

Original article

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Original surgical technique for patients with medial knee osteoarthritis: short-term and medium-term results

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Abstract

Introduction Knee osteoarthritis (OA) represents a significant challenge in modern orthopedics and can be associated with short-term and long-term disability. Medial knee OA correlates with medial meniscus extrusion, leading to rapid progression of OA.

The **objective** was to compare surgical outcomes of patients with medial knee OA treated with original and standard methods.

Material and methods Treatment outcomes of 80 patients (44.5 [43.0; 47.0] years) with grade 2 medial knee OA due to medial meniscus damage are reported. The patients were surgically treated using arthroscopic partial meniscus resection (Group 1; $n = 20$); arthroscopic meniscus centralization (Group 2; $n = 20$); arthroscopic partial meniscus resection combined with fibular osteotomy (Group 3; $n = 20$); original technique of arthroscopic meniscus centralization and proximal fibular osteotomy (Group 4; $n = 20$). Patients were examined preoperatively, at three, six and 12 months of surgery using WOMAC, Lysholm and KOOS grading systems, radiology and MR imaging. The nature of meniscal injury and the extent of meniscal extrusion were evaluated using the WORMS method. Statistical processing of the results was performed using the IBM SPSS Statistics Version 25.0 software package.

Results There were statistically significant differences in the WOMAC, Lysholm, and KOOS scores ($p < 0.05$) in patients of group 4 and groups 1–3 at 12 months. Statistically significant differences were seen in the WOMAC and Lysholm scores ($p > 0.05$) in patients of group 3 and group 1 and in Lysholm scores of group 2 ($p < 0.05$). Statistical differences were recorded in the width of the joint space in the medial knee joint of patients of groups 1, 2 and groups 3, 4, while no differences were found between groups 3 and 4 for this parameter, $p > 0.05$.

Discussion The effectiveness of the original technique could be caused by the synergistic effect of the two components. Realignment and restored function of the meniscus facilitated normal load distribution, and proximal fibular osteotomy ensured decompression of the medial compartment and the limb realignment with improved function and objective radiographic changes.

Conclusion The original surgical method offered for the treatment of the medial knee OA demonstrated superior results compared to the standard approaches facilitating lasting pain relief, restored knee function and improved quality of life for patients.

Keywords: knee osteoarthritis, gonarthrosis, meniscal extrusion, arthroscopy, proximal fibular osteotomy

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INTRODUCTION

Knee osteoarthritis (KOA) represents a significant challenge in modern orthopedics and can be associated with short-term and long-term disability reducing the quality of life of patients [1, 2]. With significant advances in the diagnosis and treatment of osteoarthritis [3], the number of patients requiring surgical treatment continues to increase due to demographic changes and improved access to high-tech medical care [4]. In the Russian Federation, osteoarthritis (OA) affects 10–12 % of the total population, indicating a high prevalence of the disease [5].

KOA has a progressive course due to pathogenesis. The primary cause of the disease is a mismatch between the mechanical axial load on the lower limb and the ability of the structural elements of the knee joint to withstand the load. The biological properties of the tissues that make up the knee joint can be compromised genetically or altered by exogenous and endogenous adverse factors [6, 7].

KOA affects the medial tibiofemoral joint ten times more common. The medial meniscus covers 50–60 % of the medial tibial plateau; involvement reduces its functionality leading to inflammation and degeneration in the knee joint [8, 9]. Connection between arthritis progression and meniscus lesions can be explained by the fact that the menisci play an important role in load distribution, shock absorption, and the knee stability. Impaired medial meniscus is associated with the extrusion [10, 11]. Meniscus extrusion can lead to rapid progression of the knee degeneration and persistent pain syndrome [12, 13]. Late patient presentation is a problem. By the time symptoms develop, approximately 80 % of patients have clinically significant coronal plane malalignment. Malalignment increases stress or focal loading in the affected joint, which may impede successful stabilization or regression of the disease. This provides a compelling rationale for developing strategies to prevent disease progression or its early detection and treatment, although literature data on this topic is limited [8].

The **objective** was to compare surgical outcomes of patients with medial knee OA treated with original and standard methods.

MATERIAL AND METHODS

This randomized, prospective, open, comparative cohort study was produced as part of the research RK 046 (01) No. 122031400545-5. The study was conducted at the trauma and orthopedic department of RZhD-Medicine (Chita) between 2022 and 2025. The study involved 80 patients including 35 (43.75 %) male and 45 (56.25 %) female patients who sought help for knee pain caused by medial KOA and injury to the medial meniscus. The median age of patients was 44.5 [43.0; 47.0] years.

