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# Unicompartmental Knee Arthroplasty: Short-Term Results

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**Abstract**

***Background***. Among the methods of surgical treatment of early stages medial knee osteoarthritis in the partial knee replacement (PKR) becomes more and more relevant. The relevance and increasing number of PKR are confirmed by data from various national registers. ***The aim of the study*** was to research the early functional results of PKR and to analyze the complications at various stages of the postoperative period. ***Materials and Methods.*** Study design: a single-center prospective study. The results of 90 operations of PKR in the period from March 2018 to April 2020 are presented. Assessment of knee function and quality of life of patients was performed according to three scales-questionnaires: KOOS, WOMAC, SF-36, which were filled in preoperatively and then at 3, 6, 9, 12, 18 months. after surgery. Patients within the reporting period provided X-rays and filled in the scales at the face-to-face examination and at remote contact. ***Results.*** The most significant improvement of quality of life and median values of the functional results observed after 3 months, and after 18 months. After replacement the best median functional outcome scales KOOS, WOMAC, SF-36 — 79,4 (73,6–84,3); 27,1 (24,8–30,6); 89,1 (85,3–92,6) compared with the functional results obtained before surgery 32,3 (22,8–38,4); 73,6 (63,6–78,8); 35,2 (31,3–42,1); p = 0,027; p = 0.023; p = 0,028, respectively. A negative correlation was obtained between BMI and functional outcome (p=0.027, R=-0.7). ***Conclusion.*** PKR allowed us to achieve an improvement in the quality of life and functional results already in the early postoperative period (from 3 to 18 months). The improvement of the operating technique, the analysis of errors and the regularity of the performed PKR will improve the results of PKR and minimize the number of complications.

**Keywords:** partial knee replacement, medial knee compartment, medial gonarthrosis, early results.

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## Introduction

Now, more and more people are choosing an active lifestyle and want to keep it until old age. The number of elderly people in the modern population is increasing, and at the same time, numerous complaints of joint pain and movement restriction caused by osteoarthritis are increasingly attracting attention. In their study, L. Murphy et al. show that half of the population aged 85 years and older will develop osteoarthritis of the knee joint [1].

There are several options for surgical treatment of the initial stages of gonarthrosis with a predominant lesion of one of the knee joint compartments: arthroscopic debridement, periarticular osteotomies [2], partial arthroplasty, and in the terminal stage of the disease — total knee arthroplasty (TKA). Osteotomies demonstrate good long-term results, but its effectiveness depends on the degree of joint lesion, so the indications for them are limited. Partial arthroplasties includes several types of surgical treatment, among which one can distinguish unicondylar knee replacement (UKA), as well as "point" (button prosthesis) replacement of the articular surface of the femoral condyles loaded zone[3].

The first experience of UKA dates back to the early 1970s. In the future, the quality of implants and surgical technique improved, which allowed us to achieve results comparable to the outcomes of TKA. Some authors consider UKA as a treatment method associated with the least number of complications compared to TKA and corrective osteotomies [4].

According to the Australian register, the share of partial arthroplasty in the structure of all knee arthroplasty in 2018 was 9.26%. UKA accounts for the largest part (92.8%) of all partial knee replacement operations. For the period from 2003 to 2018, we can note a tendency to decrease the frequency of UKA, and then to increase in the last three years by 5% annually. At the same time, the frequency of UKA is steadily increasing*. The great interest of orthopedic surgeons in UKA is also confirmed by the data of other countries registers. Thus, according to the Swedish register of arthplasty, in 2018 the share of UKA of the knee joint medial compartment was 8.3% of the TKA**. There is also a tendency to increase the number of UKA implementation every year**. Similar results are presented in the New Zealand Register for the last 10 years***.

More and more people every year complain about pain in the knee joints in the early stages of the disease, when the lesion does not affect the entire knee joint, but only part of it. Isolated injuries of the knee joint medial compartment can often be found, and modern diagnostic methods allow them to differentiate and offer patients narrowly targeted treatment. Such surgical treatment is a UKA of the knee joint medial compartment.

The aim of the study was to evaluate the early functional results of UKA of the knee joint medial compartment and to analyze complications at various stages of the postoperative period.

## Materials and Methods

### *Research design*

This study is a single-center prospective study in which all surgeries were performed by one surgeon and two teams of assistants.

In the period from March 2018 to April 2020, 90 operations of UKA of the knee joint medial compartment with the Oxford III model (Zimmer Biomet) were performed in 89 patients. The time spent from diagnosis to surgery in the preoperative period was from 3 weeks up to 1.5 months. Before the surgery,

* Australian Orthopaedic Association National Joint Replacement Registry. Annual Report 2019. Available from: https://aoanjrr.sahmri.com/annual-reports-2019.

** Swedish Knee Arthroplasty Register. Annual report 2019. Available from: http://myknee.se/pdf/SVK_2019_1.0_Eng.pdf.

*** The New Zealand Joint Registry. Annual Report 2019. NZOA, 2020. Available from: https://nzoa.org.nz/nzoa-joint-registry.

all patients underwent X-ray examination and assessed the function of the knee joint and the quality of life using the following questionnaire scales: KOOS, WOMAC, SF-36. The assessment of patients functional state according to KOOS and WOMAC was calculated as a percentage of the maximum possible score on each of the scales. In the future, the assessment was performed 3, 6, 9, 12 and 18 months after the operation. The maximum follow-up period was 24 months (3 cases). Communication is maintained with patients, they are repeatedly invited for a clinical examination and filling in the scales. Some of them (7 cases) were contacted remotely, the scales were filled in by phone.

