

# Stump Entrapment of the Torn Anterior Cruciate Ligament

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Abbreviations: ACL, anterior cruciate ligament; MRI, magnetic resonance imaging

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## Abstract

We present a case of anterior cruciate ligament stump entrapment in a 24-year-old gentleman who traumatically injured his knee. The anterior stump became entrapped in the intercondylar notch and after a process of inflammation and fibrosis, produced a mass similar to the more familiar cyclops lesion that may complicate anterior cruciate ligament reconstruction.

## Introduction

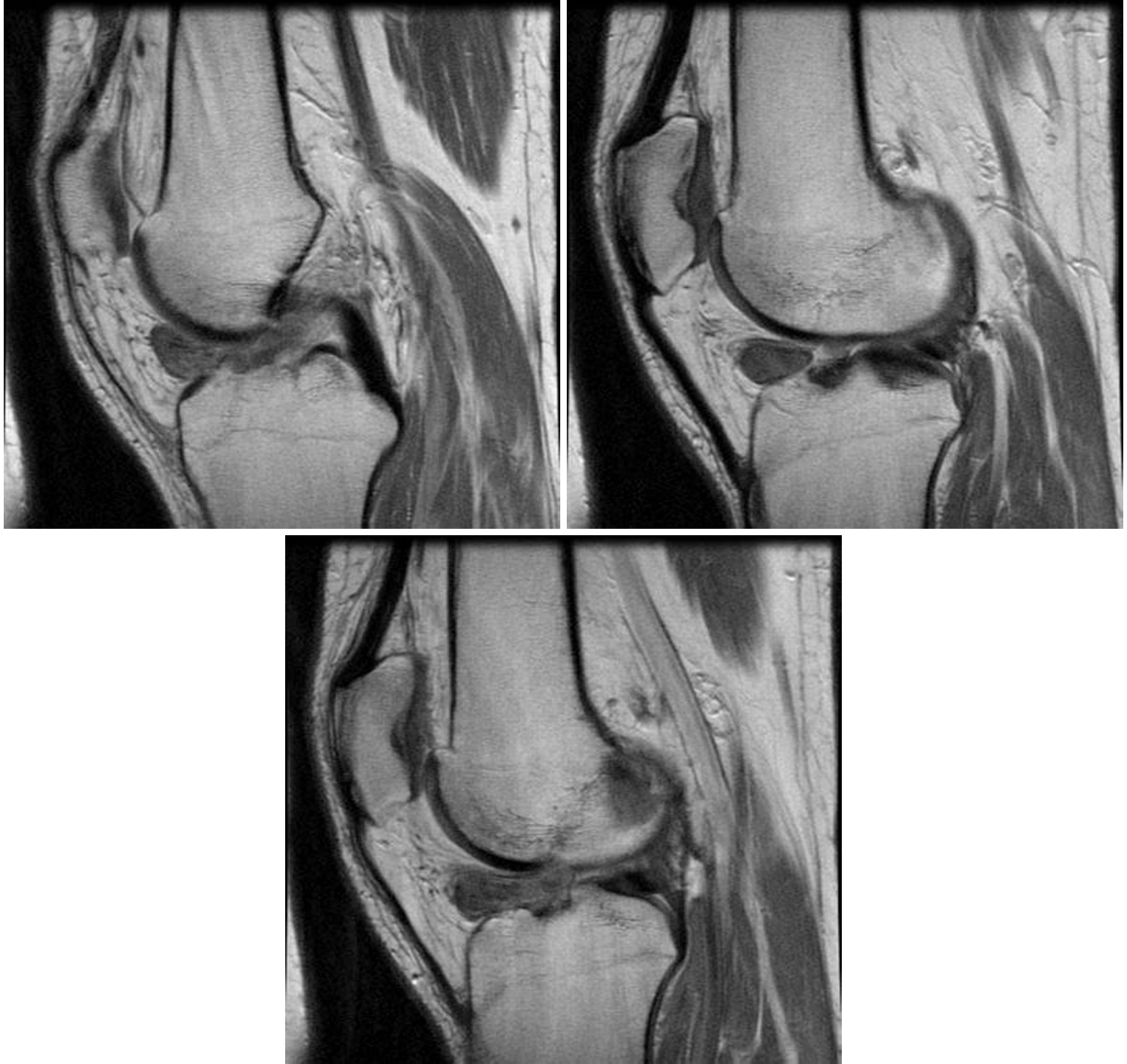
While injury to the anterior cruciate ligament (ACL) is very common, stump entrapment following an ACL tear is an uncommon finding and is considered a variant of the typical cyclops lesion. In comparison to the traditional cyclops lesion, there is no history of previous ACL repair in stump entrapment, which is also known as a pseudocyclops lesion.

