



## MRI findings of Stener-like lesion of the knee: A case series with surgical correlation



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### ABSTRACT

**Purpose:** To describe the MRI findings of the “Stener-like” lesion of the knee and its distinction from simple medial collateral ligament (MCL) tear. A “Stener-like” lesion of the superficial medial collateral ligament is a tear involving the distal fibers, where the torn fibers become displaced superficial to the pes anserinus fibers, a displacement which can prevent healing.

**Methods:** Nine cases of Stener-like lesion were prospectively diagnosed on MRI. Retrospective, IRB-approved, HIPAA-compliant chart review was performed to determine correlation of surgical and MRI findings. Seven cases were surgically confirmed and are included in the series.

**Results:** MRI is useful in making the diagnosis of Stener-like lesions and prompting the surgeon to explore the distal MCL. Coronal MRI shows variable proximal retraction of the torn ligament. It has a lax contour and abuts the pes anserinus. The proximity of the torn ligament end to the pes can result in misdiagnosis of a partial tear. Axial images are useful to confirm position of the ligament superficial to the pes. All cases had associated tear of the deep MCL fibers, as well as sprains of the proximal superficial MCL.

**Conclusions:** It is important to recognize the Stener-like lesion because this lesion is usually managed surgically, while most MCL tears are managed conservatively. The presence of injury to the proximal MCL is usually present, and may be a distractor from the distal injury. Care must be taken to include the distal attachment of the sMCL on coronal MRI images.

### 1. Introduction

Medial collateral ligament (MCL) injuries are the most frequent knee ligament injuries and can be due to either contact or noncontact valgus force or valgus plus twisting injury [1]. The ligament usually tears in its midsubstance or proximal attachment, but may tear distally. A review of National Football League Combine participants found that of 337 MCL injuries evaluated by MRI, 87% were injured proximally, 8% in the midsubstance, and 5% distally [2]. MCL injuries have been graded as Grade 1–3 sprains. Most MCL sprains, including Grade 3, do not warrant surgical treatment [3,4]. However, surgical repair is advocated for distal MCL tears [5,6].

A unique injury to the superficial MCL (sMCL) ligament has been briefly described in the orthopedic literature as a “Stener-like” lesion. Like the Stener lesion of the thumb, the injured ligament is prevented from healing because of interposition of a tendon between the ligament and its bony attachment. In the knee, the Stener-like lesion is a medial

collateral ligament tear involving the distal fibers of the sMCL insertion, in which the ligament displaces proximally and lies superficial to the pes anserinus tendons [6] (Fig. 1), preventing MCL healing. The term Stener-like lesion draws an analogy to the Stener lesion of the thumb, where interposition of the aponeurosis of the adductor pollicis prevents reapposition of a torn ulnar collateral ligament. The diagnosis of a Stener-like lesion of the MCL is heavily reliant upon MRI, as clinical examination of this lesion may be inconclusive.

The MCL is comprised of both a superficial (sMCL) and deep (dMCL) component [7,8]. The sMCL fibers originate from a point approximately 3 mm proximal and 5 mm posterior to the medial femoral epicondyle. Distally, the vertically oriented sMCL has been described as inserting at two distinct tibial insertion sites. The main insertion is slightly proximal and anterior to the obliquely oriented pes anserinus tendons. In addition, there is a small component which on MRI merges with the semimembranosus and posterior oblique ligament. The main tibial attachment site of the sMCL is approximately 6 cm distal to the tibial plateau,

