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Correlation between MRI and clinical examination in the evaluation of posterolateral corner injuries of the knee joint

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An analysis of the possibilities of MRI diagnostics of posterolateral corner injuries of the knee was performed. Thirty-three patients, 5 women and 28 men with a mean age of (32.9 ± 9.8) years (range 18–59), participated in the study. MRI was performed on average (7.8 ± 3.8) months after injury, with a minimum time of three months and a maximum of 18 months. The purpose of the study was to evaluate the correlation between MRI, clinical examination and diagnostic arthroscopy in posterolateral corner injuries of the knee. A comparative analysis was performed between MRI reports, clinical examination data and diagnostic arthroscopy results for the patients who underwent reconstruction of the posterolateral corner. Thus, we assessed the effectiveness of MRI for the diagnosis of such injuries. The results of the study showed that MRI in standard sequences has a sensitivity of 100 % for anterior cruciate ligament injuries, 86.96 % for posterior cruciate ligament injuries, 57.58 % for lateral collateral ligament injuries, and 24.24 % for hamstring tendon injuries. Conclusion: Posterolateral corner injuries are difficult to visualize and interpret; therefore, MRI imaging should not be used alone for diagnosis. Lateral collateral ligament injuries are described in MRI reports in 57.5 % of cases, and hamstring tendon injuries in only 24.2 %, and these diagnostic percentages cannot be used to guide surgical treatment. Visualization of posterolateral corner damage is possible on coronary oblique views, which are not routinely performed, so clinical diagnosis may be crucial for establishing the diagnosis.

Мета. Проаналізувати кореляцію між результатами магнітно-резонансної томографії (МРТ), клінічним обстеженням і діагностичною артроскопією в разі ушкоджень задньолатерального кута (ЗЛК) колінного суглоба. Методи. Проведено порівняльний аналіз між звітами МРТ, даними клінічного обстеження та результатами діагностичної артроскопії в пацієнтів після реконструкції ЗЛК та оцінено ефективність МРТ для діагностики таких ушкоджень. У дослідженні взяли участь 33 пацієнти, 5 жінок і 28 чоловіків із середнім віком (32,9 ± 9,8) років (діапазон 18–59). МРТ виконували в середньому через (7,8 ± 3,8) міс. після травми, із мінімальним часом 3 міс. та максимальним 18. Результати. Виявлено, що МРТ у стандартних послідовностях має 100 % чутливість у разі уражень передньої схрещеної зв'язки, 86,96 — за задньої, 57,58 — за умов травм латеральної колатеральної зв'язки та 24,24 % — сухожилка підколінного м'яза. Результати нашого дослідження доводять, що, на відміну від уражень схрещених зв'язок, периферичні ураження латерального відділу рідше діагностуються за допомогою МРТ. Висновок. Ушкодження задньолатерального кута важко візуалізувати й інтерпретувати, тому МРТ-зображення не слід використовувати окремо для діагностики. Ураження латеральної колатеральної зв'язки описано в звітах МРТ у 57,5 % випадків, а сухожилка підколінного м'яза — лише в 24,2. Зазначимо, що такими відсотками діагностики не можна керуватися під час визначення показів до хірургічного лікування. Візуалізація ушкодження задньолатерального кута можлива на косих проєкціях, котрі рутино не проводяться, тому клінічна діагностика може бути вирішальною для встановлення діагнозу.

Ключові слова. Коліно, магнітно-резонансна томографія, клінічна діагностика, задньолатеральний кут, передня схрещена зв'язка, задня схрещена зв'язка, латеральна колатеральна зв'язка, сухожилок підколінного м'яза.

Keywords. Knee, magnetic resonance imaging, clinical diagnosis, posterolateral corner, anterior cruciate ligament, posterior cruciate ligament, lateral collateral ligament, hamstring tendon

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Introduction

Injuries to the posterolateral corner (PLC) of the knee joint are difficult to diagnose [1, 2], as they are rare and often isolated lesions, accounting for less than 2% of cases. Most injuries are associated with complex knee trauma, particularly involving the anterior and posterior cruciate ligaments [2–4].

The study of the posterolateral complex of the knee joint is becoming increasingly important due to the rotational instability caused by its injury and the higher likelihood of unsatisfactory outcomes after reconstruction of the anterior or posterior cruciate ligaments when associated PLC insufficiency remains undetected as a concomitant injury [4–10].

