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Traumatic instability in the knee joint due to an anterior cruciate ligament (ACL) injury in a 23-year-old athlete

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ABSTRACT

Introduction
In this paper, we aim to present an analysis of the diagnostic, therapeutic, and rehabilitation procedures in a 23-year-old athlete with an anterior cruciate ligament (ACL) injury. The study includes the patient's medical history, circumstances of the injury, diagnostic and therapeutic procedures applied, as well as the course of postoperative rehabilitation.
Objective
The objective of our study is to present the anatomy of the ACL, the typical mechanism of injury, and diagnostic and therapeutic possibilities.
Methods
This is a retrospective study. The medical documentation and imaging studies were subjected to analysis. The analysis was complemented by a literature review based on publications in the English-language PubMed database.
Results
The case involves a 23-year-old soccer player with an isolated ACL injury in the right knee joint. The case analysis highlights the challenges related to diagnosis and decision-making regarding therapeutic procedures. ACL reconstruction using the STG method and lateral tenodesis with the iliotibial band in combination with postoperative rehabilitation resulted in a positive outcome in terms of knee joint stability and return to sports.
Conclusions
The review of this medical case underscores the importance of a personalized approach to each patient with an ACL injury, taking into account age, level of physical activity, and coexisting injuries within the knee joint. This allows for the correct decision on the best treatment method for the patient, facilitating a return to sports and minimizing the risk of complications.

Keywords: Anterior Cruciate Ligament (ACL), ACL injury, ACL diagnosis, ACL treatment, ACL rehabilitation, lateral tenodesis.

Background

The knee joint, due to its complex structure and weight-bearing role, is susceptible to injuries. Comprising the tibia, femur, and patella, this joint provides stability through a ligamentous apparatus, including the medial collateral ligament, lateral collateral ligament, posterior cruciate ligament, and the crucial anterior cruciate ligament (ACL). Contributing to its elasticity are the medial and lateral menisci, acting as shock absorbers to ensure even weight distribution during each step or turn. The ACL plays a crucial role in the stability of the knee joint, attaching to the inner side of the lateral femoral condyle, running obliquely and medially, and attaching to the anterior part of the intercondylar eminence of the tibia [1].

The anterior cruciate ligament (ACL) is the primary structure that prevents the anterior displacement of the tibia and serves as a secondary restraint against rotation of the tibia, valgus stress, and varus stress. ACL injuries most commonly occur in athletes participating in team sports and downhill skiing disciplines [1].

ACL injuries often result from a twisting mechanism, involving excessive external or internal rotation combined with extension and a valgus or varus movement of the limb [2].

In clinical examination, the Lachman Test plays a significant role. It is used to assess the integrity of the ACL and is performed by an orthopedic doctor. The patient lies on their back with the knee flexed at 15-30 degrees. The orthopedist stabilizes the limb above and below the knee joint and attempts to displace the shin forward. A positive Lachman test occurs when excessive mobility of the shin relative to the femur is felt, indicating ACL damage [3].

The primary additional imaging study in diagnosis and treatment planning is magnetic resonance imaging (MRI). It allows visualization of the ACL, assessing its continuity, and identifying other accompanying injuries, such as meniscus damage [4].

There are several surgical treatment methods for a damaged ACL. The orthopedic surgeon decides on the type of surgical procedure based on the extent of the injury. Common methods include ACL repair using the InternalBrace technique, reconstruction using the STG method, and the BTB method. The choice of method depends on the clinical presentation, the experience of the orthopedic surgeon, and the patient's consent [5].

After surgical treatment, rehabilitation is essential, aiming to rebuild muscle mass, improve range of motion, enable a return to preoperative functionality, and prevent re-injury [6].

