year after symptoms had appeared.

The diagnosis of ligament calcification was based on MRI and arthroscopic findings of this case and previous reports. Arthroscopic images showed that the calcification was in the synovial membrane of the PCL and were similar to findings observed in a previous report of ACL calcification [3]. Synovial mesenchymal stem cells can also differentiate into chondrocytes [8], which may have given rise to the calcification in the synovial membrane. However, there have been no reports of intrasynovial calcification other than in solid tumor tissue. In our case, the calcification in the synovial cavity developed among sparse fibers in the absence of tumor tissue. One possible scenario is that the lining integrity of the synovial barrier was disrupted during joint inflammation and monocytes which can undergo autophagy migrated to the synovial cavity [9].

Differential diseases in this case included MMPRT and crystal-induced arthritis. It was difficult to diagnose the MMPRT on MRI because it was an incomplete tear (type 1) [10] and had no extrusion (stage 0) [11]. MMPRTs can sometimes lead to severe pain. However, the pain experienced by our patient could not have been due to osteoarthritis of the knee and MMPRT because he had severe pain even at rest, the MMPRT was not fresh, and only the PCL calcification was treated through debridement. Additionally, the patient did not have crystal-induced arthritis because synovial fluid analysis did not reveal any crystals. Thus, we concluded that the pain had been caused by the PCL calcification.

Arthroscopic surgery was selected for treatment and also for conducting further examinations, since the patient could not sleep at night due to the pain and wanted to be diagnosed and treated as soon as possible. During the operation, a minimal amount of the synovial membrane of the PCL was removed and the calcification was pushed out to retain as much of the PCL as possible. This led to some of the calcification being retained behind the PCL, as was observed in postoperative CT scans. However, the patient was able to completely recover. This suggests that the calcification does not have to be removed completely for an optimal outcome. A previous study also demonstrated that ultrasound-guided

debridement of MCL calcification led to early complete recovery with a small calcification left behind [12]. In our case study, arthroscopic surgery was performed to determine if there was another cause for the pain, but ultrasound-guided debridement might have had a similar outcome.

The histological analysis led us to believe that calcification was present. Calcification is defined as the deposit of calcium salts in tissue. In contrast, ossification is defined as the formation of bone (calcification in the collagen matrix) whether or not there is bone marrow [13]. In our case, calcium deposits were found in the fibrous tissue but the fibers were sparse and there was no bone-like tissue. Therefore, we speculated that the calcium deposits were not indicative of bone formation but of calcification. Calcification can occur in vessels, muscles, tendons, and ligaments [14]. Trauma, overuse, and metabolic disorders like diabetes can cause calcification in the articulation [14–18]. However, the pathogenesis of that process remains unclear. Our patient had a history of diabetes. The reference range for serum uric acid in humans is 1.5-6.0 mg/dL for women and 2.5-7.0 mg/dL for men, while hypouricemia is commonly diagnosed when levels drop to 2.0 mg/dL or less. There is currently no report regarding any correlation between calcification in the joint and uric acid. However, it has been reported that hypouricemia can increase oxidant stress [19], which in turn can lead to vessel calcification [20]. In our case study, low blood uric acid levels could have also led to low uric acid levels in the joint, resulting in oxidant stress and calcification. Our patient had diabetes as well as relatively low blood uric acid, which could have easily induced calcification in the body. However, it remains unclear why calcification did occur behind the PCL in this case.

The underlying mechanism for calcification within the knee joint remains unclear. Calcification of the rotator cuff is induced by chondrocyte-like cells [21], which may be involved in endochondral ossification. In addition, calcific tendonitis of the rotator cuff can lead to severe pain during the resorption phase because of inflammation around the calcification [21]. In this phase, the deposit has a creamy or toothpaste-like consistency while it has a stiff mass like chalk in the calcific phase [14]. In our case, the calcium deposit may have been in the resorption phase because the tissue contained multi-nucleated giant cells and was soft enough to break apart in the synovial fluid. This could have led to inflammation of the synovial membrane and severe pain.

In conclusion, PCL calcification is rare. In our case, metabolic disorder may have been the cause of the calcification. This is the first report where debridement of calcification was performed soon after symptoms first appeared, leading to complete recovery.

Abbreviations

MCL	Medial collateral ligament
ACL	Anterior cruciate ligament
PCL	Posterior cruciate ligament
CT	Computed tomography
MRI	Magnetic resonance imaging
MMPRT	Medial meniscus posterior root tear

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Not applicable.

Author contributions
YN treated the patient as a primary care physician. YI performed the surgery. KT assisted in the surgery. NA edited the manuscript. All authors read and approved the final manuscript.

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Data availability
No datasets were generated or analysed during the current study.

Declarations

Ethics approval and consent to participate
Institutional review board of Saiseikai Hiroshima Hospital has approved present case study. Consent to participate was obtained from the patient.

Consent for publication
The patient gave written informed consent for their personal and clinical details along with any identifying images to be published in this study.

Competing interests
The authors declare no competing interests.

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