*Inclusion criteria:*

- knee osteoarthritis I-II according to the classification of N.S. Kosinskaya (1961), IV-V st. according to the classification of Ahlbäck (1968); III-IV st. according to the classification of Kellgren-Lawrence (1963) with a predominant lesion of the medial compartment;
- pronounced thinning of articular cartilage in the medial compartment;
- satisfactory condition of the knee joint lateral compartment (intact meniscus and full thickness of articular cartilage);
- intact anterior and posterior cruciate ligaments, as well as the entire ligamentous apparatus;
- intact articular surface of the posterior tibia;
- the possibility of complete extension of the knee joint or flexor contracture no more than 10°, varus deformity no more than 10°.

*Exclusion criteria:*

- total degenerative-dystrophic lesion of all compartments of the knee joint;
- simultaneous damage to the internal and external departments;
- pronounced contracture;
- instability of the knee joint ligaments;
- pronounced patello-femoral arthrosis;
- an active infectious process or the possibility of latent infection;
- lack of active extension in the knee joint (failure of the extensor apparatus or muscle dysfunction) –
- chronic concomitant diseases in the decompensation stage.

## *Patients*

This study presents the results of 89 patients treatment who underwent 90 UKA of the medial compartment, including 15 men (16.9%) and 74 women (83.1%). The average age was 63.8 years (from 39 to 77 years). The median body mass index (BMI) was 31.9 kg/m$^2$ (interquartile range from 27.6 to 45.2).

The median surgery time was 67 minutes (interquartile range from 59 to 81). All patients underwent spinal anesthesia. All surgeries were performed using a pneumatic tourniquet (under pressure of 270-300 mm Hg), except for two patients (who had severe atherosclerosis of the lower extremities vessels stage 3A), and were accompanied by minimal blood loss (Table 1).

*Table 1*

**Patient charasteristics**

| Parameter | Value |
|---|---|
| UKA quantity | 90 |
| Gender, male/female | 15/74 |
| Surgery side: right/left | 54/36 |
| Age, years | 63,8 (от 39 до 77) |
| BMI, kg/m$^2$ | 31,9 (27,6–45,2) |
| Surgery time, min* | (72–93) |

* The data is presented in the median (interquartile range) format.

Of the 90 operations, 54 were performed on the right knee joint, and 36 — on the left knee joint. Of these, the femoral component Small was implanted in 26 patients, Medium — 48 patients, Large — 16 patients. The tibial component A was implanted in 14 patients, B — 43 patients, C — 20 patients, D — 11 patients, E — 2 patients. A 3 mm thick liner was implanted in 36 patients; 4 mm — 31; 5 mm — 15; 6 mm — 4; 7 mm — 3; 8 mm — 1 patient.

### *Surgical technique*

For implantation, a minimally invasive medial curved approach from the upper pole of the patella with 9-11 cm length was used. Intraoperatively, a visual and clinical check of contraindications to the operation of the UKA was carried out, for each surgery, an additional set of TKA implants was prepared in case of contraindications to UKA performing. For implantation, the instruments of the Oxford Microplasty system were used, with its help navigation and processing were carried out for the tibial and femoral components (Fig. 1). On the tibial plateau, after sawing, the integrity of the posterior tibia articular surface was visualized, which indicated the consistency of the anterior cruciate ligament and the correct choice of the endoprosthesis type (Fig. 2). After checking the movements and stability of the joint on the fitting components, implantation was performed according to the standard method (Fig. 3). Local infiltration anesthesia was performed before suturing. No drainage was used.

**Figure 1.** Medial condyle of the femur after milling

**Figure 2.** Morphological picture of the saw cut of the medial condyle of the tibia

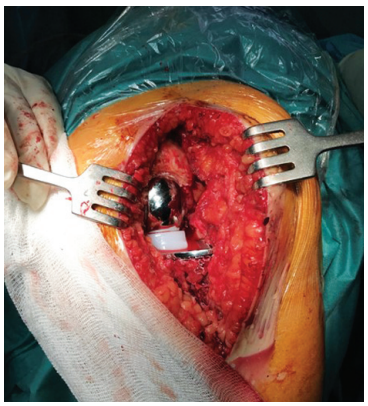

**Figure 3.** Implanted PKR of the medial compartment

### *Postoperative period*

In the postoperative period, from the next day after the surgery, all patients received an anticoagulant drug in preventive dosages for 3 weeks after the surgery. Anticoagulant therapy was combined with the use of the lower extremities elastic bandaging for 2 months after surgical treatment. Radiography was performed on the next day after the surgery and in the long-term period.

### *Statistical analysis*

Standard statistical packages were used for statistical processing: MS Excel, Statistica 10.0. When conducting statistical processing of the study results, the Student's criterion (t-criterion) was used to determine the distribution for normality. For a comparative analysis of the study quantitative indicators, nonparametric criteria were used: the Wilcoxon rank criterion of signs,

the Mann-Whitney rank criterion (comparative analysis before and after surgery). Spearman's rank correlation coefficient (R) was used to establish the relationship between BMI and functional results. The correlation analysis was carried out using the Pearson criterion. Relative (%) and absolute frequencies were used to describe qualitative features. The differences with the criterion $p<0.05$ were considered statistically significant.

## Results

The functional state of the knee joint before surgery was 32.3% on the KOOS scale (interquartile range from 22.8 to 38.4), 73.6% on the WOMAC scale (interquartile range from 63.6 to 78.8), and 35.2 points on the SF-36 scale (interquartile range from 31.3 to 42.1), which corresponds to unsatisfactory results.

