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**Original article**

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# *Comparison of results of the anterior cruciate ligament reconstruction of the knee joint using peroneus longus tendon autograft or patellar tendon autograft with two bone blocks*

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***Abstract***

**Introduction** Growing knowledge and understanding of the biomechanics and kinematics of the knee are prompting the search for new surgical techniques and new ACL grafts. **Purpose** Evaluation of the medium-term results of primary arthroscopic reconstruction of the anterior cruciate ligament of the knee using peroneus longus tendon autograft and comparing the results with the control group of patients who underwent primary arthroscopic reconstruction of the anterior cruciate ligament using patellar tendon autograft with two bone blocks. **Materials and methods** 108 patients were operated on in 2017-2018. They were divided into two groups. 55 patients underwent reconstruction of ACL using peroneus longus ligament autograft – group 1 (study group). 53 patients underwent reconstruction of ACL using patella tendon autograft – group 2 (control group). Evaluation of the knee joint function was based on clinical examination, medical history, results of functional tests, MRI results, on the data of instrumental diagnostic methods (CT-1000) after the surgical treatment, patient responses when filling out scales before surgery and two years after the surgery (Tegner Lysholm, IKDC). Additionally, the patients of the study group underwent a study on a plantograph before surgery and 24 months after it. Postoperative evaluation was also performed using the AOFAS scale. **Results** In group 1, the average score on the Tegner Lysholm scale before surgery was 69.2 ± 10.7 points, after surgery – 92.2 ± 10.4 points; on the IKDC scale before surgery – 68.2 ± 10.6 %, after surgery – 90.1 ± 9.5 %. KT-1000 – 3.7 ± 1.4 mm, AOSAF – 95.3 ± 7.5 %. An autograft rupture within 2 years after the surgery was detected in 4 out of 50 patients, which amounted to 8 %. Measurements on the PKS-01 plantograph 24 months after the operation did not reveal changes in the arch of the foot. In group 2, the average score on the Tegner Lysholm scale before surgery was 70.2 ± 11.6 points, after surgery it was 94.3 ± 8.7 points. The mean value on the IKDC scale before surgery was 68.6 ± 8.7 %, after surgery it was 91.5 ± 8.2 %. KT-1000 – 3.4 ± 1.2 mm. Autograft rupture within 2 years after the surgery was detected in 3 out of 50 patients, which amounted to 6 %. **Conclusion** The results of the operations performed in the two groups can be assessed as good, no statistically significant differences were found, which indicates that the peroneus longus tendon autograft is an alternative option for primary ACL repair.

***Keywords***: anterior cruciate ligament, plasty, peroneus longus tendon, patellar tendon, knee joint, instability

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Rupture of the anterior cruciate ligament (ACL) is one of the most common knee injuries in physically active people [1], and the history of arthroscopic ACL repair has more than 30 years [2, 3]. In modern surgical practice, there are many surgical techniques, grafts and methods for their fixation in bone canals. It is believed that the grafts of choice in the primary repair of the ACL are autografts from the tendons of the gracilis and semitendinosus muscles and the patellar tendon with two bone blocks (BTB) [4, 5]. However, as with the use of any autograft, along with the advantages, there are also disadvantages, for example, the use of the BTB graft has high rates of pain in the anterior part of the knee joint, at the site of graft donor site (in 60 % of cases), the risk of developing osteoarthritis and rupture of the ACL of the contralateral limb [6]. The use of an autograft from the tendons of the gracilis and semitendinosus muscles can cause muscle imbalance between the flexor and extensor muscles of the leg, which increases the risk of autograft rupture [7, 8].

ACL xeno- and allografts are used less often in practice due to various reasons, such as an increased risk of graft rupture, remaining residual Lachman and pivot-shift in the long-term and high cost [9–14]. Growing knowledge and understanding of the biomechanics and kinematics of the knee joint motivate the search for new surgical techniques aimed at preserving the dynamic stabilizers of the knee joint. One of the promising options for ACL autograft is the peroneus longus tendon (PLT). This graft has a number of advantages, such as harvesting speed, graft thickness, no effect on the dynamic stabilizers of the knee joint – these properties help to avoid complications associated with the harvesting of the above autografts, allowing it to be used in arthroscopic ACL repair [15, 16]. However, nowadays in Russia and over the world, the possibilities of using

this autograft in arthroscopic ACL reconstruction and the effect of the graft harvesting on foot function have not been studied sufficiently, and therefore this topic requires further studies .