Inclusion criteria included young and middle age as graded by WHO; primary KOA of the medial compartment of the stage II with extrusion of the medial meniscus; absence of chronic diseases in the sub- and decompensation stage, oncological pathology and constant therapy with glucocorticosteroids; the ability to evaluate the short- and medium-term functional results. Exclusion criteria included patient age over 50 years; KOA stage III; presence of chronic diseases in the sub- and decompensation stage, oncological pathology; glucocorticosteroid therapy; combined injury of the capsular-ligamentous apparatus of the knee joint; patient refusal to participate in the study.

Patients were randomly divided into four equal groups (20 patients each) matched for inclusion criteria, gender, and age. Patients in Group 1 ($n = 20$, median age 43.5 years [40.3; 46.0]) underwent arthroscopic partial resection of the medial meniscus of the knee joint. Patients in Group 2 ($n = 20$, 45.0 years [40.3; 46.8]) underwent arthroscopic centralization of the medial meniscus of the knee joint. Patients in Group 3 ($n = 20$, 44.5 years [43.0; 47.0]) underwent arthroscopic partial resection of the medial meniscus of the knee joint combined with proximal fibular osteotomy and segmental resection. Patients in group 4 ($n = 20$, 45.0 years [43.0; 48.0]) underwent surgery using an original technique (RU Patent No. 2816801) [14], including arthroscopic centralization of the medial meniscus of the knee joint and proximal fibular osteotomy with segmental resection.

There were four checkpoints for the patients during the study (preoperatively and at three, six, and 12 months postoperatively). Complaints were collected at each checkpoint, anamnesis data reviewed, including a detailed treatment history for medial KOA, and a complete physical examination of the knee was performed to include various tests (Aly, Ober, Lachman, reverse Lachman, varus and valgus of the tibia at 30° flexion, McMurray, Apley, Grind, Waldron's sign, and the vastus medialis test), muscle strength and range of motion measured. Laboratory tests were conducted in accordance with the current clinical guidelines of the Russian Ministry of Health "Gonarthrosis" (2024).

Surgical procedures were performed under spinal anesthesia in the four groups. Patients were also comparable in terms of conservative treatment and rehabilitation (Clinical Guidelines of the Russian Ministry of Health "Gonarthrosis," 2024). The day after surgery, patients were active and could walk with full weight-bearing on the operated limb without the use of assistive devices (crutches, canes), and no additional immobilization of the operated limb was required.

Instrumentation methods included radiographic examination. Osteoarthritis was graded using the classification of J. Kellgren and J. Lawrence. The width of the joint space of the medial portion was evaluated using control radiographs of the knee joint. Magnetic resonance imaging (MRI) of the knee joint was performed preoperatively and at 12 months of surgery. Verification of the nature of meniscus damage and the extent of meniscus extrusion were performed using the WOMS (Whole-Organ Magnetic Resonance Imaging Score) method. Meniscus damage was graded as follows: grade 0 for intact meniscus; grade 1 for minor radial tear or parrot-beak-shaped tear; grade 2 for undisplaced tear; grade 3 for displaced tear or partial maceration or destruction; grade 4 for complete maceration or destruction of the anterior, middle and posterior horns of the medial meniscus. Meniscus extrusion was evaluated as grade 0 for the meniscus being located parallel to the medial tibial plateau; grade 1 for less than 50 % of the meniscus body extending beyond the tibial plateau; grade 2 for more than 50 % of the meniscus body extending beyond the tibial plateau [15, 16].

A comprehensive assessment of the knee functionality was produced prior to surgery and at three, six, and 12 months of the procedure using scoring systems characterized by high degrees of validity, reliability, sensitivity to changes, specificity and reproducibility [17]. The WOMAC (Western Ontario and McMaster University Osteoarthritis Index, a scale used to assess the condition of patients with KOA) scores were calculated using a questionnaire consisting of three blocks (pain, stiffness, and daily functions). The results were assessed using a scoring system as excellent with 0–14 scores; as good with 15–28 scores; as satisfactory with 29–38 scores; as poor with more than 38 scores [17]. The Lysholm scale was used to assess the functional condition of joints evaluating lameness, use of additional support devices, impingement, joint instability, pain, joint swelling, walking up stairs, and squatting. The results were assessed as poor with less than 65 scores, as fair with 65–83 scores, as good with 84–94 scores, as excellent with 95–100 scores [18, 19].