In the subsequent analysis of the scale indicators after 3, 6, 9, 12 and 18 months after surgery, functional results improved, that is, there was a clinically and statistically significant improvement (Fig. 4). The best results were obtained in the study 18 months after surgery and amounted to 79.4% ($p = 0.027$) on the KOOS scale; 27.1% ($p = 0.023$) on the WOMAC scale and 89.1 points ($p = 0.028$) on SF-36.

Our study presents the dynamics of changes in early functional results (from 3 to 18 months) at various terms. These results are regarded as good (Table 2, Fig. 4). The WOMAC scale is a reversible questionnaire; the results obtained using this scale also confirm the improvement of early functional results.

The association of unsatisfactory results with BMI was also revealed, which should be taken into account when determining treatment tactics. In the study of dependencies, we obtained a statistically significant correlation between BMI and functional results ($p = 0.027$). The negative value of Spearman's rank correlation coefficient ($R = -0.7$) indicates that the higher the median BMI values, the worse the achieved functional results of patients (R, %) 12 months after surgery. The best functional results were achieved in people with the lowest BMI (Fig. 5).

In the postoperative period, we received complications in 8 patients. Of these, 3 patients underwent revision surgical treatment, and 5 patients underwent conservative treatment (Table 3).

In patient No. 35, a large thickness of the endoprosthesis liner was mistakenly chosen, which led to the progression of osteoarthritis in other parts of the knee joint. 6 months after the surgery, a revision was performed, as a result of which a TKA was performed (Fig. 6).

*Table 2*

**Functional results before and after surgery**

| Scale | Before surgery (n = 90) | 3 months (n = 69) | 6 months (n = 61) | 9 months (n = 50) | 12 months (n = 41) | 18 months (n = 22) | *p* |
|---|---|---|---|---|---|---|---|
| Koos Knee Survey, % | 32,3 (22,8–38,4) | 56,6 (49,1–62,1) | 64,4 (57,8–67,3) | 70,2 (64,2–77,1) | 78,7 (69,8–82,9) | 79,4 (73,6–84,3) | 0,027 |
| WOMAC, % | 73,6 (63,6–78,8) | 43,6 (39,1–47,2) | 37,7 (34,1–39,8) | 34,8 (31,4–37,9) | 28,3 (25,3–31,2) | 27,1 (24,8–30,6) | 0,023 |
| SF-36, points | 35,2 (31,3–42,1) | 51,1 (44,2–56,6) | 58,7 (51,2–63,8) | 79,8 (73,7–84,2) | 86,6 (81,2–90,9) | 89,1 (85,3–92,6) | 0,028 |

*n* — the number of cases; the data is presented in the median format (interquartile range).