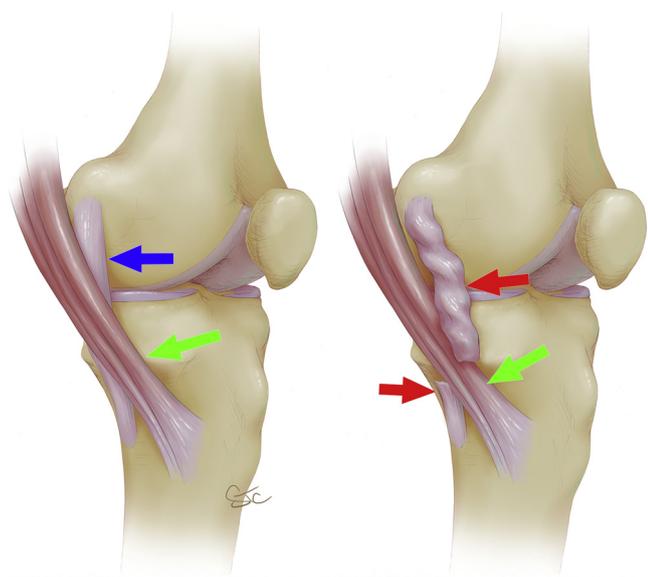
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**Fig. 1.** Drawing showing the normal relationship of the medial collateral ligament to the pes anserinus (Fig. 1A) and the interposition of the pes between the injured ligament and bone in the Stener-like lesion (Fig. 1B). Green arrows point to pes anserinus. Blue arrows show intact sMCL and red arrows point to torn sMCL. Illustration by Stacy Cheavens, MS, CMI.

is broad based and attaches directly to the tibial periosteum. It serves as the posterior floor to the overlying pes anserinus bursa.

Just deep to the sMCL, the deep MCL (dMCL) is a confluence of numerous soft tissue structures including the meniscofemoral, meniscocapsular, and meniscotibial ligaments. A bursa separates the deep and superficial MCL and is biomechanically important by allowing anteroposterior excursion of the sMCL during flexion and extension [1,9]. Posterior to the MCL is the posterior oblique ligament (POL), a condensation of the joint capsule which is tight in extension and forms part of the posteromedial corner of the knee [10,11].

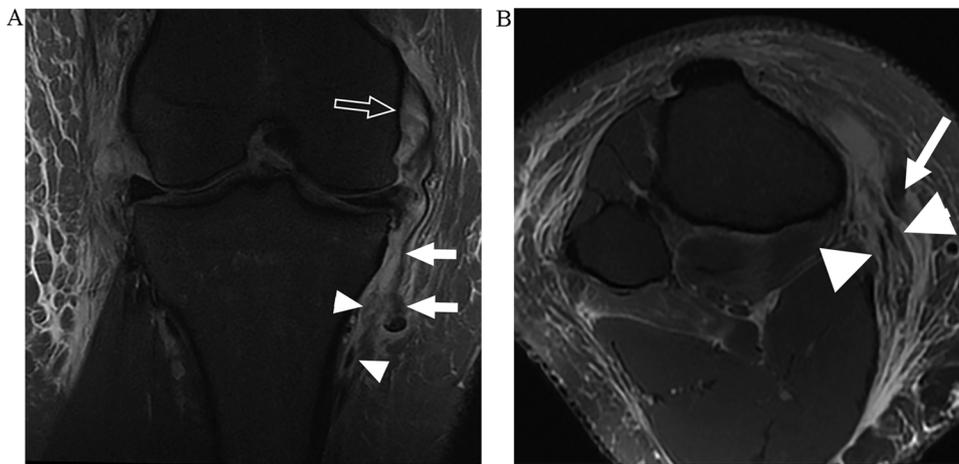
The MCL is the primary restraint against valgus stress [12]. At 25° of flexion, the MCL provides 78% of the valgus restraining force. In extension, the ACL and posterior medial corner (PMC) also stabilize against valgus stress and the MCL provides 57% of the restraining force against valgus stress. Dissection studies have shown a 3–5 mm joint opening in extension after the MCL is transected [13]. Additional transection of the PMC increases the joint opening. In general, an isolated MCL tear leads to valgus laxity in flexion, while additional injury to the secondary valgus restraints (PMC or ACL) leads to increased laxity in extension. The dMCL is a major secondary restraint to anterior translation of the tibia, and also provides minor static stabilization against valgus stress.