## Case Report

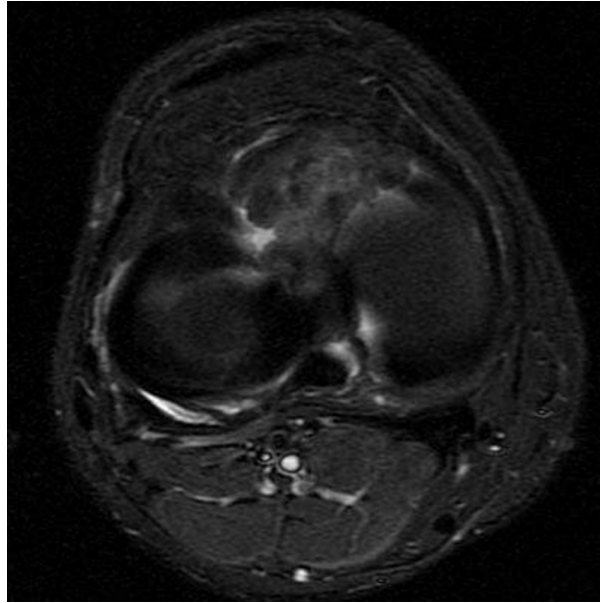
A 24-year-old gentleman came to the emergency room after injuring his knee while skateboarding three weeks prior to presentation. He had no history of any prior surgery or injury to the affected knee.

On exam, his knee was swollen and painful. He had decreased range of motion and was unable to fully extend his knee. Initial radiographs of the knee were unremarkable. A subsequent MRI showed increased signal within the ACL as well as a nodular mass of mixed signal intensity between the lateral femoral condyle and the tibia, which extended into the anterior joint recess. There were associated contusions in the femoral condyles. The imaging findings supported the diagnosis of a partial ACL tear with stump entrapment. Of the two subtypes described in the literature, we favor the

diagnosis of a type I entrapment. The patient did not return to the orthopedic clinic and was lost to follow up.