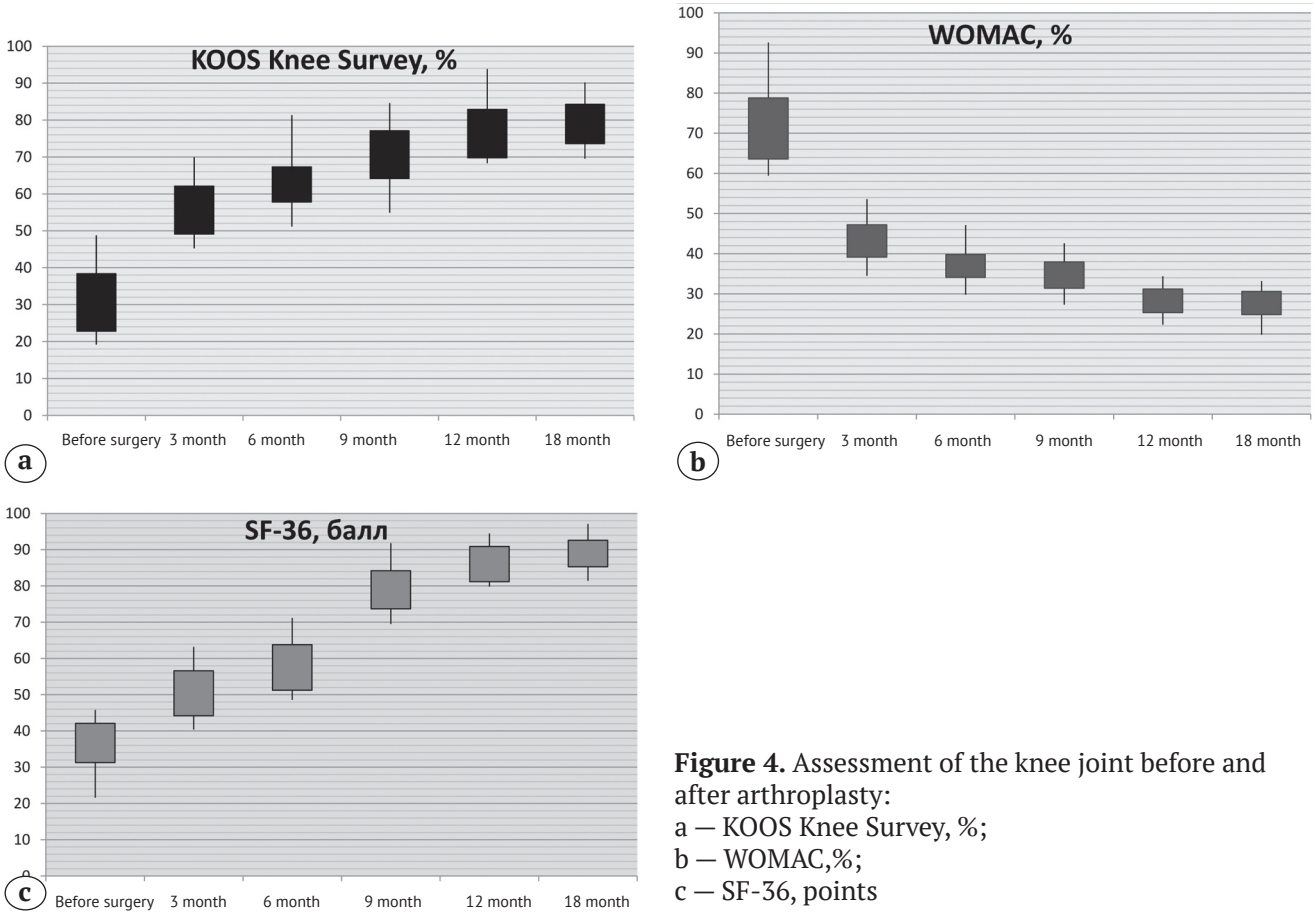


**Figure 4.** Assessment of the knee joint before and after arthroplasty:
a — KOOS Knee Survey, %;
b — WOMAC,%;
c — SF-36, points

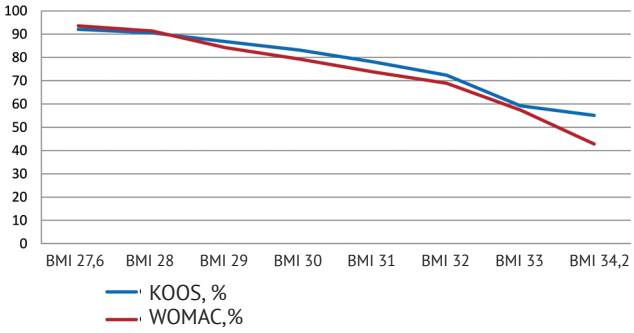


**Figure 5.** Functional results 12 months after surgery depending on BMI, %

On panoramic radiographs, the articular gap of the left knee joint is 3 mm, the thickness of the endoprosthesis liner is 8 mm on the operated limb. It is impossible to assess the overload of the lateral compartment in comparison with a healthy joint in the absence of cartilage and bone tissue defects, since with a stable ligamentous apparatus and an intact subchondral bone, deviation is not visible. Therefore, on panoramic radiographs, the axis of the limb is correct. When the tibia deviates outward due to a thicker liner, there is a constant load on the cartilage of the lateral condyle of the femur, which contributes to the rapid progression of osteoarthritis. The intraoperative photo during the conversion surgery shows the areas of chondromalacia of the femur lateral condyle. When performing the primary UKA, we always conduct an assessment of the external compartment, and this patient did not have them.

In patient No. 69, an insufficient thickness of the endoprosthesis liner was mistakenly selected. In the postoperative period, self-reducting dislocations of the endoprosthesis liner were noted. After 4 months, a revision was performed, as a result of which the endoprosthesis liner was replaced with a liner with a larger thickness (instead of 3 mm, a 7 mm liner was installed).

*Table 3*

**Complications**

| Number of surgery since the beginning of the technique use | Time since the beginning of the technique development, months | Interval after the previous UKA, weeks | Complication 's type | Complications description | Outcomes |
|---|---|---|---|---|---|
| 5 | 1 | 2 | Early | Error in the selection of components | Overlaying components on control radiographs of 2-3 mm |
| 15 | 6 | 4 | Early | A site of localized superficial skin necrosis measuring 4.0x4.0 cm at a distance of 3 mm from the postoperative wound (BMI > 45 kg/m$^2$) | After the healing of the postoperaive wound, necrosis excision was performed with skin grafting |
| 21 | 6 | 2 | Early | Synovitis in the early postoperative period | Knee punctures were performed; conservative treatment |
| 24 | 6 | 2 | Early | Severe pain syndrome, the appearance of an abundant discharge from the wound on the 4th day after the surgery | Debridement; during the revision, a defect of the joint capsule was revealed due to the sutures rupture |
| | | | Deferred | Periprosthetic infection | Revision, debridement; spacer implantation; after stopping the infectious process, the knee TKA was performed |
| 35 | 12 | 2 | Deferred | Progression of the external compartment osteoarthritis. Severe pain syndrome. A large thickness of the endoprosthesis liner (8 mm) was mistakenly chosen | Revision TKA after 6 months |
| 36 | 12 | 2 | Early | Hemarthrosis in the early postoperative period. Concomitant disease: severe atherosclerosis of the lower extremities vessels stage 3A. The surgery was performed without a pneumatic tourniquet, it was conducted without elastic bandages (according to the recommendations of a vascular surgeon) | Knee joint punctures were performed; conservative treatment |
| 69 | 20 | 3 | Deferred | The insufficient thickness of the endoprosthesis liner was mistakenly selected. Self-reducting dislocation of the endoprosthesis liner | Revision via 4 months, the liner was replaced from 3 to 7 mm |

In patient No. 24, the appearance of a pronounced pain syndrome and abundant discharge from the postoperative wound on the 4th day after the surgery was noted. During the revision, a defect of the joint capsule was revealed due to the rupture of the continuous suture. In the long-term period, a periprosthetic infection was detected, diagnostic punctures of the knee joint were performed. After 11 months, a revision was performed, the first stage was the knee joint spacer implantation. Diagnostic punctures were performed, no flora growth was detected, after 5 months the second stage was performed: removal of the spacer, TKA.