The KOOS (Knee Injury and Osteoarthritis Outcome Score) was used to assess severity of pain, dysfunction of the affected joint, and the impact of the disease on the patient's quality of life, including sports activity. The KOOS assesses five domains: pain, other symptoms, ADL function, sport and recreation, and knee-related quality of life. All items were scored from 0 to 4. The scores were then normalized to a score from 0 to 100 for each domain as well as a total score of all domains where 0 indicated extreme problems and 100 indicated no problems [20].

Statistical processing of the results was performed using the IBM SPSS Statistics Version 25.0 software package (license no. Z125-3301-14, IBM, USA). The principles of the International Committee of Medical Journal Editors (ICMJE) and the "Statistical Analysis and Methods in Published Literature" (SAMPL) guidelines were used for statistical analysis. The Shapiro – Wilk test was used to examine if a variable was normally distributed in the population. Considering the distribution of features that differed from normal in the study groups, the data were presented as the median, the first and third quartiles, — Me (Q1; Q3). Rank analysis of variance according to Kruskal – Wallis

was used to compare four independent groups by one quantitative feature. Pairwise comparison was performed using the Mann-Whitney test in the presence of statistically significant differences, taking into account the Bonferroni correction ($p < 0.0125$). Comparison of two dependent groups (assessment of the significance of changes in the postoperative parameters) was performed using the Wilcoxon test. In all cases, $p < 0.05$ was considered statistically significant [21].

The study was performed in accordance with ethical principles for medical research involving human subjects stated in the Declaration of Helsinki developed by the World Medical Association as revised in 2024 [22]. The study received a favourable opinion from the local ethics committee of the Chelyabinsk State Medical Academy of the Russian Ministry of Health (protocol No. 124 of November 10, 2022). All patients were informed about the treatment and diagnostic procedures to be carried out and provided written consent for publication of the findings.

RESULTS

Combined medial meniscus extrusion grade 1 or 2 (comparable by the number of patients in the groups) and an injury to the posterior horn of the medial meniscus grade 3 were observed intraoperatively in patients of all groups. Patients underwent partial resection of the involved area of the posterior horn of the medial meniscus. The extruded meniscus was fixed according to the original technique in groups 2 and 4. High fibular osteotomy and segmental resection were sequentially performed in groups 3 and 4 [14]. No complications (venous thromboembolic, purulent-inflammatory, persistent synovitis, etc.) were recorded in any of the groups in the early and late periods of surgical treatment. Patients were discharged after two or three days, postoperative sutures removed in the trauma center after ten postoperative days. The results of a comprehensive assessment of the knee in patients of the study groups at control points are presented in Table 1.

Table 1

Results of a comprehensive assessment of the knee joint, Me[Q1;Q3]

Description	Control points	Study groups				Test statistics	
		Group 1 (n = 20)	Group 2 (n = 20)	Group 3 (n = 20)	Group 4 (n = 20)	Kruskal – Wallis test (H)	Mann – Whitney test and Bonferroni correction (U)
WOMAC	pre-op	44.0 [38.0;46.75]	42.0 [38.25;48.0]	41.5 [39.0;43.75]	41.0 [39.0;43.0]	H = 0.23, $p = 0.972$	$U_{1-2} = 195, p = 0.891$; $U_{1-3} = 177, p = 0.529$; $U_{1-4} = 191, p = 0.795$; $U_{2-3} = 195, p = 0.902$; $U_{2-4} = 196, p = 0.912$; $U_{3-4} = 195, p = 0.902$
	3 months after surgery	30.0 [23.0;33.5]	30.0 [29.25;40.0]	30.0 [24.5;33.0]	21.5 [20.0;23.75]	H = 22.17, $p < 0.001$	$U_{1-2} = 158, p = 0.252$; $U_{1-3} = 190, p = 0.786$; $U_{1-4} = 90, p = 0.003$; $U_{2-3} = 159, p = 0.264$; $U_{2-4} = 45, p = 0.001$; $U_{3-4} = 59, p < 0.001$
	6 months after surgery	24.0 [18.0;28.75]	26.5 [20.75;32.5]	26.0 [19.0;30.0]	15.0 [14.0;15.0]	H = 28.79, $p < 0.001$	$U_{1-2} = 150, p = 0.175$; $U_{1-3} = 177, p = 0.524$; $U_{1-4} = 80, p = 0.001$; $U_{2-3} = 171, p = 0.424$; $U_{2-4} = 20, p < 0.001$; $U_{3-4} = 36, p < 0.001$
	12 months after surgery	29.0 [21.0;33.75]	26.5 [15.0;33.75]	20.0 [10.25;24.75]	13.0 [11.0;14.0]	H = 25.62, $p < 0.001$	$U_{1-2} = 172, p = 0.440$; $U_{1-3} = 104, p = 0.009$; $U_{1-4} = 12, p < 0.001$; $U_{2-3} = 138, p = 0.093$; $U_{2-4} = 84, p = 0.002$; $U_{3-4} = 116, p = 0.022$