Specific clinical examination tests described to assess PLC injury include the “recurvatum and external rotation” test, the “posterolateral drawer” test, the “reverse pivot-shift” test, and the “dial test” (posterolateral rotational test) [11–14].

Despite the description of numerous clinical examination techniques for detecting PLC injuries, various reports indicate that they are not identified in 72 % of cases at initial presentation, reflecting the difficulty of clinical diagnosis. This is due to pain in the knee, as most PLC injuries result from high-energy trauma and are part of complex ligamentous knee injuries. The diagnostic difficulty increases significantly when one or both cruciate ligaments or the medial collateral ligament are also injured [15].

In our opinion, it is important to use additional diagnostic tests for PLC injuries. According to the medical literature, magnetic resonance imaging (MRI) has an accuracy of up to 95 % for detecting the main injured structures of the PLC, namely injuries to the lateral collateral ligament, the popliteus tendon, and the popliteofibular ligament [16].

In their study, Yu et al. found that an oblique coronal T2-weighted sequence should be performed to improve visualization of PLC structures [17]. LaPrade et al., using a protocol including all slices through the fibular head, achieved high sensitivity for PLC injuries and improved visualization of the lateral collateral ligament, popliteus tendon, and popliteofibular ligament in the oblique coronal plane. The gold standard for determining the presence or absence of PLC injuries is considered to be arthroscopic identification of damaged structures combined with repeated clinical tests under anesthesia [18, 19].

Purpose: to analyze correlations between MRI findings, clinical examination, and intraoperative identification of injuries to the structures of the posterolateral corner of the knee joint.

Materials and Methods

A prospective study was conducted involving 33 patients with injuries to the ligamentous structures of the posterolateral corner of the knee joint who underwent surgical reconstruction between February 2017 and August 2022.

The study materials comply with all requirements and provisions of the Declaration of Helsinki on Human Rights, the Constitution and the fundamental legislation of Ukraine on health care, and ethical standards for clinical research (Protocol No. 14 dated 26.11.2025 of the Bioethics Committee of Zaporizhzhia State Medical and Pharmaceutical University). All patients provided written informed consent for examination and treatment.

Patients with ligament injuries requiring reconstruction of the lateral collateral ligament and the popliteus tendon were included. Patients with vascular injuries or fractures in the region of the knee joint were excluded.

Patients were assessed in the order in which they presented to our clinic. All patients underwent MRI of the injured knee. The examination was performed in different diagnostic centers, but always using a 1.5- or 3.0-T MRI scanner. Figure 1 shows the positioning of oblique coronal sequences, Figure 2 shows an example of visualization of intact PLC structures in oblique coronal sequences, and Figure 3 shows an

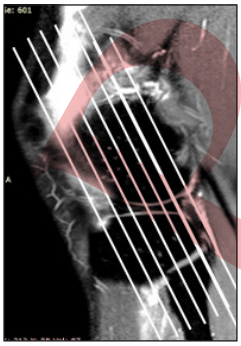


Fig. 1. MRI slice of the knee joint in 15° external rotation with oblique coronal sequences parallel to the inclination of the popliteus tendon posterior to the tibia.

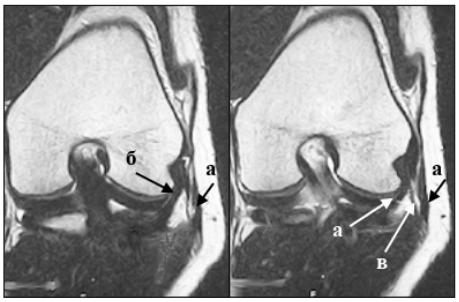


Fig. 2. Example of MRI in oblique coronal sequence showing: (a) lateral collateral ligament, (b) popliteus tendon, (c) popliteofibular ligament.

