

## INJURIES

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### Video case report: ACL and PCL distension injury in an MMA fighter

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**Key words:** MMA, injury, ACL, PCL, return-to-play

#### Abstract

**Background.** Mixed Martial Arts (MMA) is a high-intensity combat sport that exposes athletes to substantial biomechanical stress, often leading to musculoskeletal injuries. Knee injuries, particularly those affecting the anterior cruciate ligament (ACL) and posterior cruciate ligament (PCL), are of significant concern due to their impact on an athlete's performance and career longevity.

**Problem and Aim.** This video case report presents a unique instance of ACL and PCL distension in an MMA fighter. The aim is to describe the injury mechanism and diagnostic findings. **Material and Methods.** Video footage from the match was utilized to analyze the recorded injury mechanism. Subsequently, the patient was examined using MRI, and a comprehensive case description was provided. **Results.** The injury occurred during a grappling sequence, where rotational and compressive forces on the knee joint led to ligamentous stress. MRI confirmed diffuse distension of the ACL and PCL without rupture or secondary joint damage, showing increased signal intensity on T2-weighted imaging.

**Conclusions.** This case highlights an uncommon pattern of ACL and PCL distension in MMA, emphasizing the importance of early diagnosis and appropriate rehabilitation strategies. The findings contribute to the growing understanding of injury mechanisms and management in combat sports, supporting the role of conservative treatment in cases of ligamentous distension without rupture.

#### Introduction

Mixed Martial Arts (MMA) is a high-intensity combat sport that has gained significant global popularity over the past few decades. Combining striking, grappling, and submission techniques from various disciplines such as

boxing, wrestling, judo, and Brazilian jiu-jitsu, MMA demands exceptional physical and mental performance [Bueno *et al.* 2022; Kirk *et al.* 2020]. The sport's multi-dimensional nature demands that athletes cultivate not only technical proficiency but also exceptional strength, endurance, agility, and cognitive adaptability to thrive in

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the dynamic and unpredictable environment of competition [Spanias *et al.* 2019; Kostikiadis *et al.* 2018; James *et al.* 2016]. Musculoskeletal injuries in MMA refer to damage affecting the bones, muscles, joints, ligaments, tendons, and other connective tissues. These injuries are common due to the high-impact, full-contact nature of MMA, which involves striking, grappling, and rapid, explosive movements [Thomas, Thomas 2018]. The inherent nature of MMA competition presents a plethora of injury mechanisms, ranging from high-velocity strikes to dynamic positional grappling exchanges, each of which places significant stress upon the musculoskeletal system [Bickley *et al.* 2023].

Injuries of the anterior cruciate ligament (ACL) are common [Liska, Zelnik 2020], particularly in sport [Renstrom 2013; LaBella *et al.* 2014; Tischer Karlsson, Seil 2024; Montalvo *et al.* 2019]. In MMA, injuries to the ACL and posterior cruciate ligament (PCL) are relatively common due to the intense physical demands of grappling, striking, and explosive movements.

This case study describes a 25-year-old Slovak MMA fighter competing at the GAMMA MMA World Championships. Senior amateur MMA bouts are typically 3 rounds of 3 minutes each, with a 60-second rest between rounds. MMA fighter is vice-world champion in MMA under the GAMMA organization, Slovak MMA champion, and multiple-time Slovak champion in Judo.

### Mechanism of injury

The injury occurred during a standard defensive wrestling sequence. An athlete who had been taken down attempted to use the cage as external support to regain his footing. The defending fighter was taken down with a standard freestyle wrestling maneuver. Upon impact with the mat, the defender initiated a structured get-up sequence, an essential aspect of modern MMA grappling designed to counter prolonged control from the bottom position.

To reinforce his position, the defending athlete shifted laterally toward the cage, aiming to use the fence as a stabilizing aid to stand. At this point, he was in a three-point stance, with one knee on the ground and the opposite foot planted, a classic transitional position for a defensive wrestler attempting to rise. The attacking fighter, maintaining control from behind, sought to prevent the get-up by employing a widely used grappling tactic. He deliberately stepped on the back of the defender's lower leg, targeting the calf, to create a mechanical obstruction that limited upward movement.

This maneuver effectively anchored the defender's foot to the mat, restricting dorsiflexion and plantarflexion while increasing rotational stress on the knee. As the defender attempted to rise, a torque vector was introduced at the knee joint: the ankle rotated in one

direction while the knee twisted in the opposite. The fighter immediately felt sharp pain, indicative of acute ligament stress, but managed to push through due to the likely analgesic effects of heightened adrenaline during competition. The fighter sustained an injury in the second round. Despite the fact that the MMA fighter sustained an injury, he managed to finish the fight with a victory.

