

# Unhappy Triad of the Knee: A Narrative Review

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## Abstract

**Background:** The unhappy triad also known as O'Donoghue's triad was first described in 1936 as a combination of injuries to the anterior cruciate ligament, medial collateral ligament and medial meniscus resulting from one initiating factor.

**Methods:** A review of the literature was conducted using PUBMED in order to gain a better understanding of this entity and make it easier to find.

**Results:** This triad faced and still is facing a lot of changes and may even potentially become a tetrad. It is most commonly seen in athletes and is usually managed surgically. The triad must also be suspected when there is a longitudinal tear of the lateral meniscus with a horizontal component at and central to the popliteal hiatus.

**Conclusion:** The triad associating injuries to the anterior cruciate ligament, medial meniscus and medial collateral ligament evolved to replace the medial with the lateral meniscus and add a new entity which is an injury to the anterolateral complex potentially becoming a tetrad.

**Keywords:** unhappy triad; O'Donoghue's triad; sports injuries; menisci; ACL; MCL; LCL

## Introduction

The unhappy triad, named due to the hard time the injured faces in order to return to his pre-injury functional status [1], is a combination of 3 disrupted knee structures due to one single initiating factor. First described by Campbell in 1936, the triad consisted of injuries to the medial collateral ligament (MCL), the medial meniscus, and the anterior cruciate ligament (ACL) [2]. In 1950, O'Donoghue played a major role in bringing this injury to light, having reported a 25% incidence of the triad in acute athletic injuries. Thus, it was named O'Donoghue's triad [3]. In his study, 22 patients had both the ACL and the MCL injured. He also showed medial meniscus injuries in 17 of these patients [4]. Since then, the components of the triad have come into question, with several studies suggesting changes such as replacing the medial meniscus with the lateral meniscus [1]. This review article is written in order to clarify the concept of the unhappy triad which keeps changing from time to time, and to help orthopedic surgeons suspect this diagnosis when appropriate.

## Knee anatomy

The knee has four major ligaments: the ACL, the MCL, the posterior cruciate ligament (PCL), and the lateral collateral ligament (LCL). Both the MCL and the ACL are classically injured in the unhappy triad.

### 3.1 The ACL

The ACL connects the posterolateral part of the distal femur to the anterior section of the proximal tibia, inserting on the intercondylar notch. Its primary function is to resist an anterior movement of the tibia in relation to the femur. It is also capable of joint position sense due to its proprioceptive fibers [3]. The ACL is the most frequently disrupted knee ligament [5], usually due to hyperextension or sudden torsion of the knee while playing sports such as basketball, football, etc. [3].

This injury leads to instability which may ultimately lead to the development of osteoarthritis [3]. These arthritic changes are due to changes in the dynamic joint loading as well as intra-articular pathogenic processes started at the time of the injury [6].

### 3.2 The MCL

The MCL, located on the posteromedial side of the knee, acts as a stabilizer by preventing exaggerated valgus movement. It attaches the femur's medial condyle proximally to the tibia's medial condyle [3]. This ligament contains both superficial and deep layers [7]. The capsular ligament, another name for the deep layer of the MCL, also consists of 2 parts. The 1<sup>st</sup> is the medial meniscomfemoral ligament which attaches between the medial meniscus and the medial femoral condyle. The 2<sup>nd</sup> is the meniscotibial, also known as the coronary ligament. It is an attachment between the medial meniscus and the tibia [7]. The MCL is usually injured due to a blow on the lateral part of the knee and/or the lower leg. The posterior fibers are more prone to damage from rotational forces than contact forces [8]. Most of MCL injuries are due to both external rotation and valgus forces, which explains the association between the disruption of the ACL and the MCL in O'Donoghue's triad [8].

### 3.3 Menisci

In addition to the ligaments, this joint contains two menisci: fibrocartilaginous structures separating the femur from the tibia and acting as shock absorbers [3]. The medial meniscus is attached to the posterior and anterior fossa of the tibia along with the MCL. Therefore, the medial meniscus is less mobile, rendering it more susceptible to injuries than the lateral meniscus, which is not attached to the LCL [3]. It is reported that with the damage of either meniscus, 50% of patients will develop osteoarthritis in the upcoming 10 to 20 years due to a reduction in their shock absorption [6].

## Evolution of the triad

In 1991, Shelbourne showed a dominance of lateral meniscus injury, thus challenging the classical definition of the unhappy triad [9]. These new findings may be attributed to arthroscopy becoming the primary tool to evaluate and treat the knee in 1975 [9]. Nevertheless, what remains unchanged is that in this triad, the ACL and MCL injuries are associated with a meniscal injury [10-13].

Later on, more studies emerged showing that injuries in the lateral meniscus were more prevalent than injuries in the medial meniscus [1]. This may be due to the new diagnostic methods and the changing rules in sports contributing to the changes of the injuries' pattern in athletes [1].

Muller suggested in his book [14] that the triad be named a tetrad due the additional finding of lesions to the anterolateral femoro-tibial ligament. In his study, Ferretti et al. showed that an injury of the anterolateral complex was present in all of the 11 patients selected for the study, reinforcing Muller's suggestion [15]. The anterolateral injury was proximal, in the deep portion of the fascia lata in the cases reported by Muller [14]. Whereas Ferretti et al. showed the lateral injury was deep at the capsular layer [15].