**The aim of the study** was to evaluate the medium term results of primary arthroscopic repair of the anterior cruciate ligament of the knee joint using an autograft from the tendon of the peroneus longus muscle and compare the results with the control group of patients who received primary arthroscopic repair of the anterior cruciate ligament using an autograft from the patellar tendon with two bone blocks.

## MATERIAL AND METHODS

Type of the study: monocentric prospective longitudinal randomized comparative controlled study.

In the period from 2017 to 2018, 108 patients who met the inclusion criteria for the study were operated on:

55 patients who received treatment including arthroscopic reconstruction of the ACL using an autograft from the tendon of the peroneus longus muscle – group 1 (study);

53 patients who received treatment including arthroscopic reconstruction of the ACL with an autograft from the patellar tendon with two bone blocks – group 2 (control).

The type of the autograft was chosen randomly. Both groups of patients were operated on in turn using the mentioned autografts without reference to any criteria.

The surgical treatment was performed using the same technique, instruments and consumables.

Inclusion criteria for the patients:

- exercising not less than three times a week;
- no medical history of injuries or ankle instability (group 1);
- age from 18 to 50 years;
- absence of any surgical interventions in the operated knee joint;
- consent for MRI of the knee before the surgical treatment;
- absence of neurological and psychiatric disorders;
- consent for filling out questionnaires and participation in the study.

Exclusion criteria for the patients:

- bilateral flatfoot 3–4 group (group 1);
- multi-ligamentous injuries;
- full-flap defect of the knee joint articular cartilage.

The evaluation of the knee joint function in two groups was based on a clinical examination, collecting an anamnesis of life and disease, the results of clinical tests, an assessment of the results of MRI, on the data of instrumental diagnostic methods (CT-1000) after surgical treatment, the responses of patients when filling out the scales before surgery and after two years after surgery (Lysholm Knee Questionnaire, IKDC-2000). Additionally, patients of the study group before surgery and 24 months after it underwent a study on a computer plantograph (PKS-01) with the calculation of the Chizhin and Schrieter index in order to assess the possible effect of taking an autograft from the tendon of the peroneus longus muscle on the arch of the foot – developing flat feet. Postoperative evaluation was also performed using the AOFAS scale.

**Statistical analysis**

The goals of this work included the calculation of average values with confidence intervals of such indices as Lysholm Knee Questionnaire, IKDC-2000, CT-1000 (after surgery) for both groups of patients (the main indicators are shown in Table 1).

The normality of distribution was tested using the one-sample Kolmogorov-Smirnov test (Table 2).

Table 1

Results of questionnaires

| Statistics | | Indices | | | |
|---|---|---|---|---|---|
| | | LKQ before surgery | LKQ after surgery | IKDC-2000 before surgery | IKDC-2000 after surgery |
| N | acceptable | 100 | 100 | 100 | 100 |
| | missed | 1 | 1 | 1 | 1 |
| Mean value | | 69.739 | 93.24 | 65.661 | 89.89 |
| Standard error of the average value | | 1.0878 | 0.9642 | 1.7108 | 1.2665 |
| Median | | 70 | 97 | 69.55 | 93.1 |
| Mode | | 63 | 100 | 67.8 [a] | 97.7 |
| Standard deviation | | 10.8779 | 9.6422 | 17.1084 | 12.6649 |
| Minimum | | 41 | 54 | 0 | 0 |
| Maximum | | 94 | 100 | 87.4 | 100 |
| Percentile | 25 | 63 | 90 | 59 | 88.5 |
| | 50 | 70 | 97 | 69.55 | 93.1 |
| | 75 | 78 | 100 | 76.725 | 96.6 |

*Note*: LKQ – Lysholm Knee Questionnaire; [a] – there are several modal values, the smallest value is shown.