MCL injuries are graded clinically based on the amount of joint line opening with a valgus force, and by the quality of the endpoint when laxity exists. According to the American Medical Association, clinical grade of injury is evaluated with a valgus force at 30° of flexion [14]. A grade 1 sprain is defined as 0–5 mm valgus laxity which corresponds to stretching and minor tearing of the MCL. This correlates with the definition of a first-degree sprain, where there is tenderness over the MCL but no instability. A grade 2 sprain is defined as 6–10 mm valgus laxity on exam which corresponds to a significant partial tear of the MCL. This correlates with the definition of a second-degree sprain where there is increased valgus laxity with a firm endpoint. A grade 3 injury is defined as greater than 10 mm of joint line opening which corresponds to a complete rupture of the MCL. This correlates with the definition of a third-degree injury where there is significant laxity with no appreciable endpoint [14–16].

MRI evaluation of MCL injuries yield characteristic findings that allow grading of extent of injury [17]. The sMCL is visualized in the

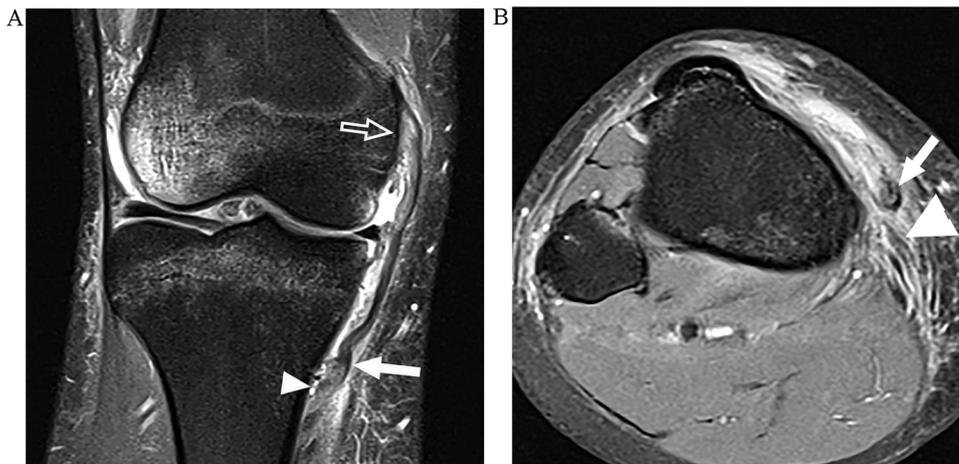
**Table 1** Seven patients with surgically proven Stener-like lesions of the knee. Key to abbreviations: ACL = anterior cruciate ligament, MM = medial meniscus, MPFL = medial patellofemoral ligament, LM = lateral meniscus, PCL = posterior cruciate ligament, POL = posterior oblique ligament.

#	Age	Sex	Injury	Associated injuries	Clinical exam	Surgery of MCL	Other surgery	Outcome
1	32	F	skating transient dislocation	ACL, MM	Grade 3	open repair	MM debrided, ACL not repaired	mild subjective instability
2	22	M	football valgus	ACL, MM	Grade 3	open repair	ACL reconstruction, meniscal repair	stable at 12 weeks
3	36	M	fell in pothole & twisted knee	MPFL, MM, POL	Grade 3	open repair	MPFL reconstruction, meniscus repair	ligaments stable at 1 year
4	20	F	gymnast fell off balance beam	ACL, LM, POL	Grade 3	open reconstruction with tibialis anterior graft	ACL and POL reconstruction	unknown
5	23	M	Slip and fall	ACL, LM, MM	Grade 3	open repair with internal brace augmentation	MM & LM repair, POL reconstruction, 2nd stage ACL reconstruction	ligaments stable at 1 year
6	16	F	Trampoline injury	ACL, LM	Grade 2	open repair with internal brace augmentation	LM repair, ACL reconstruction	ligaments stable at 1 year
7	18	M	Football valgus	POL, MPFL, MM, partial PCL	Grade 3	open repair with internal brace augmentation	MM repair, PCL debridement	ligaments stable at 3 years, painful screw MFC removed



**Fig. 2.** Twenty-three-year-old male slipped. MRI performed for ACL tear evaluation, also showed Stener-like lesion and tear of the medial meniscus.