CASE REPORT

During a soccer training session, a 23-year-old player sustained an injury to his right knee joint. The injury occurred during a non-contact twisting of the knee joint while abruptly changing direction. He reported intense pain within the joint and heard a popping sound. Five days after the injury, he presented to the Emergency Department due to persistent severe pain and significant swelling of the right knee joint, preventing full range of motion. During the examination in the Emergency Department: no wounds, abrasions, or bruises were observed. Lachman Test (negative), anterior drawer test (negative), posterior drawer test (negative), patellar ballottement sign (negative), V-V test (negative), meniscal signs (negative). Range of motion (ROM) limited by pain - extension deficit of 5 degrees, flexion of 110 degrees, tenderness in the region of the distal attachment of the biceps femoris muscle. Ultrasound examination revealed a normal amount of fluid in the joint, intact menisci, ACL unable to be assessed, intact PCL, and features of partial tear in the distal attachment of the biceps femoris muscle. A preliminary diagnosis of partial tear of the biceps femoris muscle of the right lower limb was established. Given the diagnosis, the RICE protocol was recommended. After 2 weeks, the pain symptoms and swelling subsided. Periodically, knee joint instability appeared during daily activities. The extension deficit persisted. After 2 months from the injury, a reevaluation of the right knee joint was recommended using ultrasound examination. The

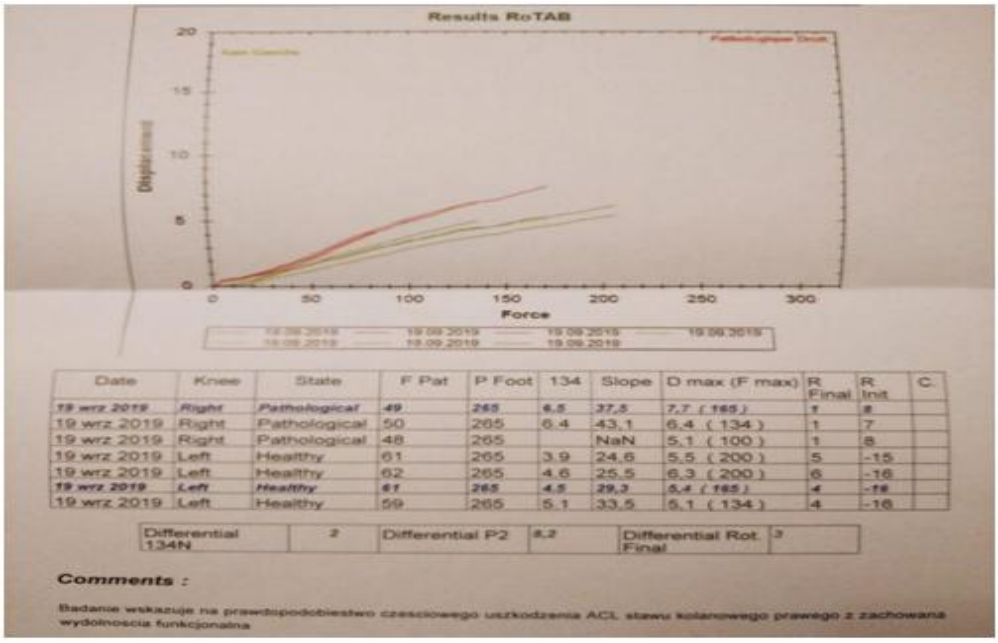
examination revealed no fluid in the knee joint cavity, cartilage at the condyle level with normal echogenicity and thickness without focal pathological changes. The quadriceps tendon, patellar ligament, and patellar ligament strands also showed no pathological changes. The lateral collateral ligament, iliotibial band region, and patellar tendon were normal. An avulsive detachment of a small bone fragment by the popliteus muscle from the lateral condyle of the femur was identified (the detached fragment had a diameter of 7 mm and was displaced laterally by about 5 mm). Subsequently, the ultrasound examination visualized the lateral collateral ligament, iliotibial band, biceps femoris tendon, and popliteus tendon - all structures were normal. The anterior and posterior cruciate ligaments, lateral and medial menisci, Hoffa's fat pad, and patellar alignment were all normal. No venous thrombosis was detected in the examination.

Figure 1. USG of the right knee joint. Avulsion fracture.

Five months after the injury, the patient continued to experience an extension deficit and periodic instability of the knee joint. The patient consulted with an orthopedic specialist. In the follow-up physical examination: Lachman Test (negative), anterior drawer test (negative), posterior drawer test (negative), patellar ballottement sign (negative), V-V test (negative), meniscal signs (negative). Range of motion (ROM) limited - extension deficit of 5 degrees, flexion of 110 degrees, deficit in thigh muscle. Based on the patient's history and physical examination, an MRI of the right knee joint was recommended.