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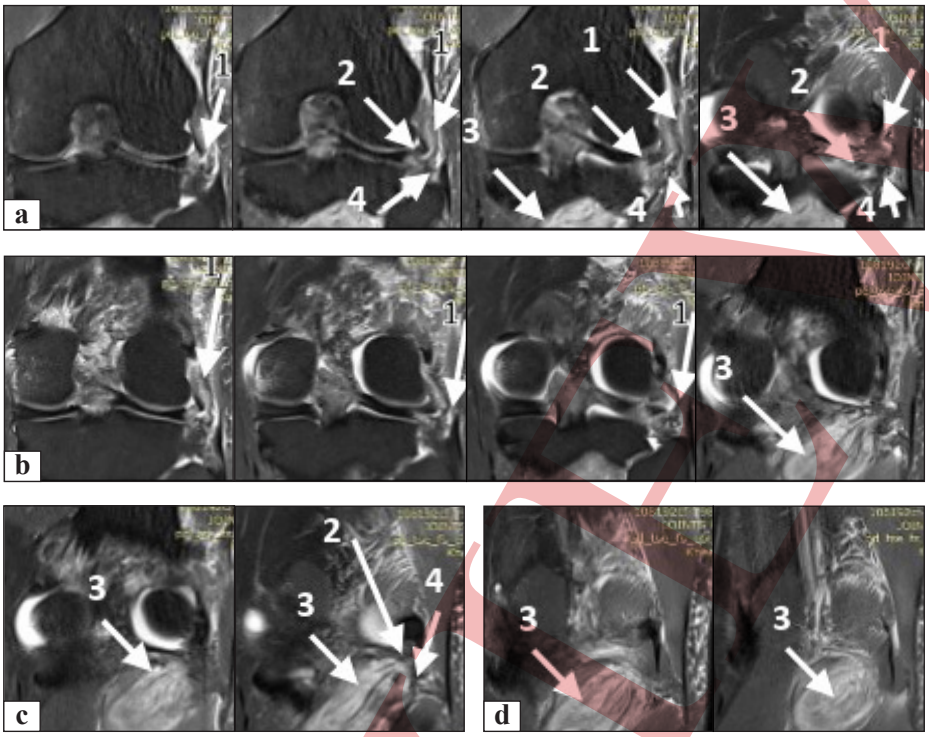


Fig. 3. Sequence of standard and oblique coronal MRI slices in a patient with clinical signs of grade III PLC injury (Fanelli C): (a, c) oblique coronal projection; (b, d) standard coronal projection. 1 — injured lateral collateral ligament; 2 — injured popliteus tendon; 3 — popliteus muscle edema; 4 — popliteofibular ligament.

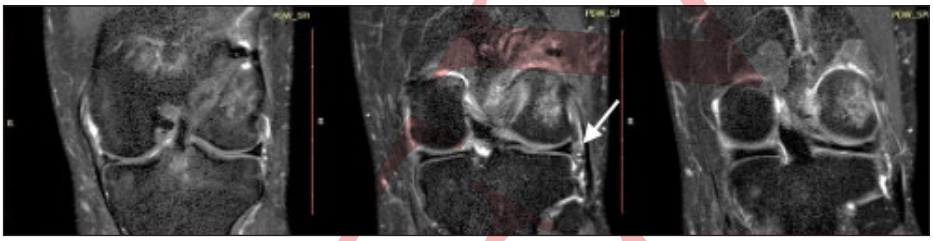


Fig. 4. MRI of the knee joint showing only the lateral collateral ligament (arrow), while the exact location of the popliteus tendon cannot be determined.

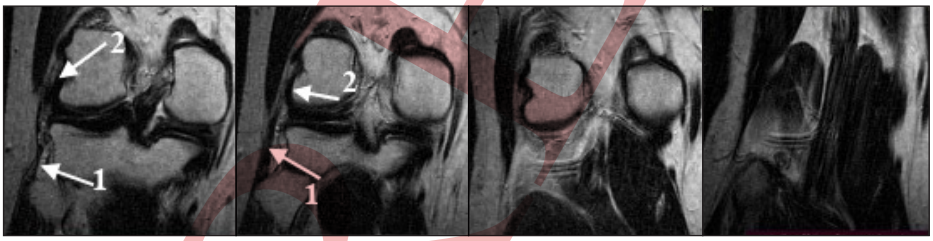


Fig. 5. Standard coronal MRI images showing the lateral collateral ligament (1) and the proximal portion of the popliteus tendon (2).

example of visualization of injured PLC structures in standard and oblique coronal projections.

Indications for surgery were based on clinical test results and magnetic resonance images, without considering the written MRI report. All patients underwent repeated clinical examination under anesthesia in the operating room to better assess the injured structures and confirm the surgical plan. During surgery, arthroscopic or open visualization of the injured structures intended for reconstruction was performed.