Table 2

One-sample Kolmogorov-Smirnov test

| N | | LKQ before | LKQ after surgery | IKDC-2000 before surgery | IKDC-2000 after surgery |
|---|---|---|---|---|---|
| | | 100 | 100 | 100 | 100 |
| Parameters of normal distribution [a, b] | Mean value | 69.739 | 93.24 | 65.661 | 89.89 |
| | Mean root square deviation | 10.8779 | 9.6422 | 17.1084 | 12.6649 |
| The largest extremal difference | absolute | 0.088 | 0.242 | 0.151 | 0.232 |
| | positive | 0.074 | 0.242 | 0.108 | 0.212 |
| | negative | -0.088 | -0.185 | -0.151 | -0.232 |
| Statistics of the criterion | | 0.088 | 0.242 | 0.151 | 0.232 |
| Asymptotic significance (two-tailed) | | 0.055 [c] | 0.000 [c] | 0.000 [c] | 0.000 [c] |

*Note*: LKQ – Lysholm Knee Questionnaire; [a] – the tested distribution is normal; [b] – calculated from the data; [c] – correction of significance of Lilgefors.

In this case, at the 95 % confidence level, only LKQ data before the operation have a normal distribution. Since the rest of the indices are not normally distributed, the differences will be checked using non-parametric comparison methods. In this case, we use the Mann-Whitney test. Nonparametric comparison for independent samples (Table 3).

The average ranks for groups in the control group in the sample exceed the study group. Let's look at the significance of these differences (Table 4).

As we can see, at 95 % confidence level, there are no significant differences between the study and control groups (to confirm significant differences, the asymptotic significance indices should not exceed 0.05 at a 95 % confidence level).

Table 3

Mann-Whitney test

| | Group | N | Average rank | Rank sum |
|---|---|---|---|---|
| LKQ before surgery | control | 50 | 51.63 | 2581.5 |
| | study | 50 | 49.37 | 2468.5 |
| | Total | 100 | | |
| LKQ after surgery | control | 50 | 54.58 | 2729 |
| | study | 50 | 46.42 | 2321 |
| | Total | 100 | | |
| IKDC-2000 before surgery | control | 50 | 53.12 | 2656 |
| | study | 50 | 47.88 | 2394 |
| | Total | 100 | | |
| IKDC-2000 after surgery | control | 50 | 51.35 | 2567.5 |
| | study | 50 | 49.65 | 2482.5 |
| | Total | 100 | | |

*Note*: LKQ – Lysholm Knee Questionnaire

Table 4

Statistical criteria

| | LKQ before surgery | LKQ after surgery | IKDC-2000 before surgery | IKDC-2000 after surgery |
|---|---|---|---|---|
| U Mann-Whitney | 1193.5 | 1046 | 1119 | 1207.5 |
| W Wilcoxon | 2468.5 | 2321 | 2394 | 2482.5 |
| Z | -0.39 | -1.429 | -0.904 | -0.294 |
| Asymptotic significance (two-tailed) | 0.696 | 0.153 | 0.366 | 0.769 |

*Note*: LKQ – Lysholm Knee Questionnaire

Differences in the proportions of patients with recurrent rupture in the study and control groups were tested using the Z-test. We studied the relationship between the diameter of the bone canal in the study group and such anthropometric indicators as weight, height and age of the patient, which was carried out by calculating the Pearson correlation coefficient. Statistical processing was performed using Excel and SPSS software. The threshold of statistical significance is $p < 0.05$. All patients were included in statistical processing, including patients with complications in the postoperative period (rupture of the ACL autograft, development of instability of the ankle joint (for the study group), damage to the branch of the sural nerve (for the study group)).

In this case, at the 95 % confidence level only the preoperative Lysholm Knee Questionnaire data have normal distribution. Since the rest of the indices are not normally distributed, the differences were tested using non-parametric comparison methods – in this case, the Mann-Whitney test was used. The average ranks in the control group in the sample exceeded the studied one. At 95 % confidence level, there are no significant differences between the study and control groups. Regarding the statistics of cases of repeated graft rupture, the z-test is insignificant for these samples.

**Surgical technique**

Before restoration of the anterior cruciate ligament in patients of both groups, diagnostic arthroscopy was performed, the necessary treatment procedures was done (resection/suture of the menisci, excision of hypertrophied folds and hypertrophied synovial lining of the joint, preparation for formation of bone canals). At the end of treatment and diagnostic arthroscopy, the sampling of the autograft and the main surgical stage were done.