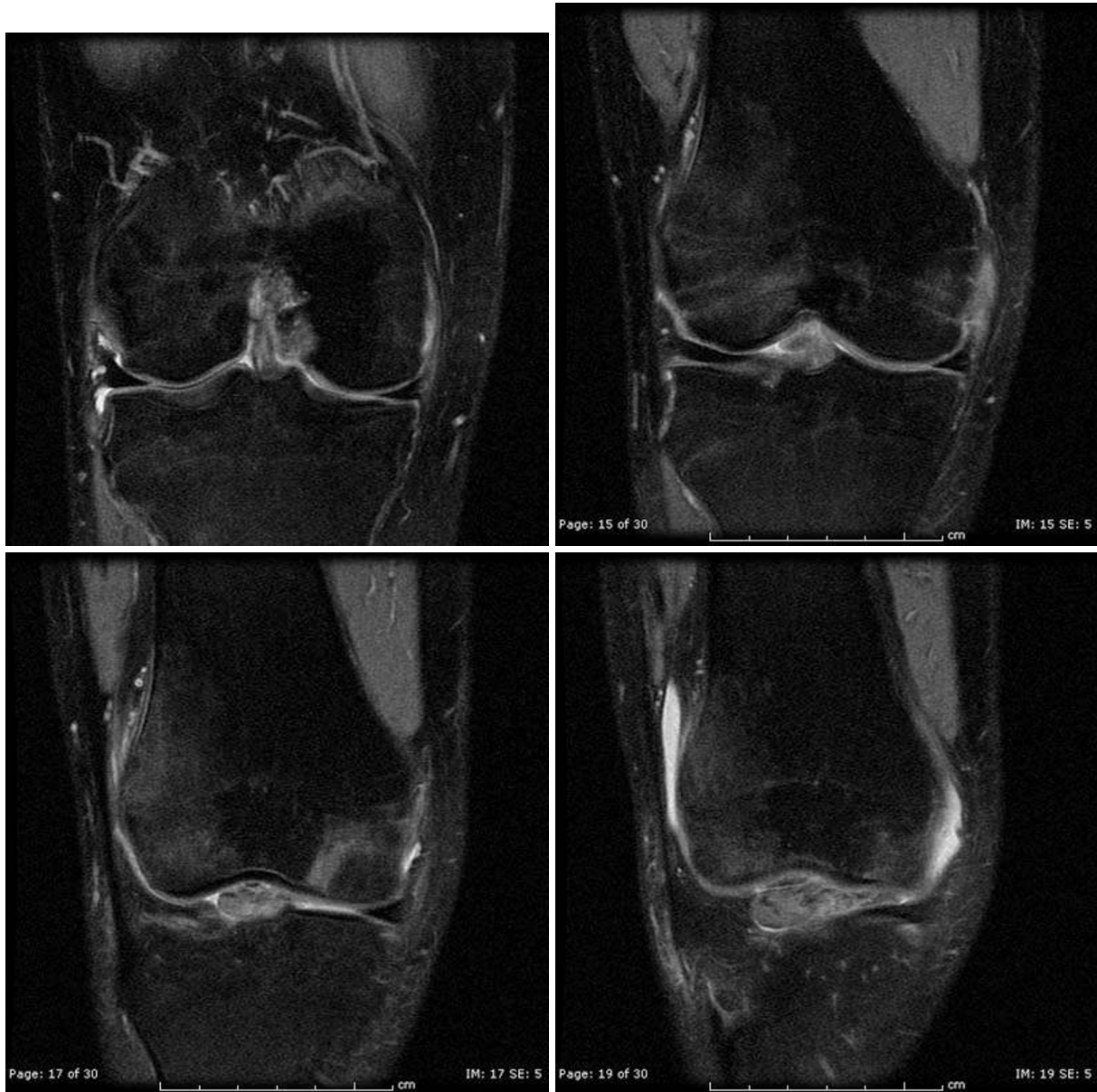
**Figure 1A.** 24-year-old man with ACL tear. Sagittal proton density-weighted MRI shows a nodular mass of intermediate signal in the intercondylar notch.



**Figure 2.** 24-year-old man with ACL tear. Axial proton density-weighted fat saturated MRI shows the nodular mass in the intercondylar notch extending anteriorly. it appears to be in continuity with the fibers of the distal ACL stump.



**Figure 3.** 24-year-old man with ACL tear. Sagittal T2-weighted MRI, which shows the nodular mass and some intact ACL fibers.



**Figure 4.** 24-year-old man with ACL tear. Coronal fat-saturated proton density-weighted MRI shows the nodular mass in the intercondylar notch. There are bone contusions, which are most prominent in the lateral femoral condyle but also to a lesser degree in the lateral tibial plateau. There is increased signal within the ACL.

## Discussion

While ACL tears are quite common, it is unusual to have an ACL tear which subsequently becomes entrapped in the anterior joint recess. With entrapment, the displaced stump is caught in the intercondylar notch between the lateral femoral condyle and the tibial plateau [1]. The displaced fragment acts as a mechanical obstruction thereby limiting full extension of the knee [2]. ACL stump entrapment presents with many of the same characteristics as a cyclops lesion but there is no history of previous ACL repair.

Two types of stump entrapment have been described. Type 1 involves a free end that is nodular or mass-like in appearance, interposed between the intercondylar notch. Type 2 describes a lesion in

which the displaced portion of the ACL has an angulated fold in the anterior end giving it a tongue-like appearance. Type 1 is the most common [1,3].

The pathophysiology of stump entrapment seems to be similar to that of localized anterior arthrofibrosis, or a cyclops lesion. The displaced and entrapped fibers elicit an inflammatory response, which causes thickening of the fibers and local accumulation of granulation tissue. Huang et al propose two mechanisms for the entrapment of the torn ACL fibers. When the ACL is torn in its proximal one-third, the stump is displaced into the intercondylar notch and undergoes fibrosis and thickens. The knee is unstable and when it translates anteriorly, the thickened and fibrotic portion of the torn ACL shifts into the anterior recess, resulting in a type 1 lesion. Type 2 lesions occur when there is a tear at the distal end of the ACL near its attachment to the femur, which leaves a long stump that folds back on itself. Histologically these lesions show a nodular mass composed of disorganized ACL fibers and fibrotic tissue [1].