For reconstruction of PLC structures, a semitendinosus tendon autograft according to LaPrade was used under arthroscopic control following the original technique. In cases of concomitant anterior cruciate ligament injuries, a two-portal all-inside technique was used with an original quadriceps tendon autograft with a bone block. In posterior cruciate ligament injuries, a quadriceps tendon autograft with a bone block was also used. Postoperatively, MRI scans were compared with intraoperative findings and the results of clinical examination under anesthesia.

Results

The study included 33 patients, 5 women and 28 men, with a mean age of 32.9 ± 9.8 years (range 18–59). MRI was performed on average 7.8 ± 3.8 months after injury, with a minimum of 3 and a maximum of 18 months. Regarding injury mechanism, 23 cases were due to motorcycle accidents, 4 car accidents, 3 falls from height, 1 sports injury, 1 criminal assault, and 1 pedestrian traffic accident. In all patients, injuries to the lateral collateral ligament and the popliteus tendon were confirmed intraoperatively. Of these, 11 (33.33 %) had concomitant posterior cruciate ligament injury, 11 (33.33 %) had anterior cruciate ligament rupture, and 13 (39.39 %) had combined anterior and posterior cruciate ligament injuries. No patient had injury of the medial collateral ligament.

When reviewing the reports, we diagnosed 21 posterior cruciate ligament injuries and 23 anterior cruciate ligament injuries, 19 lateral collateral ligament injuries, and 8 popliteus tendon injuries. Comparing clinical examination under anesthesia and intraoperative findings with MRI reports, we found a sensitivity of 100% for anterior cruciate ligament injuries, 86.96% for posterior cruciate ligament injuries, 57.58 % for lateral collateral ligament injuries, and 24.24 % for popliteus tendon injuries. Visualization of all structures on standard MRI slices is uncommon; typically, the popliteus tendon and the lateral collateral ligament cannot be clearly visualized simultaneously.

More frequently, only the lateral collateral ligament can be clearly visualized, as shown in Fig. 4. In some cases, the popliteus tendon can also be partially visualized (Fig. 5). In contrast, all structures can be seen much more clearly on oblique coronal projections (Fig. 6). Figure 7 presents MRI scans of standard coronal sequences with intraoperatively confirmed injuries of the PLC.

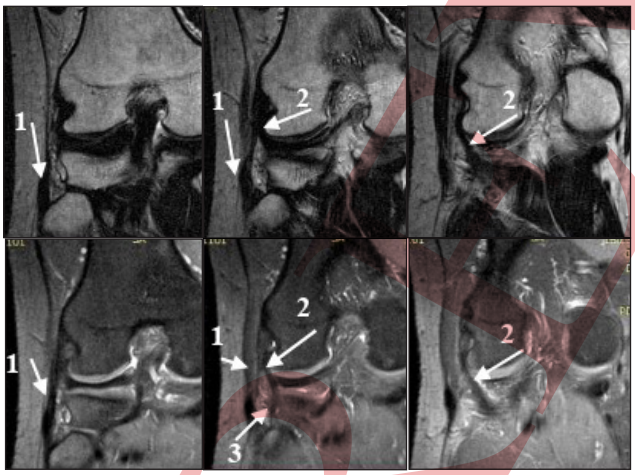


Fig. 6. Oblique coronal sequence showing the lateral collateral ligament (1), popliteus tendon (2), and popliteofibular ligament (3).

Discussion

The PLC of the knee joint is composed of multiple structures; however, current literature clearly identifies the lateral collateral ligament, the popliteus tendon, and the popliteofibular ligament as the three main structures responsible for stabilizing this region [18, 19].

Clinical diagnosis of these injuries cannot always be clearly established even using a wide range of diagnostic maneuvers available for clinical examination [13, 23]. Therefore, additional imaging studies play an important role in diagnosis.

The anatomical structure of PLC components has been studied through dissection, with determination of their location, attachment sites, and dimensions, and an MRI protocol has been developed for their evaluation [18, 24–26].

However, we believe that in clinical practice it remains difficult to reliably detect injuries to these structures on MRI, even with modern scanners. Our study demonstrates the full complexity of diagnosis in both clinical and radiological practice in the current setting.