### Post-fight symptomatology and pathophysiological progression

Following the conclusion of the bout, the fighter initially reported mild discomfort, a common post-competition response often dismissed as transient soft-tissue irritation. However, within a 4 to 5-hour post-fight window, the pain escalated markedly, accompanied by: progressive joint stiffness and a significant reduction in active range of motion (ROM), accompanied by difficulty in bearing weight

### MRI description

The examination was performed by an experienced radiologist with 15 years of practice. MRI imaging protocol included proton density fat-suppressed (PD FS) sequences in transverse (TRA), coronal (COR), and sagittal (SAG) planes, along with T1-weighted sagittal (T1 SAG) sequences.

The patella was positioned at an appropriate height and location, with no signs of damage to the retropatellar and trochlear articular cartilage. The surface structure of the cartilage was homogeneous, with no evidence of fibrillation or erosion. The retinacula and the m. quadriceps tendon exhibited normal structure and thickness, with no ruptures or degenerative changes. The prepatellar space showed no fluid collections or other pathological changes. A mild signal intensity increase in the non-thickened proximal attachment of the patellar ligament suggested mild tendinosis.

The popliteal fossa showed no pathological changes, and there were no signs of expansive processes or abnormalities in the vascular structures. In the sagittal plane, the ACL did not display a continuous signal, indicating diffuse distension of the ligament (figure 1a, figure 1b). The PCL demonstrated similar signal changes, without clear evidence of rupture (Figure 2a, Figure 2b). However, the absence of edema-related changes in the joint's bony structures suggested that this was a less severe lesion without secondary consequences. The collateral ligaments were intact, with no signs of elongation or fiber damage.



Figure 1a. Distension of ACL PD FS sagittal



Figure 1b. Distension of ACL PD FS axial

The medial meniscus shows minimal signal intensity increase in its internal structures, without compromising the meniscal integrity, ruling out rupture or advanced degeneration. A cystic, septated lesion measuring AP 7 x LL 20 x CC 36 mm was identified above the medial femoral condyle, likely a septated ganglion cyst unrelated to the MMA injury. This lesion does not exhibit local expansiveness and is not connected to the popliteal vascular bundle, confirming its benign nature.

There are no signs of bone bruising within the joint, indicating no bone contusions or microfractures. The compact bone layer is preserved in the proximal tibia and distal femur regions, with a thickness up to 4 mm, reflecting normal trabecular structure without evidence of osteoporosis or other metabolic changes.



Video 1.



Figure 2a. Distension of PCL PD FS sagittal

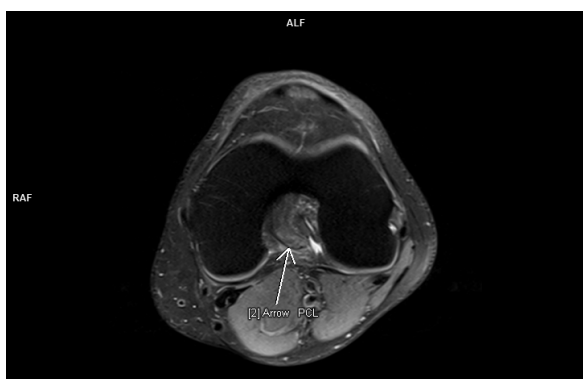


Figure 2b. Distension of PCL PD FS axial

### Discussion

This case report highlights a unique mechanism of ACL and PCL distension injury during a competitive MMA bout. Approximately 13.2% of injuries sustained in UFC bouts affect the knee, with almost half involving the ACL, often accompanied by PCL damage, underscoring the distinct joint-loading stresses that are characteristic of MMA competition [Human Kinetics, 2010]. This case exemplifies the complex interplay between biomechanics, and acute injury mechanisms in MMA. The rotational force vector applied to the knee joint during a high-tension transitional sequence represents a mechanism for ligamentous distension or partial tearing, particularly of the cruciate ligaments. The injury mechanism detailed in this case, an opponent-induced torque vector at the knee joint during a transitional get-up sequence, illustrates how specific grappling maneuvers can generate acute stress on the knee’s ligamentous structures. The opposing rotational forces at the knee, compounded by the external restriction imposed on the defender’s ankle, created conditions for ligamentous strain. This biomechanical scenario is representative of the multi-vector forces that athletes in MMA are regularly exposed to, elevating their risk for complex joint injuries [Machado *et al.* 2010]. Additionally, the rapid escalation of symptoms post-competition emphasizes the role of

heightened adrenaline in masking acute injuries during athletic performance. It suggests a need for immediate post-fight evaluations to identify potential injuries that may be overlooked due to delayed symptom onset.

The case reports indicate a relatively mild knee injury with an overall favorable prognosis. The confirmed diffuse distension of the ACL and PCL are mild sprains involving overstretching of ligament fibers without tears or permanent structural damage. The term “diffuse” suggests generalized stress on these ligaments rather than localized damage. Importantly, the absence of ruptures means that surgical intervention is not necessary, and conservative treatment, such as physical therapy, is likely to suffice.