Table 1 (continued)

Results of a comprehensive assessment of the knee joint, Me[Q1;Q3]

Description	Control points	Study groups				Test statistics	
		Group 1 (n = 20)	Group 2 (n = 20)	Group 3 (n = 20)	Group 4 (n = 20)	Kruskal – Wallis test (H)	Mann – Whitney test and Bonferroni correction (U)
Lysholm	pre-op	59.5 [57.0;61.75]	59.0 [57.0;61.0]	58.0 [57.0;62.75]	58.0 [56.0;63.75]	H = 0.107, p = 0.991	U ₁₋₂ = 189, p = 0.754; U ₁₋₃ = 190, p = 0.775; U ₁₋₄ = 196, p = 0.913; U ₂₋₃ = 194, p = 0.859; U ₂₋₄ = 191, p = 0.807; U ₃₋₄ = 198, p = 0.945
	3 months after surgery	76.5 [72.25;80.0]	78.5 [76.25;80.0]	78.0 [75.0;81.5]	81.0 [79.0;82.0]	H = 11.02, p = 0.012	U ₁₋₂ = 158, p = 0.251; U ₁₋₃ = 155, p = 0.220; U ₁₋₄ = 93, p = 0.004; U ₂₋₃ = 199, p = 0.978; U ₂₋₄ = 112, p = 0.016; U ₃₋₄ = 119, p = 0.270
	6 months after surgery	86.5 [84.25;90.0]	88.5 [86.25;90.0]	88.0 [85.0;91.5]	90.5 [88.25;92.0]	H = 8.75, p = 0.031	U ₁₋₂ = 157,5, p = 0.244; U ₁₋₃ = 154, p = 0.208; U ₁₋₄ = 97, p = 0.005; U ₂₋₃ = 199, p = 0.978; U ₂₋₄ = 129, p = 0.053; U ₃₋₄ = 137, p = 0.083
	12 months after surgery	75.5 [73.25;79.0]	77.0 [75.0;78.75]	88.0 [87.0;89.75]	95.5 [95.0;97.75]	H = 67.14, p < 0.001	U ₁₋₂ = 171, p = 0.420; U ₁₋₃ = 0, p < 0.001; U ₁₋₄ = 0, p < 0.001; U ₂₋₃ = 0, p < 0.001; U ₂₋₄ = 0, p < 0.001; U ₃₋₄ = 0, p < 0.001
KOOS	pre-op	35.0 [32.5;35.0]	32.5 [15.63;34.38]	32.5 [21.5;35.0]	32.5 [15.63;34.38]	H = 4.32, p = 0.229	U ₁₋₂ = 136, p = 0.079; U ₁₋₃ = 150, p = 0.166; U ₁₋₄ = 136, p = 0.079; U ₂₋₃ = 183, p = 0.630; U ₂₋₄ = 200, p = 1.000; U ₃₋₄ = 183, p = 0.630
	3 months after surgery	50.0 [41.5;57.44]	53.25 [41.94;56.31]	53.5 [42.13;59.94]	50.0 [47.5;57.25]	H = 0.55, p = 0.907	U ₁₋₂ = 192, p = 0.827; U ₁₋₃ = 186, p = 0.693; U ₁₋₄ = 196, p = 0.913; U ₂₋₃ = 168, p = 0.376; U ₂₋₄ = 196, p = 0.913; U ₃₋₄ = 186, p = 0.703
	6 months after surgery	71.5 [58.13;85.75]	64.25 [57.31;70.56]	69.63 [58.19;77.5]	67.5 [60.0;75.0]	H = 3.22, p = 0.360	U ₁₋₂ = 145, p = 0.136; U ₁₋₃ = 175, p = 0.497; U ₁₋₄ = 166, p = 0.355; U ₂₋₃ = 154, p = 0.211; U ₂₋₄ = 158, p = 0.252; U ₃₋₄ = 188, p = 0.744
	12 months after surgery	75.0 [51.88;85.56]	71.5 [53.5;84.31]	80.5 [69.56;85.75]	85.75 [85.05;85.75]	H = 13.49, p = 0.004	U ₁₋₂ = 189, p = 0.755; U ₁₋₃ = 162, p = 0.303; U ₁₋₄ = 102, p = 0.007; U ₂₋₃ = 138, p = 0.093; U ₂₋₄ = 78, p < 0.001; U ₃₋₄ = 120, p = 0.027