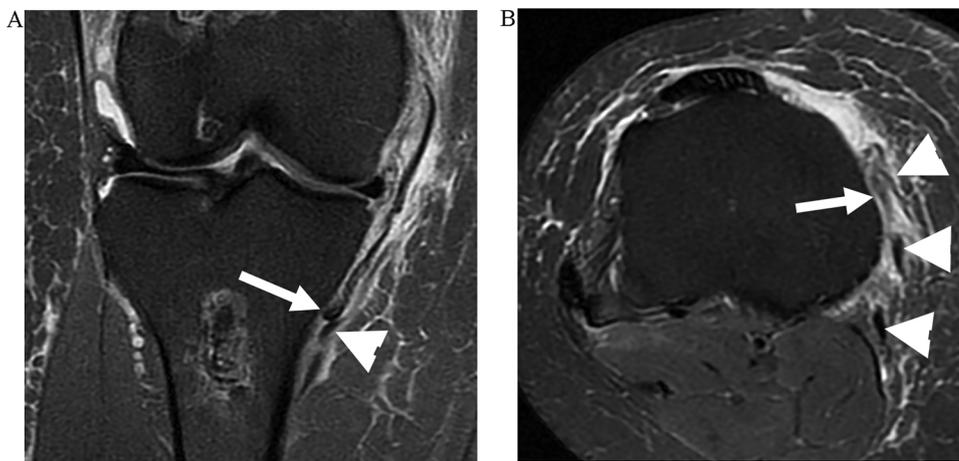
**2A.** Coronal PDFS image shows the sMCL is torn distally (arrows), and the torn end lies superficial to the pes anserinus (arrowheads). A partial tear of the proximal sMCL (open arrow) can distract attention from the complete distal tear, especially if a small field of view is used. **2B.** Axial PDFS image is helpful in confirming that the pes anserinus (between the 2 arrowheads) lies deep to the torn sMCL (arrow).



**Fig. 3.** Twenty-two-year-old male with valgus injury in football. MRI performed for evaluation of ACL tear.

**3A.** Coronal PDFS image is very similar to previous case. The sMCL is torn distally (arrow) and lies immediately superficial to the pes anserinus (arrowhead). The close proximity of the 2 structures could be misinterpreted as a strained but intact sMCL.

**3B.** Axial PDFS image shows that the sMCL (arrow) is superficial to the pes anserinus (arrowhead).



**Fig. 4.** Forty two year old woman with history of systemic lupus erythematosus suffered a fall with subjective subluxation. Case is not part of our series, and is included for comparison to Stener-like lesions.

**4A.** Coronal PDFS image shows that the torn end of the MCL (arrow) is deep to the pes anserinus (arrowhead). This indicates this is not a Stener-like lesion. The instability resolved after conservative management with a knee brace and physical therapy. Bone infarcts are seen in the femur and tibia, attributable to the presence of systemic lupus erythematosus.

**4B.** Axial PDFS image confirms that the torn ligament end (arrow) lies deep to the pes anserinus (arrowheads).

normal knee as a hypointense structure on all sequences, separated by fat from the dMCL. It is well evaluated on both coronal and axial images. Grade 1 injuries demonstrate a thickened ligament, and periligamentous edema within the adjacent soft tissues. Grade 2 injuries demonstrate partial ligamentous tears which may manifest as high signal intensities within the ligament. Grade 3 or complete thickness tears demonstrate discontinuity of the MCL complex. One early MRI study compared physical exam findings from orthopedic exams to MRI findings and reported that the physical exam findings were 87% accurate in diagnosing MCL sprains [18].

The Stener-like lesion was first described in a report of 2 surgically-

confirmed cases where MRI showed a tear of the distal sMCL just proximal to the proximal tibial attachment site, and displacement of the torn ligament end superficial to the pes anserinus [6]. In both cases, the proximal MCL fibers were normal, and in both cases the MRI was performed to evaluate for ACL tear, which was also present. Our study shows a wider spectrum of findings in a series of 7 cases.

