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Percutaneous release of the medial collateral ligament during knee arthroscopy

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The complete visualisation of the internal joint space is crucial for effective knee arthroscopy. However, limited access to certain areas can lead to complications, including cartilage damage. Percutaneous partial release of the medial collateral ligament has been shown to effectively widen the medial compartment of the joint. Objective. This study aimed to determine the effect of percutaneous release of the medial collateral ligament on the postoperative period and restoration of knee joint function. Methods. The patients were divided into two groups: the study group (n = 32) and the comparison group (n = 36). The study group underwent partial resection of the medial meniscus in combination with percutaneous partial release of the medial collateral ligament, while the comparison group underwent only partial removal of the medial meniscus without widening the medial joint gap. The assessment included pain, functional recovery according to the Tegner Lysholm scale, and the possibility of developing medial instability. Results. The analysis of VAS scores showed a significant reduction in pain in both groups over time. However, there was no significant difference in pain intensity between the two groups during the study. According to the Tegner Lysholm scale, there was a statistically significant improvement in the functional status of patients 6 months after surgery compared to preoperative values in both the study group (p = 0.0034) and the control group (p = 0.0071). However, there was no statistically significant difference between the groups on the same scale (p = 0.871). The study group showed a slight increase in valgus deviation of the tibia (no more than 5°) in 14 (43.75 %) patients during the valgus stress test performed on days 7–10 postoperatively. However, after 6 weeks, none of the patients reported any subjective instability or weakness of the knee joint. Therefore, it can be concluded that the procedure was successful. Conclusion. Percutaneous release of the medial collateral ligament to widen the medial aspect during knee arthroscopy has no effect on the postoperative period or the results of partial removal of the medial meniscus.

Повна візуалізація внутрішнього простору суглоба є ключовим аспектом для ефективного проведення артроскопії колінного суглоба, але обмежений доступ до деяких ділянок може призвести до ускладнень, включаючи ушкодження хряща. Черезшкірне часткове розсічення медіальної колатеральної зв'язки зарекомендувало себе ефективною методикою розширення медіальних відділів суглобової щілини. Мета. Визначити вплив черезшкірного розширення медіальної щілини на перебіг післяопераційного періоду та відновлення функції колінного суглоба. Методи. Пацієнти були розподілені на дві групи: дослідження (n = 32) — виконано парціальну резекцію медіального меніска в поєднанні з черезшкірним частковим розсіченням медіальної колатеральної зв'язки, та порівняння (n = 36) — здійснено лише парціальне видалення медіального меніска, без розширення медіальної щілини суглоба. Проведено оцінювання больових відчуттів, функціонального відновлення за шкалою Tegner Lysholm і можливості розвитку бокової нестабільності. Результати. Аналіз показників за візуальною аналоговою шкалою виявив значне зменшення больового синдрому в обох групах у динаміці, але інтенсивність не відрізнялась під час їхнього порівняння протягом дослідження. За шкалою Tegner Lysholm, покращення функціонального стану пацієнтів через 6 міс. після операції було статистично значущим у порівнянні з передопераційними показниками як у групі дослідження (p = 0,0034), так і у групі порівняння (p = 0,0071), але між групами не виявлено статистично значущої різниці за цією самою шкалою (p = 0,871). Вальгус-стрес тест, проведений на 7–10 день після операції, показав незначне збільшення вальгусного відхилення гомілки (не більше 5°) у 14 (43,75 %) пацієнтів групи дослідження, проте через 6 тижнів не виявлено суб'єктивної нестабільності або слабкості колінного суглоба в жодного з хворих. Висновок. Часткове черезшкірне розсічення медіальної колатеральної зв'язки для розширення медіальної щілини під час артроскопії колінного суглоба не впливає на перебіг післяопераційного періоду та результати парціального видалення медіального меніска. Ключові слова. Артроскопія, колінний суглоб, медіальний меніск, медіальна колатеральна зв'язка, нестабільність колінного суглоба.