Analyzing three cases that led to revision surgery, we found that in all these cases, the break after the previous UKA was 2 or more weeks, and these surgeries were performed by a surgeon who performed the 3rd endoprosthesis surgery in a row on this day. For all these three patients, the primary surgery was performed last according to the schedule of operations for that day.

In patient No. 5, the control X-ray revealed an overhang of the tibial component of 2-3 mm. Error in the selection of components — 1 patient. Patient No. 15 had a site of localized superficial skin necrosis measuring 4.0x4.0 cm at a distance of 3 mm from the postoperative wound (Fig. 7). After wound healing, necrosis was excised with skin plasty, which did not affect the functional result in the future (BMI >45 kg/m$^2$).

Patient No. 21 had synovitis of the operated knee joint in the early postoperative period, patient No. 36 had hemarthrosis in the early postoperative period. Patient No. 36 has a pronounced atherosclerosis of the lower extremities vessels stage 3A. He was consulted by a vascular surgeon, and together it was decided to conduct surgical treatment without a pneumatic tourniquet, and in the postoperative period to treat the patient without elastic compression. Both patients underwent knee joint punctures, against the background of which the above-described phenomena were stopped.

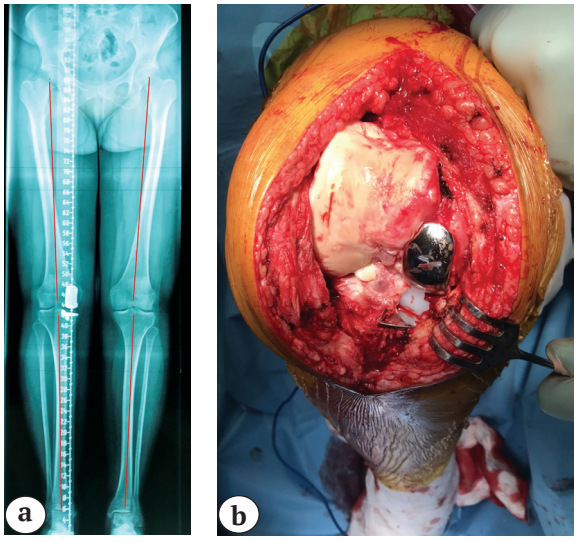


**Figure 6.** Patient No. 35:
a — an 8 mm insert was selected, which caused an overload of the lateral compartment;
b — osteomalacia of the lateral condyle of the femur; intraoperative photo during the conversion to TKA

**Figure 7.** Site of localized surface necrosis in a patient with a BMI >45 kg/m$^2$

## Discussion

The most obvious tendency to improve the clinical and functional results and indicators of the scales in our patients was observed 3 months after surgery. Already starting from the three-month period after the surgery, patients noted an improvement in the quality of life and an increase in motor activity. Similar results were presented in their study by N. Fisher et al. They noted that 93% of people

returned to their normal physical and athletic activities after UKA performing [4].

In the future, an increase in positive dynamics was noted on all scales. The best results were obtained 18 months after surgery and amounted to 79.4%; 27.1% and 89.1 points on the KOOS, WOMAC and SF-36 scales, respectively, with statistically significant differences. These results are regarded as good.

More and more scientists in their research show that an adequate selection of patients and timely surgical treatment can achieve good results comparable to the results after TKA [5], while UKA allows you to maintain proprioception and normal kinematics of a healthy joint, faster recovery. In our study, the above dependencies were confirmed. The data obtained in our study also indicate good results in correctly selected patients for surgical treatment — this is evidenced by an improvement in their quality of life. The criteria for including patients in our study are presented in the section "Materials and methods". And which patients can be considered "correctly selected"? This question remains relevant at the present time. T.W. Hamilton and co-authors in their prospective study evaluated a thousand operations of UKA and came to the conclusion that such contraindications as age up to 60 years, weight 82 kg and more are not absolute, and did not reveal differences in clinical results in groups of patients with 10-year endoprostheses survival [6]. On the contrary, according to J.F. Nettrour et al., the frequency of revisions in the morbid obesity group (BMI >40 kg / $m^2$) was 6 times higher than the frequency of revisions compared to the non-obese group. 85.7% of the causes of conversions in the group with morbid obesity were the progression of osteoarthritis in other parts of the knee joint or instability of the liner [7]. The same tendency to deterioration of the functional result and decrease in patient satisfaction with the quality of life in the postoperative period was obtained in our study in the form of a negative correlation between BMI and the functional result in our patients ($p = 0.027$; $R = -0.7$).

According to E.N. Hansen at el., in young patients, the survival of the endoprosthesis components and the functional result were worse than in older patients [8]. We obtained similar data and a direct dependence of patient satisfaction on the increase in the age at which the arthroplasty was performed: the older the people, the better the indicators of the scales. If patient in the early stages of gonarthrosis has a UKA performed on time, this most often leads to the cessation of the development of the disease in adjacent parts of the joint [9].

The advantages of UKA over TKA include: a smaller volume of bone resection; less surgical trauma; earlier and complete rehabilitation; achieving greater volume of movements; maintaining proprioception and normal kinematics of the knee joint; comparable results of TKA after UKA with primary TKA [10, 11, 12, 13]. However, according to recent studies, the results of replacing a unicondyle endoprosthesis with a total one are not as optimistic as previously thought. The functional results are influenced by the implant model, the reason for the revision, the size of the bone defect and the features of the surgical technique [14]. Another opinion on this issue is reflected in the article by D.S. Casper et al., who believe that functional results are better in patients with medial gonarthrosis after UKA than after TKA [15].