Figure 2. Magnetic Resonance imaging of the right knee joint.

The magnetic resonance imaging revealed damage to the right knee's anterior cruciate ligament (ACL). Subsequently, the patient was referred for arthrometric examination.



Date	Knee	State	F Pat	P Foot	134	Slope	D max (F max)	R Final	R Init	C.
19 wrz 2019	Right	Pathological	49	265	6.5	37,5	7,7 (165)	1	8	
19 wrz 2019	Right	Pathological	50	265	6.4	43,1	6,4 (134)	1	7	
19 wrz 2019	Right	Pathological	48	265		NaN	5,1 (100)	1	8	
19 wrz 2019	Left	Healthy	61	265	3.9	24,6	5,5 (200)	5	-15	
19 wrz 2019	Left	Healthy	62	265	4.6	25,5	6,3 (200)	6	-16	
19 wrz 2019	Left	Healthy	61	265	4.5	29,3	5,4 (165)	4	-16	
19 wrz 2019	Left	Healthy	59	265	5.1	33,5	5,1 (134)	4	-16	

Differential 134N	2	Differential P2	8,2	Differential Rot. Final	3

Figure 3. Results of arthrometric examination.

Thanks to the arthrometric examination, partial damage to the right knee's anterior cruciate ligament (ACL) with preserved functional capacity was diagnosed. Due to clinical symptoms such as an extension deficit and a sense of knee joint instability, the patient was qualified for surgical treatment. The patient was offered arthroscopic ACL reconstruction using the STG

method and lateral tenodesis with a 1/3 middle portion of the iliotibial band. The operation was performed 8 months after the injury. The applied treatment included arthroscopic reconstruction of the anterior cruciate ligament of the right knee joint:

- A triple-folded graft of the semitendinosus tendon and a double-folded graft of the gracilis tendon. Graft thickness: 7.5mm, reinforced with Fiber Tape.
- Fixation: femoral Endobutton CL Ultra 20mm, tibial screw Biosure PK 8x20mm.
- Iliotibial band lateral tenodesis of the 1/3 middle portion.
- Fixation: femoral screw Biosure PK 6x20mm.

Postoperative diagnosis: Anterior instability of the right knee joint. Complete rupture of the anterior cruciate ligament. The patient was mobilized the day after the procedure, using crutches. Rehabilitation was recommended two weeks after the operative intervention. Postoperative rehabilitation aimed to restore normal range of motion and rebuild muscle mass.

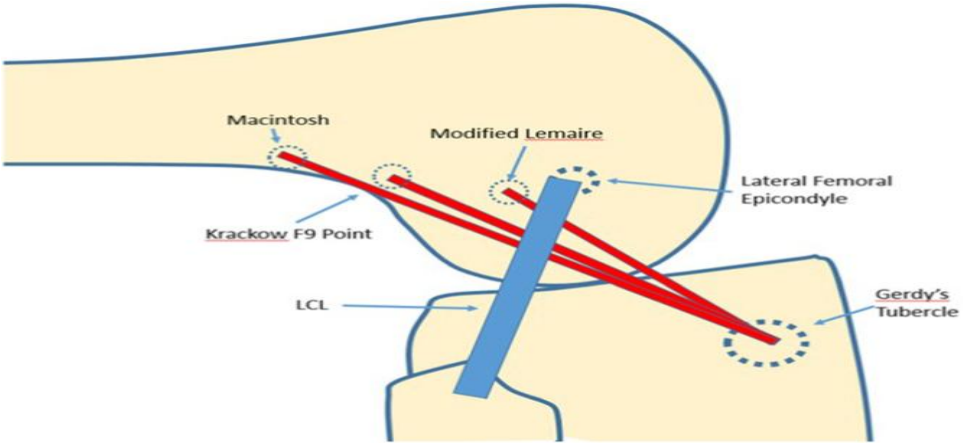


Figure 4. Lateral aspect of knee showing several anchorage points for lateral extra-articular tenodesis. The femoral anchor points from distal to proximal are the modified Lemaire, Krackow F9, and Macintosh anchor points. (LCL, lateral collateral ligament.) [9]