Table 1 (continued)

Results of a comprehensive assessment of the knee joint, Me[Q1;Q3]

Description	Control points	Study groups				Test statistics	
		Group 1 (n = 20)	Group 2 (n = 20)	Group 3 (n = 20)	Group 4 (n = 20)	Kruskal – Wallis test (H)	Mann – Whitney test and Bonferroni correction (U)
Radiological examination	pre-op	5.0 [4.63;5.45]	5.0 [4.50;5.00]	5.0 [4.63;5.00]	5.0 [4.50;5.00]	H = 4.24, p = 0.236	U ₁₋₂ = 147, p = 0.132; U ₁₋₃ = 147, p = 0.130; U ₁₋₄ = 137, p = 0.080; U ₂₋₃ = 198, p = 0.941; U ₂₋₄ = 184, p = 0.637; U ₃₋₄ = 179, p = 0.536
	6 months after surgery	5.0 [4.63;5.45]	5.0 [4.50;5.00]	5.0 [5.00;5.15]	5.0 [4.58;5.10]	H = 2.70, p = 0.440	U ₁₋₂ = 147, p = 0.132; U ₁₋₃ = 161, p = 0.264; U ₁₋₄ = 169, p = 0.394; U ₂₋₃ = 181, p = 0.576; U ₂₋₄ = 170, p = 0.401; U ₃₋₄ = 188, p = 0.736
	12 months after surgery	4.95 [4.50;5.35]	5.0 [4.50;5.00]	5.4 [5.30;5.60]	5.5 [5.30;5.60]	H = 36.94, p < 0.001	U ₁₋₂ = 172, p = 0.436; U ₁₋₃ = 77, p < 0.001; U ₁₋₄ = 59, p < 0.001; U ₂₋₃ = 35, p < 0.001; U ₂₋₄ = 13, p < 0.001; U ₃₋₄ = 174, p = 0.477

Note: p, statistical significance of differences at $p < 0.05$.

The findings showed (Table 1) that the groups of patients were comparable in terms of the parameters explored and demonstrated poor WOMAC, Lysholm, KOOS scores, $p > 0.05$ at the first control point (pre-op). The width of the joint space in the medial knee measured with radiographs showed no differences between the groups, $p > 0.05$. Positive dynamics in WOMAC, Lysholm, KOOS scores was noted in groups 1, 2 and 3 demonstrating a “fair” result at the second control point (three months after surgery). The Lysholm and KOOS scores suggested a fair result in group 4 with the WOMAC score being significantly different in group 4 as compared with groups 1, 2, 3 ($p < 0.05$) and suggested a good result.

Good results were observed in all groups at the third control point (six months after surgery). However, statistically significant differences in the WOMAC score ($p < 0.05$) were found between patients in groups 1–3 and group 4; and in the Lysholm score ($p < 0.05$) between patients in group 1 and group 4. No statistically significant differences were found in the width of the joint space in the medial knee joint, $p > 0.05$.

Analysis of the results at the fourth control point revealed significant differences in the WOMAC, Lysholm and KOOS scores between patients of group 4 and patients of groups 1, 2, 3 ($p < 0.05$). Statistically significant differences in the WOMAC and Lysholm scores were found in patients of group 3 with group 1, as well as with group 2 ($p < 0.05$). Statistical differences were recorded in the width of the joint space in the medial knee joint between patients of groups 1, 2 and patients of groups 3 and 4, with no differences observed between groups 3 and 4 for this parameter, $p > 0.05$.