Keywords. Arthroscopy, knee joint, medial meniscus, medial collateral ligament, knee instability

Introduction

Arthroscopy of the knee joint is the most common operation during the treatment of meniscal injuries [1]. An effective arthroscopic examination of the cavity and elimination of an impairment involve a full visualization inside the knee joint [2]. However, access to some of its areas is sometimes limited, which complicates it and carries the risk of iatrogenic damage to the cartilage [3]. The lack of sufficient working space for instruments increases the duration of the operation and can prevent optimal clinical results, as it makes it difficult to determine the degree of damage to the medial meniscus [4]. In such cases, valgus stress of the knee with slight flexion (10° – 20°) can be tried to increase the working space in this area. However, this technique is sometimes insufficient for adequate visualization and operation of an arthroscopic instrument. To increase the working space of the posterior medial part of the knee, a percutaneous partial dissection (release) of the medial collateral ligament is performed [5]. Several studies have described this technique, and a recently published systematic review concluded that this technique is an effective means of medial joint space augmentation without residual valgus instability, pain, loss of function, or injury to the saphenous nerve or great saphenous vein [6]. Despite the conclusions drawn from previous studies, this technique is not widely described, and there are some contradictions regarding its feasibility and implementation technique.

Purpose: to determine the effect of percutaneous expansion of the medial cleft on the course of the postoperative period and recovery of knee joint function.

According to this method, it is planned to analyze the results of arthroscopic treatment of patients with damage to the medial meniscus of the knee joint, who underwent percutaneous partial dissection of the medial collateral ligament. The main evaluation criteria are the intensity of the pain syndrome, the level of functional recovery, and the presence of residual valgus instability.

Material and methods

This prospective study was conducted on the basis of the Department of Traumatology and Orthopedics of Zaporizhzhia State Medical and Pharmaceutical University and was approved by the Bioethics Commission

(Protocol No. 8 dated 26.12.2022) in accordance with the rules of the ICH GCP, the 2002 Helsinki Declaration of Human Rights, the Council of Europe Convention on Human Rights and Biomedicine

approved in 1977, as well as the current legislation of Ukraine.

All identified patients ($n = 68$) were informed about the purpose and conditions of the study and gave written informed consent to participate in the clinical trial. All arthroscopic operations were performed by one surgeon between January 2022 and September 2023. The criteria for inclusion in the study were: isolated injury of the medial meniscus with indications for surgical treatment with its partial removal; lack of instability of the knee joint before the operation; written voluntary consent to participate in the study. Exclusion criteria: damage to the lateral meniscus, cruciate and collateral ligaments of the knee joint; seam of the medial meniscus; systemic connective tissue diseases that can affect knee joints (rheumatoid arthritis, gout, systemic lupus erythematosus); previous intervention regarding arthroscopic resection of the medial meniscus; osteoarthritis of stages 3 and 4 according to Kellgren-Lawrence; refusal to participate in the study for personal reasons.

Patients who agreed to participate in this study were divided into two groups: the study group ($n = 32$) were individuals who underwent partial resection of the medial meniscus combined with percutaneous partial dissection of the medial collateral ligament to provide access to the posteromedial compartment of the knee joint with the aim of partial removal of the medial meniscus, and the comparison group ($n = 36$) — patients underwent only partial removal of the medial meniscus, without expansion of the medial joint gap. Assessment of the level of pain sensations was carried out before the operation, on the second day and after 6 weeks.

Patients were also examined for damage to the large saphenous vein and saphenous nerve, namely the infrapatellar branch, which passes close to the medial collateral ligament, by physical examination and determining complaints of hematomas or paresthesias.

During the assessment of the functional state of the knee joint, patients were surveyed according to the Tegner Lysholm Scale questionnaire before surgery and 6 weeks after it. In order to objectify the obtained results, an analysis of the lateral stability of the knee joint was also performed using the valgus stress test before the operation and 6 weeks after.