## 2. Materials and methods

Nine cases of Stener-like lesion of the knee were prospectively diagnosed by a single radiologist on MRI over a 4 year period. Seven were

confirmed surgically and are included in this series. The other 2 cases were lost to follow-up. A single distal tear of the MCL without Stener-like lesion was also diagnosed prospectively on MRI, and treated conservatively, and is included for comparison. Review of cases was IRB-approved and HIPAA-compliant. The medical records were reviewed for mechanism of injury, surgical and clinical findings, and findings at follow-up visits.

### 3. Findings

#### 3.1. Patient characteristics

Patient demographics, mechanisms of injury, associated injuries and surgical treatment are shown in Table 1. None of our cases presented with signs of isolated MCL injury, and in each case the MRI was requested in order to evaluate for other injuries.

#### 3.2. MRI findings

Each case showed a characteristic picture of redundant distal MCL fibers, which were displaced superficial to the pes anserinus (Figs. Fig. 22 and Fig. 33). The position of the torn fibers superficial to the pes anserinus could be seen on both coronal and axial views. However, if the fibers of both the pes and the sMCL are not followed on sequential images, the findings can be missed. In all cases, the meniscotibial and menisiofemoral fibers of the dMCL were at least partially torn, and there were grade 2 injuries of the proximal MCL fibers. In one case (Fig. 3), the position of the sMCL relative to the pes anserinus was borderline on MRI, but the diagnosis of Stener-like lesion was prospectively made, and confirmed surgically. In all cases, there was also disruption of the dMCL, and partial tears of the proximal sMCL. All cases had other torn ligaments, with six out of seven cases having concomitant anterior cruciate ligament (ACL) tears

A comparison case without a Stener-like lesion is shown in Fig. 4, where there MCL is torn distally, but remains deep to the pes anserinus. The proximal MCL is also partially torn. This case healed with conservative management, including a brace and physical therapy.

### 4. Discussion

A previous report found that Stener lesions of the sMCL may present clinically as grade 1 or 2 sprains, as well as grade 3 sprains [6]. In our series, 6/7 patients had clinical grade 3 injury. MRI in all cases in our series also showed grade 2 injury of the proximal MCL. The presence of a proximal MCL injury might distract attention from the distal, Stener-like lesion, especially if a smaller MRI field of view is employed.

In order to detect distal sMCL tears, the MRI field of view must extend to the metadiaphysis of the knee, which is achieved when the knee joint line is centered and a 16 cm field of view is utilized. The relationship of the sMCL to the pes anserinus must be scrutinized. The Stener-like lesion is generally well-seen on coronal sequences, in which the proximal portion of the torn MCL will appear “wavy”, shortened and medially displaced. The distal stump of the severed ligament can sometimes be seen, and is appropriately positioned deep to the pes anserine tendons at the tibial attachment sites. The torn proximal portion often abuts the pes anserinus, which can lead the unwary to mistake the pes anserinus for the sMCL. One recent report cited 2 cases where MRI missed a distal sMCL tear which was evident clinically and at surgery [19]. Review of the published coronal MRI images in that report shows that the fibers of pes anserinus have been mistaken for

sMCL, leading to a misinterpretation of the MRI findings. This misinterpretation emphasizes the need for careful analysis of the sMCL anatomy. Axial images are useful in distinguishing the pes anserinus from the sMCL.

Valgus injuries are often associated with anterior cruciate ligament tear, and with bone contusions on the lateral side of the knee. Either MRI finding merits a second look at the MCL.

If the entire sMCL is included in the coronal MRI field of view, the pes anserinus is identified and distinguished from the distal sMCL, and axial as well as coronal images are reviewed, MRI can show the Stener lesion of the knee, and is useful to guide the surgeon to explore the distal MCL.

### Declaration of Competing Interest

The authors have no conflict of interest, and received no funding.

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