## Etiologies

When O'Donoghue first described this triad, he suspected it occurred due to lateral blocking or the cut-back motion (foot in external rotation with stress over the MCL) [4]. The latter etiology is the most severe and was the most common at that time [1]. Later, case series reported the most frequent etiologies being sports-related injuries.

One example was a patient who suffered from the triad while playing rugby and in a position where he was 'bridging a ruck' (the body leaning forward with the weight being distributed between his hands and feet), and an opposing player ran into him at maximum velocity [3]. This caused a valgus force along with a twisting of the knee while the foot was planted, thus causing an injury to the ACL, MCL, and medial meniscus [3]. In a case series by Barber et al., the most common knee injuries were caused by skiing followed by soccer, basketball, football, motor vehicle, work accidents, and miscellaneous athletic injuries [16].

## Presentation and diagnosis

The presentation usually differs depending on the severity of the injury. Since it is a triad, the symptoms usually are a combination of signs that are present in individual ACL, MCL, or meniscal injury. Classically, the patient reports a popping sound at the time of the trauma, along with knee pain, swelling, stiffness, instability, inability to bear weight, and a sensation of the knee locking [3, 17].

Initially a history and physical should be performed to assess the integrity of each of the concerned knee structures in the triad. If the diagnosis is still unclear, the healthcare provider will proceed with imaging techniques in order to confirm the presence of the unhappy triad.

These techniques will not only confirm the diagnosis, but will also provide the physician with details about the injury such as location, size, severity, etc. This is helpful in order to establish a treatment plan. The most appropriate imaging technique is the magnetic resonance imaging (MRI) used in order to diagnose the unhappy triad while identifying the characteristics of each of the lesions and ruling out associated bone injuries. The ultrasound is used as a second option since it is fast, and it will allow the specialist to see the knee during flexion and extension. The Xray, when used, is to rule out other pathologies [17].

While MRI is considered to have an accuracy of 90% in diagnosing ACL injuries [18], patient history and accurate clinical examination were found to be more accurate for AC injuries (98%), although only 72% in meniscal injuries [19]. Other studies also found that there was a higher correlation between clinical and arthroscopic findings when compared to MRI and arthroscopy [20, 21]. Alioto et al. and Thomas et al. showed that MRI will prevent an arthroscopy in just 18% and 16% of the cases, respectively [22,23]. This demonstrates that a clinical diagnosis is often sufficient without the use of imaging [23]. Barber et al. also questioned the cost effectiveness of MRI and other imaging techniques when compared to arthroscopy in diagnosing meniscal pathologies associated to the triad [16].

An underdiagnosis of subtle injuries in the MCL [7] might occur due to the fact that sometimes ligamentous instabilities may be subclinical during the physical examination [24]. Additionally, the superficial part of the MCL may be difficult to visualize on knee arthroscopy [25]. This will result in an underdiagnosis of subtle injuries in the MCL [7]. In a study by Staron et al., it was reported that out of 16 knees with the unhappy triad, only two had an unstable MCL during physical examination but all 16 were abnormal on MRI [7]. An acute injury of the MCL shows an increased signal intensity on the MRI due to edema or hemorrhage [27]. Whereas 2 years after the injury, due to the inflammatory reaction, injured ligaments on MRI appear irregular and thickened [7]. Thus, it has been concluded that a thickened and irregular appearance of the MCL suggests a previous injury [7]. Subtle sprains in this ligament may be diagnosed by the presence of an abnormal fluid superficial to the MCL [7, 27-30] which may stay present as long as 2 years after the initial inciting factor [7]. Staron et al. also suggested an injury to both the ACL and the medial meniscus can be seen as an indirect proof of MCL injury [7].

When the lateral meniscus is involved, most of the injuries are a longitudinal tear with a horizontal component situated at the popliteal hiatus and central to it [16]. Thus, the presence of such injury should alert the surgeon to the presence of the triad, especially if the injury was several weeks ago giving time for the MCL to heal [16].

### **Treatment and follow up**

When O'Donoghue first described the unhappy triad in 1950 he recommended an early surgical intervention as the treatment [4]. The treatment depends on the severity of the injury. Regarding the ACL, a mild injury can be treated conservatively by physical therapy, immobilization and a knee brace. These mild injuries will not affect current knee function, but it will likely cause knee instability in the upcoming years [31].

ACL and menisci injuries in the young are usually treated surgically [17]. The MCL is treated conservatively most of the time [32]. The surgery is usually followed by a lengthy physical therapy program along with immobilization in order for the knee to heal completely [17].

### **Conclusion**

The unhappy triad changed since its description by O'Donoghue. Being first described as a rupture in the ACL, MCL and medial meniscus, the latter was replaced by the lateral meniscus as a more frequent presence in this triad. Studies are now showing that due to the association of the triad with lesions of the anterolateral complex this is now a tetrad. It is important for the physicians to primarily rely on history taking and clinical examination in case of suspicion of this diagnosis and to search for the triad when patients present with one or two components of it. The triad must also be suspected when there is a longitudinal tear of the lateral meniscus with a horizontal component at and central to the popliteal hiatus.

### **Conflict of interest**

The authors declare no conflicts of interest

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Nothing to mention

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