Increasing the joint space width of the medial knee yields a more significant excellent result in Group 4, where surgical treatment was aimed at preserving the anatomical position of the medial meniscus as compared to the other three study groups. Functionality yielded good WOMAC, Lysholm scores and excellent KOOS score in patients of Group 3 treated with partial arthroscopic resection of the damaged meniscus in combination with high fibular osteotomy and segmental resection. In contrast, patients in Group 1 showed a decline in functionality at the fourth checkpoint.

DISCUSSION

KOA combined with meniscal damage and extrusion is common with OA affecting all articular structures, and pathological processes in different tissues can occur partially independently and at different rates [23]. Arthroscopic examination and magnetic resonance imaging showed that in addition to damage to the articular cartilage, KOA affects the menisci and synovial membrane [24], and pathology of the medial meniscus correlates with the extrusion [8]. Research shows that most people with painful OA have extensive structural disease, including changes in the biomechanical axis of the lower limb, which can hinder successful stabilization or regression of the disease [25]. A damage to the meniscus and ligamentous apparatus changes the load on the knee joint, which can be a predisposing factor to the progression of KOA [26, 27, 28]. Arthroscopic restoration is the preferred treatment method for a meniscus rupture and absence of severe OA or severely malaligned limb axis [28].

There is a high risk of recurrence with meniscus repair. Risk factors for poor postoperative clinical outcome and reoperation rates include advanced age, high body mass index, malaligned limb axis and/or articular relationships of the limb segment [29, 30]. There is a connection between meniscal extrusion and meniscal dysfunction, increased cartilage pressure, early arthritic changes, and a high failure rate with root repair and meniscal allograft insertion [29, 30, 31]. Root tears and any type of meniscus tears that cause annular dysfunction or meniscal resection can lead to extrusion [25]. A recent biomechanical study of cadaveric knee specimens showed that increasing the posterior tibial angle and knee flexion angle resulted in increased force on the medial meniscus, suggesting that lower limb position influences meniscal root repair [33]. Varus knee alignment was shown to increase the force on the medial meniscus.

This study is clinically significant because the findings may impact treatment methods for meniscal pathologies. Arthroscopic meniscal centralization can be offered for meniscal root reconstruction and obvious anterior cruciate ligament pathology using magnetic resonance imaging or arthroscopy. First studies examining arthroscopic centralization as an adjunctive treatment for posttraumatic medial meniscectomy tears showed positive results [34]. Given that varus deformity increases the load on the meniscal root, femoral or tibial osteotomy can be considered to reduce the load on the medial meniscus.

In this context, a recent retrospective study showed promising short-term clinical and radiographic outcomes of combined tibial osteotomy, meniscus centralization in varus knee and medial meniscus extrusion [35]. However, there is a paucity of high-quality clinical studies to compare the effectiveness of root restoration with and without centralization and/or realignment procedures. The effectiveness of our original technique relies on the synergistic effect of the two components. Restoring the position and function of the meniscus normalizes load distribution, while proximal fibular osteotomy decompresses the medial compartment and realigns the limb. Proximal fibular osteotomy was shown to be an effective treatment for medial KOA by relieving pain and preventing progression of varus deformity [36, 37]. In our series, this was confirmed by improved functionality and objective radiographic changes with increased joint space width in groups 3 and 4.

Limitations of the Study

Limitations of the study include strict inclusion and exclusion criteria and a short follow-up period (12 months). Longer follow-up period is needed for patients with medial KOA surgically treated with the original method.

CONCLUSION

The original surgical treatment offered for patients with medial KOA demonstrated superior results compared to the standard approaches discussed. The technique differs from standard approaches in the inclusion of decompression of the medial compartment of the knee joint widening the medial

compartment in addition to restoring the integrity and functionality of the medial meniscus of the knee joint through proximal fibular osteotomy and segmental resection. The technique helps prevent the progression of medial KOA, recurrent injury to the medial meniscus providing lasting pain relief and regained knee function. The use of the organ-preserving technique may delay or avoid the need for unicompartmental or total knee arthroplasty in patients with medial KOA.

Conflict of interest None of the authors has any potential conflict of interest.

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Ethical Approval The study was approved by the local ethics committee of the Federal State Budgetary Educational Institution of Higher Education "ChSMA" of the Ministry of Health of the Russian Federation (Protocol No. 124 dated 10.11.2022).

Informed Consent The patients gave informed consent for publication of the findings without identification.

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