Discussion

We present the case of a young athlete who suffered an injury qualifying for surgical treatment. We outline the diagnostic, therapeutic, and postoperative rehabilitation course. We present the anatomy of the affected area [1], the injury mechanism, necessary diagnostic tests, and the applied treatment method. In the literature review, it was noted that ACL injury is a typical trauma for soccer players. It occurs in a twisting mechanism of the knee joint during a

sudden change of direction, most commonly without contact with an opponent [2]. To qualify for surgical treatment, it is necessary to deepen diagnostics with imaging studies such as magnetic resonance imaging to visualize the extent of the injury [3]. In addition to the physical examination, which is a subjective assessment, arthrometric examination of the knee joint comparing the performance of the healthy and affected ACL is useful - an objective examination [7]. In the diagnostic process, the clinical image of the patient plays a crucial role. In the described case, the patient did not meet the diagnostic criteria for ACL injury in the physical examination. In additional studies such as MRI [4], ultrasound [8], and arthrometry [7], no complete ACL damage was visible. However, the patient reported significant instability of the joint, a lack of full range of motion (ROM), which, combined with inconclusive results of additional examinations, led to the patient being qualified for surgical treatment.

Conclusions

In the case of an injury involving ACL damage, clinical examination combined with imaging studies is essential for qualifying for surgical treatment. These assessments allow for the selection of the most suitable treatment method for the patient, depending on the time elapsed since the injury and the extent of damage to internal structures within the knee joint.

DISCLOSURE

Author's contribution:
Conceptualization: Nina Taborska, Anna Martyka, MartynaKubicka-Figiel
Methodology: Nina Taborska, Anna Martyka, Martyna Kubicka-Figiel
Software: Nina Taborska, Anna Martyka, Martyna Kubicka-Figiel
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List of figures:

REFERENCES

1. Cimino F, Volk BS, Setter D. Anterior Cruciate Ligament Injury: Diagnosis, Management, and Prevention. *afp*. 2010;82(8):917-922.
2. Bahr R, Krosshaug T. Understanding injury mechanisms: a key component of preventing injuries in sport. *Br J Sports Med*. 2005;39(6):324-329. doi:10.1136/bjsm.2005.018341
3. Coffey R, Bordoni B. Lachman Test. In: *StatPearls*. StatPearls Publishing; 2023. Accessed November 19, 2023. http://www.ncbi.nlm.nih.gov/books/NBK554415/
4. Filbay SR, Grindem H. Evidence-based recommendations for the management of anterior cruciate ligament (ACL) rupture. *Best Pract Res Clin Rheumatol*. 2019;33(1):33-47. doi:10.1016/j.berh.2019.01.018
5. Wilson WT, Hopper GP, Banger MS, Blyth MJG, Riches PE, MacKay GM. Anterior cruciate ligament repair with internal brace augmentation: A systematic review. *The Knee*. 2022;35:192-200. doi:10.1016/j.knee.2022.03.009
6. Brinlee AW, Dickenson SB, Hunter-Giordano A, Snyder-Mackler L. ACL Reconstruction Rehabilitation: Clinical Data, Biologic Healing, and Criterion-Based Milestones to Inform a Return-to-Sport Guideline. *Sports Health*. 2021;14(5):770-779. doi:10.1177/19417381211056873
7. Li J, Tang J, Yao L, et al. The validity of the Ligs digital arthrometer at different loads to evaluate complete ACL ruptures. *Front Bioeng Biotechnol*. 2023;11:1049100. doi:10.3389/fbioe.2023.1049100
8. Kumar S, Kumar A, Kumar S, Kumar P. Functional Ultrasonography in Diagnosing Anterior Cruciate Ligament Injury as Compared to Magnetic Resonance Imaging. *Indian J Orthop*. 2018;52(6):638-644. doi:10.4103/ortho.IJOrtho_28_17
9. Wait TJ, Kolaczko JG, Stevanovic O, et al. Lateral Extra-articular Tenodesis: The Onlay Technique. *Arthrosc Tech*. 2023;12(8):e1383-e1389. doi:10.1016/j.eats.2023.04.007