Surgical treatment of patients in group 1 (study) was carried out using a single-beam technique with the formation of anatomical canals through the anterior medial port. An autograft from the tendon of peroneus longus muscle of the ipsilateral lower limb was used to repair the ACL. The diameter of the bone canals depended on the diameter of the resulting graft. The graft was fixed using biodegradable interference screws (composite – "polylactic acid – hydroxyapatite"): the diameter of the screw corresponded to the diameter of the canal, the length was 25 mm for the femoral canal and 30 mm for the tibial canal.

To harvest the graft, the course of the tendon of the long peroneal muscle was determined by inversion of the foot, after which a skin incision was made along the course of the tendon along the posterior edge of the lateral malleolus, about 2 cm long (Fig. 1).

Using vascular scissors, the skin was mobilized in the proximal and distal directions along the tendon. The fascia was dissected, after which, with the help of a clamp (dissector, Billroth clamp), the tendon of peroneus longus muscle was isolated (Fig. 2).

**Fig. 1** Skin incision in projection of the tendon of peroneus longus muscle of the left tibia

**Fig. 2** Exposing the tendon of peroneus longus muscle of the left tibia using the instrument

It should be noted that the harvesting was done with an instrument with blunt branches in the ventral direction in order to prevent injury to adjacent anatomical structures, especially n. suralis. The tendon of the long peroneal muscle (PL) lies superficially relative to the tendon of the short peroneal muscle. A distinctive feature of the tendon of the short peroneal muscle is a shorter and thinner tendon part and the presence of muscle fibers at the level of the harvesting, which allows for a differential assessment in order to prevent error before suturing the graft (Fig. 3).

After exposing the tendon of the long peroneal muscle, the proximal part was sutured with a 25 mm Krakow suture, the distal part was sutured with a biodegradable suture, after which the tendon was cut between the sutured fragments. The distal part of the tendon of the long peroneal muscle was sutured to the tendon portion of the tendon of the short peroneal muscle. Using a stripper, the proximal part of the tendon was separated from the muscle and the graft was harvested (Fig. 4).

**Fig 3** Comparing the tendon of the long peroneal muscle and the tendon of the short peroneal muscle

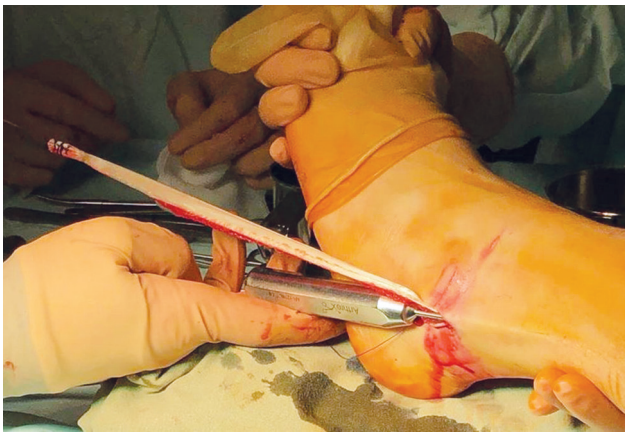

**Fig. 4** Harvesting the autograft from the tendon of the long peroneal muscle of the left tibia

Using biodegradable suture the fascia was sutured and after than the skin was sutured using non-biodegradable suture.

After the procedure of graft harvesting the assistant prepared the graft for implantation the following way: the muscular fibers were separated from the tendon; the graft was doubled; the proximal and two distal ends of the graft were fixed at the station of graft preparation. The 25-mm Krakow suture with a thread was used to suture the non-sutured portion; after than the 25-mm of the proximal part was sutured with the biodegradable thread 2/0 (Fig. 5). Then, the diameter of the graft was measured using the calibrator.

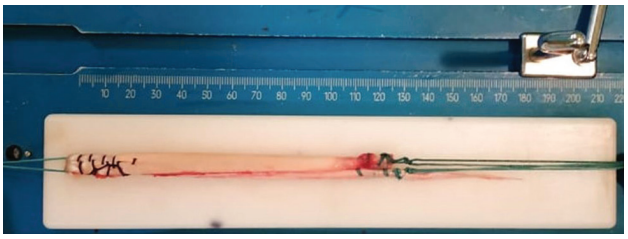

**Fig. 5** The ready-to-use autograft

At the same time the main surgeon was forming bone canals according to the technique described above. After the graft was ready it was put through the formed canals and fixed using biodegradable screws.