Surgical technique. All patients were examined clinically, laboratory and instrumentally, no contraindications for surgery were found. Surgical interventions were performed with the patient lying on his back, with the operated limb fixed without the use of a hemostatic tourniquet under intravenous or

spinal anesthesia. Standard anterolateral and anteromedial portals and a 4.0 mm 30° arthroscope were used to examine intra-articular structures during knee arthroscopy. If during the operation it was found that access to the posterior medial part was limited and there was a risk of iatrogenic damage to the articular cartilage, then a partial dissection of the medial collateral ligament was performed by “needling” “outside-in” with a 21G 0.8 × 40 mm needle to obtain an additional opening of the joint space by 3–4 mm.

With a constant valgus force applied to the knee, a 21G injection needle was used to perforate the superficial layer of the medial collateral ligament with rapid back-and-forth movements until an increase in the width of the joint space was noted (Figure).

After percutaneous partial dissection of the medial collateral ligament, manipulations were performed on the posterior part of the medial meniscus. Active aspiration with drainage was not used.

Patients were discharged the day after surgery. After surgery, they underwent a standard postoperative rehabilitation protocol without additional immobilization. They were allowed to bear full weight on the operated limb, without the use of additional support (crutches, walkers), were also recommended a series of exercises to improve range of motion and strengthen the quadriceps muscle, and were warned to avoid sudden movements to the middle of the knee joint.

Patients in the comparison group underwent partial meniscectomy of the medial meniscus under arthroscopic control without violating the integrity of the medial collateral ligament. The postoperative management protocol did not differ from the study group.

Statistical evaluation. The results of the questionnaire were recorded in Microsoft Office 360,

the statistical analysis was performed in the STATISTICA for Windows 10 software. The methods of parametric and non-parametric variational statistics were used in the analysis process. The reliability of the results (for indicators differing from the normal law of distribution) was assessed using non-parametric criteria: the Mann-Whitney U-test (for two independent groups), the Wilcoxon T-test (for several dependent groups). Indicators were provided in the form: for data that corresponded to the normal distribution law, given as the mean value (M) and the mean standard error (m); data, the distribution of which differed from normal — as median (Me), lower and upper quartiles, respectively. Statistically significant differences were considered in $p < 0.05$.

Results

A total of 68 patients aged 18 to 55 years who met all criteria were progressively enrolled in the prospective study. Among them, 29 are men and 39 are women with an average age of (44.3 ± 9.7) years. The number of meniscus resections performed on the right leg was 45, and 23 on the left.

The study group included 32 patients, the comparison group — 36 subjects. All patients were familiarized with the conditions of participation in the study, received explanations and gave voluntary consent.

Characteristics of patient groups, taking into account age, sex, BMI, affected side, are shown in Table 1.

Intensity of the pain syndrome according to the visual analog scale (VAS). Changes in the subjective feeling of pain intensity before treatment, on the 2nd day after surgery and after 6 weeks were determined by means of a survey using the VAS.

The analysis of the indicators obtained according to VAS revealed a significant decrease in pain syndrome in both groups in terms of dynamics:

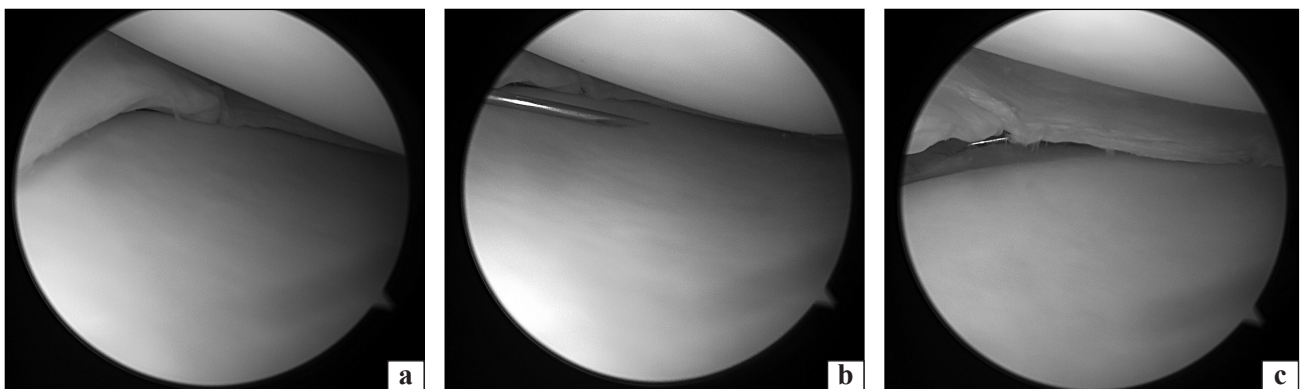


Figure. Images obtained during arthroscopy of the knee joint: a) condition of the medial part of the knee joint — opening; b) partial dissection of the distal portion of the medial collateral ligament with a needle; c) the result of opening the medial part of the knee joint