The indisputable advantage of UKA can be considered that after successfully performed and correctly positioned unicondylar endoprosthesis, the knee joint and its ligamemts continue to function for many years in a similar way to a healthy joint that has not been subjected to surgical treatment. This is stated in their study by D. Hollinghurst et al., who conducted a 10-year follow-up of patients who underwent UKA [9]. Similar evidence of this advantage can be found in the work of T. Walker et al. [16].

S.A. Banks et al. compare patients with UKA of the medial knee joint compartment

and patients who underwent UKA of the medial and lateral compartments, and the cruciate ligaments remained intact, with each other and with patients who underwent TKA. So, patients who underwent UKA of the medial and lateral compartments, due to the preserved cruciate ligaments, have a greater range of movements and better kinematics of the knee joint than patients after TKA, but less compared to patients who underwent UKA of the medial compartment. Patients with medial UKA have more dynamic and load-stable gait characteristics than patients of the other two groups [17].

The disadvantages of UKA include the inability to use it with simultaneous damage to several parts of the knee joint and instability of the ligamentous apparatus of the knee joint, pronounced contracture or angular deformation in the knee joint, the presence of pronounced patello-femoral arthrosis, rheumatoid and specific arthritis [18].

In their study, M.H. Song et al. report early complications after performing UKA. Four out of 100 patients had dislocation of the liner — the solution to the problem was to replace the liner with more thick one [19]. In their article, N.N. Kornilov et al. cite one case of dislocation of the mobile liner, which occurred 4 years after the surgery. The patient underwent a conversion surgery: replacement of the unicondylar endoprosthesis with a total one [20]. Such complication as dislocation of the liner occurs due to a violation of the balance of the flexor and extensor spaces [21]. The authors refer to the data that such a complication is detected after 12-17 months. In our study, one case of the liner dislocation was also identified. We performed a revision intervention 4 months after the operation and replaced the 3 mm liner with a 7 mm insert.

Also, according to N.N. Kornilov et al., up to 25% of revisions after UKA are carried out due to the progression of osteoarthritis in adjacent parts of the knee joint [20]. For a similar reason, 6 months after the initial operation of UKA, one patient in our study was converted to TKA with improved clinical and functional results.

It is worth noting that the works of other scientists present data that most complications after UKA occur in the first 5 years, which is associated with mistakes in determining the indications for this tactic of surgical treatment, as well as with a relatively small number of performed UKA compared to the number of TKA and insufficiently developed surgical technique when performing these operations [21, 22].

An example of good results and a 5-year survival rate of the UKA is a study by scientists from Korea [23]. According to T. Xu et al., the 6- and 8-year survival rate of the Oxford Phase-3 endoprosthesis was 97% and 93%, respectively [24], it should be noted that the study involved local residents with an average BMI = 24.7 kg/m$^2$. Various authors describe the 20-year survival rate of UKA, reaching up to 90% [25, 26, 27]. You can find data from scientists from France on the 26-year survival of components without performing revisions for any reason, which was 83% [28].

K.T. Kim et al. report a 10-year survival rate and good results of UKA in patients younger than 60 years of age [29]. This is due to the fact that such patients are able to recover faster and more fully after surgery, while they will be more active. Thus, according to scientists from Asia [4, 25], a good result can be due to a combination of factors that include anthropometric features of the population of the studied people. In their study, D. A. Crawford and co-authors did not find differences in the data after UKA in people with high and low activity [30].

The service life and survival of the endoprosthesis is greatly influenced by the wear of its components, this is stated by W. Harris in his study [31]. Every year, there is an improvement and modification of the types of implants that are able to withstand a greater number of friction cycles. According to B.J.

Kendrick et al., the polyethylene liner used in the Oxford endoprosthesis has long-term wear resistance. In their study, they showed that the thickness of the polyethylene liner decreased by an average of 0.4 mm over 20 years [32], which may have a favorable prognostic sign and suggests a minimum number of UKA revisions due to component wear. This was one of the factors in choosing the company of endoprosthesis implants for starting operations and mastering surgical tactics.

In our study, all operations were performed by one surgeon and two teams of assistants, which further led to an improvement in the learning curve, improved coordination of actions and reduced surgery time. An analysis of the early complications that led to revision showed that these surgeries were performed with more than a two-week interval. Moreover, as it turned out, they were performed last on the operating days and were the 3rd surgery for the same team with a preliminary operating time of more than 3 hours and a 3-hour outpatient appointment. The world literature describes studies that show the dependence of intraoperative complications on the fatigue of the surgeon [33], as well as on the time of the surgery beginning. R.R. Kelz et al. showed the dependence of complications on the time of the surgery beginning. It turned out that the beginning of surgeries from 16:00 to 18:00 hours is associated with an increase in complications compared to operations started in the first half of the working day, from 7:00 to 16:00 hours [34].

### *Limitations and prospects*

The limitation of this study is a relatively short follow-up period, which at this stage did not affect the results.

Prospects of the study: further monitoring of patients is required in order to assess the long-term results and clarify the indications for surgery.

## Conclusion

Adequate selection of patients with early stages of the knee joint medial compartment osteoarthritis, timely implementation of UKA allows you to slow the progression of arthrosis in other departments and within 3 months from the moment of surgery to improve the quality of life of patients and regain lost motor activity.

Analyzing the data obtained on the frequency of complications that led to revision, and the data of the time interval in weeks after the previous UKA, we came to the conclusion that the surgeon should perform at least one primary UKA per week. The improvement of the operating technique, the analysis of mistakes and the regularity of the surgeries performed will allow to minimize the number of complications in the future.