The diagnostic findings in this case – diffuse distension of both the ACL and PCL without rupture, are significant for several reasons. First, the absence of secondary joint damage, such as bone bruising or meniscal tears, is indicative of a less severe injury. This highlights the potential resilience of ligamentous structures under submaximal stress and the importance of early and accurate imaging to differentiate between mild sprains and more severe injuries requiring surgical intervention.

Unlike traditional knee ligament injuries, often associated with single-plane trauma (e.g., pivoting or direct impact), the rotational and compressive forces in MMA create a special injury profile. This necessitates sport-specific preventive measures, including proprioceptive training, strength conditioning, and the refinement of grappling techniques to mitigate ligamentous stress.

The prognosis in this case was favorable, given the diffuse nature of the injury and the intact integrity of both ligaments. The successful recovery, facilitated by conservative management, including physical therapy and a structured return-to-sport protocol, reinforces the value of evidence-based rehabilitation approaches in minimizing downtime and ensuring safe reintegration into competition.

The athlete, after two months of rehabilitation, underwent a comprehensive series of tests designed to assess their readiness to return to sports following an injury. These included the one-sided hop test, side-to-side hop test, triple hop test, Y-balance test, ACL-RSI questionnaire, and the 8FT test. The results of the tests demonstrated a full recovery, with the athletes meeting all the necessary benchmarks for safe and effective performance. After a thorough evaluation by physiotherapists, the athlete was officially cleared to resume training and competition in MMA.

While this report provides valuable insights into the mechanism and management of ligamentous injuries in MMA, the findings are based on a single case. Future research should aim to establish a broader epidemiological understanding of cruciate ligament injuries in MMA athletes, incorporating a multidisciplinary approach that includes biomechanics, sports medicine, and rehabilita-

tion. Enhanced understanding of these factors could guide the development of targeted injury prevention and rehabilitation programs tailored to the demands of combat sports.

## Conclusion

This video case report illustrates a rare instance of simultaneous ACL and PCL ligamentous distension in an MMA athlete, resulting from a sport-specific mechanism involving rotational and compressive loading during a transitional grappling sequence. The absence of complete ligament rupture and secondary joint damage facilitated a successful return-to-sport via conservative management and structured rehabilitation.

These findings underscore the importance of high-resolution imaging for early differentiation between ligament sprain and rupture, particularly in combat sports where adrenaline may mask acute injury symptoms. Moreover, the case supports the role of individualized rehabilitation protocols and highlights the resilience of ligamentous structures under controlled recovery.

Future research should investigate similar injury patterns across a broader cohort of MMA athletes to inform evidence-based prevention strategies and sport-specific rehabilitation guidelines.

## Conflict of interest

Authors declare no conflict of interest.

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## Opis przypadku wideo: Uszkodzenie więzadła krzyżowego przedniego (ACL) i więzadła krzyżowego tylnego (PCL) u zawodnika MMA

**Słowa kluczowe:** MMA, kontuzja, ACL, PCL, powrót do gry

### Streszczenie

Tło. Mieszane sztuki walki (MMA) to sport walki o wysokiej intensywności, który naraża sportowców na znaczne obciążenia biomechaniczne, często prowadzące do urazów układu mięśniowo-szkieletowego. Urazy kolana, zwłaszcza te dotyczące więzadła krzyżowego przedniego (ACL) i więzadła krzyżowego tylnego (PCL), budzą poważne obawy ze względu na ich wpływ na wyniki sportowców i długość ich kariery.

Problem i cel. Niniejszy opis wideo przedstawia wyjątkowy przypadek rozciągnięcia ACL i PCL u zawodnika MMA. Celem jest opisanie mechanizmu urazu i wyników diagnostycznych. Materiał i metody. Do analizy zarejestrowanego mechanizmu urazu wykorzystano materiał wideo z walki. Następnie pacjent został zbadany za pomocą rezonansu magnetycznego i przedstawiono kompleksowy opis przypadku.

Wyniki. Uraz nastąpił podczas sekwencji chwytów, w której siły obrotowe i ściskające działające na staw kolanowy doprowadziły do przecięcia więzadeł. Badanie MRI potwierdziło rozlane rozciągnięcie więzadła krzyżowego przedniego (ACL) i więzadła krzyżowego tylnego (PCL) bez zerwania lub wtórnego uszkodzenia stawu, wykazując zwiększoną intensywność sygnału w obrazowaniu T2.

Wnioski. Przypadek ten podkreśla rzadki wzorzec rozciągnięcia więzadła krzyżowego przedniego i tylnego w MMA, podkreślając znaczenie wczesnej diagnozy i odpowiednich strategii rehabilitacyjnych. Wyniki badań przyczyniają się do lepszego zrozumienia mechanizmów urazów i postępowania w sportach walki, potwierdzając rolę leczenia zachowawczego w przypadkach rozciągnięcia więzadeł bez zerwania.