6 weeks after arthroscopy in the study group — 2.0 [1.0; 2.0] points, in the comparison group — 2.0 [0.0; 2.0] points, compared to the initial level — 5.0 [3.0; 6.0] and 5.0 [4.0; 6.0] points, respectively ($p = 0.0054$ and $p = 0.0037$).

All patients in the study group reported moderate to mild medial knee pain that persisted during the first week after surgery. During the analysis of pain syndrome intensity indicators 6 weeks after the intervention, no statistically significant difference was found between the groups of patients participating in the study ($p = 0.871$).

Assessment of the functional state of patients using the Tegner Lysholm Scale questionnaire. The results of the study indicate that 6 months after the op-

eration, both groups of patients noted improvement according to the Tegner Lysholm scale in comparison with the preoperative indicators. It was statistically significant both in the study group ($p = 0.0034$) and in the comparison group ($p = 0.0071$) (Table 3). However, comparing the functional state according to the Tegner Lysholm scale in 6 months did not reveal a statistically significant difference between patient groups ($p = 0.871$). Accordingly, the median score was 93.0 [90.0; 95.0] in patients who underwent percutaneous release of the medial collateral ligament, and 92.0 [87.0; 94.0] points in persons who did not undergo ligament dissection.

Conducting a valgus stress test at a knee flexion angle of 30° on the 7–10th day after surgery showed a slight increase in valgus deviation of the tibia (no more than 5°) compared to the opposite side in 14 (43.75 %) patients of the study group who underwent partial dissection of the medial collateral ligament. After 6 weeks, none of the patients had such a symptom. But they did not have subjective instability or weakness of the knee joint. The valgus stress test was negative in the patients of the comparison group.

Discussion

For the first time in 2004, Agneskirchner and Lobenhoffer described a minimally invasive technique of dissection of the medial section by repeated percutaneous puncture of the capsulo-ligamentous structures of the posteromedial area with the help of an injection needle [7]. Since then, several modifications of this technique have been described, but they are divided “inside-out” through the anteromedial portal, or the percutaneous “outside-in” technique (“pie-crusting”) and the release of the superficial portion of the medial collateral ligament using open access with subperiosteal removal.

Hauer et al. describe their technique of percutaneous release of the medial collateral ligament, which consists in first inserting an 18G needle submeniscally to the body of the medial meniscus, then advancing it distally by 3 cm and forward by 1 cm to the posteromedial edge of the tibia [8].

The transportal technique is performed by inserting an 18G spinal needle through the anteromedial portal [9]. The needle is inserted proximal to the junction of the meniscus and joint capsule, starting posteriorly and advancing forward, applying moderate valgus pressure to the knee. The advantages of this technique are a lower risk of damage to the subcutaneous vascular-nerve bundle, the absence of additional skin punctures that can provoke pain in the postoperative period, and the absence of the need

Table 1

General characteristics of the groups of patients involved in the study, M ± m

Characteristics	Group		Probability of differences (p)
	study (n = 32)	comparison (n = 36)	
Age, years	42 ± 6.7	45 ± 5.4	0.6322
Gender (M/F)	21/11	18/18	0.1711
BMI, kg/m ²	26.7 ± 3.7	24.8 ± 2.7	0.4723
Affected joint:			
– right	23	22	—
– left	9	14	—

Table 2

Intensity of pain syndrome after surgery according to the VAS, Me [Q25; Q75]

Term of study	Group		p*, value
	study (n = 32)	comparison (n = 36)	
Before operation	5.0 [3.0; 6.0]	5.0 [4.0; 6.0]	0.7970
Day 2	6.0 [4.0; 6.0]	6.0 [3.0; 6.0]	0.2050
6 weeks	2.0 [1.0; 2.0]	2.0 [0.0; 2.0]	0.8710
p*, value	0.0054	0.0037	—

Notes: * Mann-Whitney; p statistically significant in $p < 0.0500$.