### *Informed consent*

The patients gave their voluntary informed consent to participate in the study and publish their clinical observations.

## References

1. Murphy L., Schwartz T.A., Helmick C.G., Renner J.B., Tudor G., Koch G. et al. Lifetime risk of symptomatic knee osteoarthritis. *Arthritis Rheum.* 2008;59(9):1207-1213. doi: 10.1002/art.24021.
2. Cao Z., Mai X., Wang J., Feng E., Huang Y. Unicompartmental Knee Arthroplasty vs High Tibial Osteotomy for Knee Osteoarthritis: A Systematic Review and Meta-Analysis. *J Arthroplasty.* 2018;33(3):952-959. doi: 10.1016/j.arth.2017.10.025.
3. Sikorski J.M., Sikorska J.Z. Relative risk of different operations for medial compartment osteoarthritis of the knee. *Orthopedics*. 2011;34(12):e847-854. doi: 10.3928/01477447-20111021-04.
4. Fisher N., Agarwal M., Reuben S.F., Johnson D.S., Turner P.G. Sporting and physical activity following Oxford medial unicompartmental knee arthroplasty. *Knee*. 2016;13:296-300. doi: 10.1016/j.knee.2006.03.004.
5. Walker T., Streit J., Gotterbarm T., Bruckner T., Merle C., Streit M.R. Sports, physical activity and patient-reported outcomes after medial unicompartmental knee arthroplasty in young patients. *J Arthroplasty.* 2015;30:1911-1916. doi: 10.1016/j.arth.2015.05.031.
6. Hamilton T.W., Pandit H.G., Jenkins C., Mellon S.J., Dodd C.A.F., Murray D.W. Evidence-Based Indications for Mobile-Bearing Unicompartmental Knee Arthroplasty in