In summary, the limited accuracy of MRI in detecting injuries of the PLC structures of the knee has led to numerous difficulties in their identification.

Therefore, specific imaging protocols are recommended, including oblique and sequential coronal

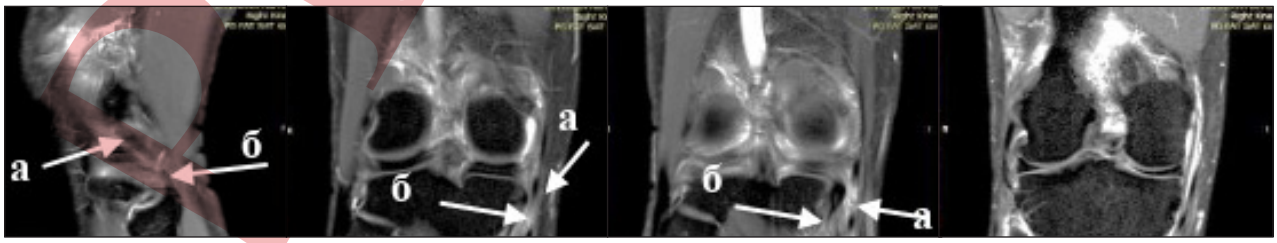


Fig. 7. MRI of the standard coronal sequence of the left knee joint with clinical signs and intraoperatively confirmed PLC injury: (a) injury of the lateral collateral ligament and (b) popliteus tendon injury.

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projections with all slices passing through the fibular head [18, 24]. However, these protocols are not routinely followed in standard knee injury imaging. The advantage of oblique coronal imaging is mainly in the assessment of the popliteus tendon and the popliteofibular ligament [18, 24].

Another reason for discrepancy may be that all MRI scans were performed during the chronic phase of injury, which may reduce diagnostic accuracy. This issue has not been extensively studied in the literature, as existing observations vary in timing due to insufficient numbers of patients evaluated at comparable post-injury intervals [24, 27].

PLC injuries, if not diagnosed and treated in a timely manner, lead over time to progressive instability and consequences such as secondary osteoarthritis and poor long-term outcomes. This fundamentally differs from injuries of the medial compartment of the knee joint, which have a better healing potential under conservative treatment [28, 29].

In acute injuries, the presence of fluid and edema in the injury site generally facilitates MRI diagnosis. Our study demonstrates that, in contrast to cruciate ligament injuries, peripheral injuries of the lateral compartment are less frequently diagnosed by MRI. This may be related to the high number of structures within a small anatomical region, as well as the layer covering the lateral aspect of the knee joint. These structures include the iliotibial band, the anterolateral ligament, the joint capsule, and the biceps femoris tendon, which complicates accurate visualization of the lateral collateral ligament and the popliteus tendon [18, 24, 26].

Finally, the lack of communication between the orthopedic surgeon, who formulated and evaluated the diagnostic hypotheses of the patient's injury, and the radiologist who prepared the imaging report hinders targeted examination, reducing the likelihood of an accurate diagnosis.

Our study aims to demonstrate the lack of correlation between data reported in the current literature and clinical practice regarding imaging-based diagnosis of posterolateral corner (PLC) injuries.

Conclusions

Injuries of the posterolateral corner are difficult to visualize and interpret; therefore, MRI imaging should not be used as the sole diagnostic tool. Injuries of the lateral collateral ligament are reported on MRI in 57.5% of cases, and injuries of the popliteus tendon in only 24.2%; such diagnostic rates cannot be relied upon when determining indications for surgical treatment. Visualization of PLC injuries is possible on oblique projections, which are not routinely performed; therefore, clinical examination may be decisive in establishing the diagnosis.

Conflict of Interest. The authors declare no conflict of interest.

Future Research. It is planned to propose an algorithm for determining indications for the use of oblique MRI slices through the fibular head.

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Author Contributions. Holovakha M. L. — study conception and objectives, manuscript writing; Yegorov V. F. — primary data analysis; Bezverkhyi A. A. — data collection and statistical analysis; Havrylenko B. S. — primary data analysis; Zabelin I. M. — primary data analysis.

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CORRELATION BETWEEN MRI AND CLINICAL EXAMINATION IN THE EVALUATION OF POSTEROLATERAL CORNER INJURIES OF THE KNEE JOINT

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