The imaging characteristics can be found as early as one week after the initial injury. Commonly associated findings are a joint effusion, meniscal tears and marrow edema in the lateral femoral condyles and the posterolateral aspect of the tibial plateau as well as injury to the medial collateral ligament [1].

The imaging characteristics of the displaced ACL fibers vary from hyperintense to isointense to muscle on T1 and T2-weighted sequences and heterogenous on proton-density-weighted images [4]. Recognition of the torn fiber morphology and the relationship to the ACL allows the diagnosis to be made. Limitation in full extension alone is not indicative of ACL stump entrapment as this is a common finding in ACL tears. The physical exam finding, however, may help in arriving at the correct diagnosis [5].

Cyclops lesions are a recognized complication of ACL reconstruction surgery and much like ACL stump entrapment, cause an inability to fully extend the knee because of a nodular mass of granulation tissue that extends into the anterior joint compartment [4,6]. As in ACL stump entrapment, the lesion lies in the intercondylar notch between the tibial plateau and the femoral condyle [7]. The lesion is so named because at arthroscopy it has a head-like morphology with a focal area of discoloration, resembling an eye [4,8]. It is thought to occur from fibrosis of either a residual tibial ACL stump, or from debris related to the surgical repair [4,7]. On MR imaging the cyclops lesion appears as a well-defined nodular mass anterior to the ACL graft, which on proton-density-weighted images is predominately of intermediate signal intensity [7]. These lesions are important to recognize as they impair normal function, are easily treated with arthroscopic resection and are not amenable to conservative therapy [4,9].

Hoffa's disease is a differential diagnosis that may be considered. Hoffa's fat pad is an extrasynovial structure just anterior to the synovial portion of the joint, though it is still considered intraarticular. It is a well vascularized and innervated area [9,10,11,12]. Hoffa's disease is thought to be caused by hemorrhage secondary to trauma, in which blood products incite an inflammatory response which results in hypertrophic fibrotic tissue. This in turn leads to a cycle where the hypertrophied fat pad is more apt to trauma as it gets caught between the femur and the tibia [10,11,12]. This area of inflamed and fibrotic tissue is painful, especially during knee extension [11]. MR images of the knee vary in the acute and chronic phases. In the acute phase there is increased T2 signal within the fat pad, which is often seen in conjunction with bowing of the patellar tendon from the mass effect. In the subacute to chronic phases the signal intensity tends to be lower on both T1 and T2-weighted images, which reflects the underlying fibrosis and hemosiderin deposition. Rarely associated ossification of fibrocartilage tissue can form [10]. ACL tears are also associated with abnormalities in Hoffa's fat

pad, the most common of which is edema, which may relate to impingement of the fat between the femur and tibia [12]. Scarring within Hoffa's fat pad can be found in patients with chronic ACL injuries and may be exacerbated by knee instability [12].

Another differential to be considered is localized nodular synovitis. Nodular synovitis is a benign lesion that results from the proliferation of an area of the synovium. It is most commonly associated with the tendon sheaths in the fingers and toes, but it does present less frequently as a focal mass within a joint, of which the infrapatellar fat pad in the knee is the most common. It is unclear if this lesion is the result of an inflammatory reaction or a true neoplasm. The MR characteristics of this lesion include a well circumscribed mass with intermediate signal intensity on T1-weighted images and mixed signal on T2-weighted images. Clinically, these patients present with knee pain and swelling and in some cases there is a previous injury [13]. It should be noted that this is a distinct entity from pigmented villodular synovitis, though the distinction between the two exceeds the purview of this article.

While there is a litany of diseases that can occur in or adjacent to Hoffa's fat pad, we feel that the imaging characteristics, along with the clinical history, are unique enough to separate ACL stump entrapment from other differentials. Stump entrapment of the ACL causes a pseudo-cyclops lesion, albeit similar in appearance and presentation to the cyclops lesion seen following ACL repair [1,2,4,6,7]. Although this entity is rare, proper understanding and recognition are imperative for prompt surgical resection.

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