a Consecutive Cohort of Thousand Knees. J *Arthroplasty*. 2017;32(6):1779-1785. doi: 10.1016/j.arth.2016.12.036.
7. Nettrour J.F., Ellis R.T., Hansen B.J., Keeney J.A. High Failure Rates for Unicompartmental Knee Arthroplasty in Morbidly Obese Patients: A Two-Year Minimum Follow-Up Study. *J Arthroplasty*. 2020;35(4):989-996. doi: 10.1016/j.arth.2019.11.003.
8. Hansen E.N., Ong K.L., Lau E., Kurtz S.M., Lonner J.H. Unicondylar Knee Arthroplasty Has Fewer Complications but Higher Revision Rates Than Total Knee Arthroplasty in a Study of Large United States Databases. *J Arthroplasty*. 2019;34(8):1617-1625. doi: 10.1016/j.arth.2019.04.004.
9. Hollinghurst D., Stoney J., Ward T., Gill H.S., Newman J.H., Murray D.W., Beard D.J. No deterioration of kinematics and cruciate function 10 years after medial unicompartmental arthroplasty. *Knee*. 2006;13(6):440-444. doi: 10.1016/j.knee.2006.07.001.
10. Kornilov N.N., Kulyaba T.A., Phedorov R.E. [Recent view at unicompartmental knee arthroplasty among other surgical approaches to patients with knee osteoarthritis]. *Travmatologiya i ortopediya Rossii* [Traumatology and Orthopedics of Russia]. 2012;(1):113-120. (In Russian). doi: 10.21823/2311-2905-2012-0-1-138-144.
11. Weale A.E., Halabi O.A., Jones P.W., White S.H. Perceptions of outcomes after unicompartmental and total knee replacements. *Clin Orthop Relat Res*. 2001;(382): 143-153. doi: 10.1097/00003086-200101000-00021.
12. Siman H., Kamath A.F., Carrillo N., Harmsen W.S., Pagnano M.W., Sierra R.J. Unicompartmental Knee Arthroplasty vs Total Knee Arthroplasty for Medial Compartment Arthritis in Patients Older Than 75 Years: Comparable Reoperation, Revision, and Complication Rates. *J Arthroplasty*. 2017;32(6):1792-1797. doi: 10.1016/j.arth.2017.01.020.
13. Friesenbichler B., Item-Glatthorn J.F., Wellauer V., von Knoch F., Casartelli N.C., Maffiuletti N.A. Short-term functional advantages after medial unicompartmental versus total knee arthroplasty. *Knee*. 2018;25(4):638-643. doi: 10.1016/j.knee.2018.04.009.
14. Zuo W., Ma J., Guo W., Zhang Q., Wang W., Liu Z. Comparison of the clinical outcomes of revision of failed UKAs to TKAs with primary TKAs: A systematic review and meta-analysis. *Medicine (Baltimore)*. 2018;97(50):e13408. doi: 10.1097/MD.0000000000013408.
15. Casper D.S., Fleischman A.N., Papas P.V., Grossman J., Scuderi G.R., Lonner J.H. Unicompartmental Knee Arthroplasty Provides Significantly Greater Improvement in Function than Total Knee Arthroplasty Despite Equivalent Satisfaction for Isolated Medial Compartment Osteoarthritis. *J Arthroplasty*. 2019;34(8):1611-1616. doi: 10.1016/j.arth.2019.04.005.
16. Walker T., Hetto P., Bruckner T., Gotterbarm T., Merle C., Panzram B. et al. Minimally invasive Oxford unicompartmental knee arthroplasty ensures excellent functional outcome and high survivorship in the long term. *Knee Surg Sports Traumatol Arthrosc*. 2019;27(5):1658-1664. doi: 10.1007/s00167-018-5299-2
17. Banks S.A., Fregly B.J., Boniforti F., Reinschmidt C., Romagnoli S. Comparing in vivo kinematics of unicondylar and bi-unicondylar knee replacements. *Knee Surg Sports Traumatol Arthrosc*. 2005;13(7):551-556. doi: 10.1007/s00167-004-0565-x.
18. Firsov S.A., Gagarin V.V. [Analysis of the unicompartmental knee arthroplasty results]. *Travmatologiya i ortopediya Rossii* [Traumatology and Orthopedics of Russia]. 2015;(2):99-105. (In Russian).
19. Song M.H., Kim B.H., Ahn S.J., Yoo S.H., Lee M.S. Early complications after minimally invasive mobile-bearing medial unicompartmental knee arthroplasty. *J Arthroplasty*. 2009;24(8):1281-1284. doi: 10.1016/j.arth.2009.07.012.
20. Kornilov N.N., Kulyaba T.A., Fedorov R.E. [Causes of revision surgery after unicompartmental knee arthroplasty]. *Travmatologiya i ortopediya Rossii* [Traumatology and Orthopedics of Russia]. 2013;(1):12-18. (In Russian). doi: 10.21823/2311-2905-2013--1-12-18.
21. Murray D.W., Liddle A.D., Dodd C.A., Pandit H. Unicompartmental knee arthroplasty: is the glass half full or half empty? *Bone Joint J*. 2015;97-B(10 Suppl A):3-8. doi: 10.1302/0301-620X.97B10.36542. Erratum in: *Bone Joint J*. 2015;97-B(12):1732. Liddle A. [corrected to Liddle A.D.].
22. Vasso M., Antoniadis A., Helmy N. Update on unicompartmental knee arthroplasty: Current indications and failure modes. *EFORT Open Rev*. 2018; 3(8):442-448. doi: 10.1302/2058-5241.3.170060.
23. Kim Y.J., Kim B.H., Yoo S.H., Kang S.W., Kwack C.H., Song M.H. Mid-term results of oxford medial unicompartmental knee arthroplasty in young asian patients less than 60 years of age: a minimum 5-year follow-up. *Knee Surg Relat Res*. 2017;29:122-128. doi: 10.5792/ksrr.16.045.
24. Xu T., Lao Y., Wang J., Liu F., Xiao L., Tong P. Mid-term results of Oxford phase-3 medial unicompartmental knee arthroplasty for medial arthritis in Chinese patients. *ANZ J Surg*. 2017;87(4):287-290. doi: 10.1111/ans.13764.
25. Koshino T., Sato K., Umemoto Y., Akamatsu Y., Kumagai K., Saito T. Clinical results of unicompartmental arthroplasty for knee osteoarthritis using a tibial component with screw fixation. *Int Orthop*. 2015;39(6): 1085-1091. doi: 10.1007/s00264-014-2564-y.
26. Vasso M., Del Regno C., Perisano C., D'Amelio A., Corona K., Schiavone Panni A. Unicompartmental knee arthroplasty is effective: ten year results. *Int Orthop*. 2015;39(12):2341-2346. doi: 10.1007/s00264-015-2809-4.
27. Yoshida K., Tada M., Yoshida H., Takei S., Fukuoka S., Nakamura H. Oxford phase 3 unicompartmental knee arthroplasty in Japan - clinical results in greater than one thousand cases over ten years. *J Arthroplasty*. 2013;28(9 Suppl):168-171. doi: 10.1016/j.arth.2013.08.019.
28. Ollivier M., Jacquet C., Lucet A., Parratte S., Argenson J.N. Long-Term Results of Medial Unicompartmental Knee Arthroplasty for Knee Avascular Necrosis. *J Arthroplasty*. 2019;34(3):465-468. doi: 10.1016/j.arth.2018.11.010.
29. Kim K.T., Lee S., Lee J.S., Kang M.S., Koo K.H. Long-Term Clinical Results of Unicompartmental Knee Arthroplasty in Patients Younger than 60 Years of Age: Minimum 10-Year Follow-up. *Knee Surg Relat Res*. 2018;30(1):28-33. doi: 10.5792/ksrr.17.025.
30. Crawford D.A., Adams J.B., Lombardi A.V. Jr., Berend K.R. Activity Level Does Not Affect Survivorship of

Unicondylar Knee Arthroplasty at 5-Year Minimum Follow-Up. *J Arthroplasty.* 2019;34(7):1364-1368. doi: 10.1016/j.arth.2019.03.038.
31. Harris W.H. Wear and periprosthetic osteolysis: the problem. *Clin Orthop Relat Res.* 2001;(393):66-70. doi: 10.1097/00003086-200112000-00007.
32. Kendrick B.J., Simpson D.J., Kaptein B.L., Valstar E.R., Gill H.S., Murray D.W., Price A.J. Polyethylene wear of mobile-bearing unicompartmental knee replacement at 20 years. *J Bone Joint Surg Br.* 2011;93(4):470-475. doi: 10.1302/0301-620X.93B4.25605.
33. Peskun C., Walmsley D., Waddell J., Schemitsch E. Effect of surgeon fatigue on hip and knee arthroplasty. *Can J Surg.* 2012;55(2):81-86. doi: 10.1503/cjs.032910.
34. Kelz R.R., Freeman K.M., Hosokawa P.W., Asch D.A., Spitz F.R., Moskowitz M. et al. Time of day is associated with postoperative morbidity: an analysis of the national surgical quality improvement program data. *Ann Surg.* 2008;247(3):544-552. doi: 10.1097/SLA.0b013e31815d7434.

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