Table 3

Functional status of patients according to the Tegner Lysholm scale, Me [Q25; Q75]

Term of study	Group		p*, value
	study (n = 32)	comparison (n = 36)	
Before operation	62.0 [56.0; 70.0]	60.0 [55.0; 67.0]	0.5960
6 weeks	93.0 [90.0; 95.0]	92.0 [87.0; 94.0]	0.7710
p*, value	0.0034	0.0071	—

Notes: * Mann-Whitney; p statistically significant in $p < 0.0500$.

for unnecessary maneuvers to safely determine the location of the needle but in this variant, the deep portion of the medial collateral ligament is released. The release of this localization through open mini-access is also described [10]. Its advantage is direct visualization of the medial collateral ligament compared with techniques that require blind perforation of the ligament; after the operation, the ligament fibers can be restored with anchors or conventional suturing. However, the use of this method can cause additional pain in patients due to the need to make an additional incision.

We use the technique of percutaneous release “outside-in” with an injection needle with the help of several punctures.

Depending on the specific technique, the goal of lengthening the medial collateral ligament can be both superficial and deep fibers. Gokhun Arican et al. compared the results of treatment of patients who underwent dissection of the superficial or deep fibers of the medial collateral ligament [11]. No differences were found in the presence of instability, cartilage damage, or peri-articular neurovascular structures between the study groups.

Moran et al. conducted an objective measurement of the size of the opening of the medial section using intraoperative fluoroscopy [12]. The opening width of the medial compartment increased from (5.95 ± 1.32) mm to (11.09 ± 1.74) mm intraoperatively after release of the medial collateral ligament. At the 6-week follow-up, radiographic evaluation showed that the average width of the medial compartment was (5.85 ± 0.99) mm, which is a slight change compared to the preoperative value, which is also confirmed by the results of the clinical examination of our patients at this time after surgery.

In another study, Moran et al. in 2020, conducted a systematic review of literature sources regarding complications arising from medial collateral ligament release [13]. They found that patients had grade 1 medial instability during the first weeks after surgery. In none of the subjects was it detected in the long term, even without the use of a postoperative orthosis or weight-bearing precautions. In addition, no postoperative complications from the subcutaneous nerve were documented. In our study, these complications were also not noted, the patients were only bothered by moderate pain in the area where the needle was inserted, which disappeared within a few days.

In their work, Herber et al. also analyzed the use of the medial collateral ligament release technique in case of restoration of the damaged root of the medial meniscus [14]. Compared with patients who did not

undergo release of this ligament, there were improvements in the Tegner Lisholm Scale in 2 and 6 months, as well as postoperative knee injury and osteoarthritis scores and the Oxford Knee Scale at 1 year. At the same time, a decrease in the level of postoperative pain at rest was documented in the group of patients who underwent release of the medial collateral ligament, compared to the group of those who did not undergo this operation. Herber et al. documented a lower rate of detachment after medial meniscal root repair in patients with an additional release of the medial collateral ligament. The authors suggested that the improved outcome measures, as well as the reduction in pain and prevention of meniscal root re-injury, were likely due to incidental medial unloading after lengthening of the medial collateral ligament [14].

Most studies show the benefits of using a medial collateral ligament release during knee arthroscopy, facilitating access to the medial meniscus and improving visualization, which facilitates anatomical repair of its root, and increases the space for instruments to avoid trauma to the cartilage and does not cause any negative consequences for the knee joint.

Conclusions

Partial percutaneous dissection of the medial collateral ligament to widen the medial cleft during knee arthroscopy does not affect the postoperative course and results of partial removal of the medial meniscus.

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

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PERCUTANEOUS RELEASE OF THE MEDIAL COLLATERAL LIGAMENT DURING KNEE ARTHROSCOPY

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