Surgical treatment of patients in group 2 (control) was done using the same technique as in group 1. For the ACL repair the autograft from the patella tendon was used with two bone blocks. In all cases the diameter of the bone canals was 10 mm. Fixation of the graft according to classical technique using biodegradable interference screws (composite – "polylactic acid – hydroxyapatite") of varying length: 8 × 25 mm for the femoral canal and 8 × 30 mm for the tibial canal.

**Postoperative care**

The protocol of postoperative management was the same in both groups of patients. The orthosis was not used in the early postoperative period. On the next day after the operation it was allowed to walk with full weight-bearing on the operated limb; flexion-extension in the operated joint in a pain-free range was also allowed. Patients were advised to stay at home for 3 weeks. By the sixth week after the operation, the patients of both groups had an angle of flexion in the knee joint of at least 90°. From the third month, the patients were allowed to run on a flat surface, in a straight line, without abrupt change in the direction of movement, and to exercise in the gym. The patients were recommended to resume sports activities after the restoration of the muscular corset of the thigh and the lower leg, on average, after 8 months. Patients came for follow-up examinations in 14, 30 days and then in 3, 6, 12 and 24 months after the surgery.

## RESULTS

*Group 1*

Out of the 55 patients included in this group, 50 patients were available for observation and follow-up examinations in the short-term and long-term postoperative periods. The average age of the patients was 33.4 ± 8.9 years; distribution by gender in the group was: 72 % of male patients, 28 % of female patients. Three patients were unavailable for communication and control examinations in the postoperative period. In 24 months after the operation, 7 out of 50 patients reported the appearance of edema at the site of graft harvesting during physical exercises. The next day after exercise, the edema got resolved. Also, in 2 patients, a portion of the sural nerve was damaged during graft sampling, which caused disorders of tactile sensitivity and paresthesia in the area of the 5$^{th}$ metatarsal bone. In 24 months after the surgery the neurological symptoms regressed; however, patients reported a permanent decrease in tactile sensitivity compared to the same area of the contralateral limb. At 24 months postoperatively, 6 out of 50 patients experienced minor pain and discomfort (1–2 points by pain VAS score) in the operated knee during exercise.

The average Lysholm Knee Questionnaire score was 69.2 ± 10.7 points before the surgery and 92.2 ± 10.4 points after the surgery. The mean value on the IKDC-2000 scale before the surgery was 68.2 ± 10.6 points, after the surgery it was 90.1 ± 9.5 points. CT-1000 according to the results of the surgical treatment was 3.7 ± 1.4 mm, AOFAS according to the results of surgical treatment was 95.3 ± 7.5 %.

Autograft rupture within 2 years after surgery was detected in 4 out of 50 patients, which was 8 %. For patients of both groups who were diagnosed with a rupture of the ACL autograft, the diagnosis was made at follow-up examinations, based on the data of objective and instrumental (according to CT-1000 tibial displacement of more than 5 mm) examinations, anamnesis, with a mandatory follow-up MRI study and confirmation of the diagnosis.

According to the results of the preoperative plantography, bilateral longitudinal-transverse flat foot of grades 1 and 2 was diagnosed in 12 patients, high arches – in 12 patients, and normal feet – in 26 patients. Measurements on the PKS-01 plantograph 24 months after the operation did not show any changes in the arch of the foot, which indicated the absence of an effect of the autograft harvesting from the tendon of the long peroneal muscle on the development of flat foot.

Also in this work, the Pearson correlation coefficient was calculated between the diameter of the bone canal depending on the diameter of the graft and such indices as the height, weight and age of the patient (the correlation index of the age, height, weight and diameter of the graft in the study group is shown in Table 5).

Table 5

The correlation index of the age, height, weight and diameter of the graft in the study group

| Index of correlation with the autograft diameter | Correlation coefficient |
|---|---|
| Correlation with age | 0.174 |
| Correlation with height | 0.234 |
| Correlation with weight | -0.001 |

As we can see, all coefficients do not exceed 0.3, so we can conclude that in this work there is no convincing connection between such anthropometric indices as the height, weight and age of the patient and the autograft diameter, and therefore, it is difficult to perform preoperative planning of the graft diameter and bone canals based on the above parameters.

*Group 2*

Out of 53 patients included into this group, 50 patients were available for observation and follow-up examination in the short-term and long-term postoperative periods. The average age of the patients was 27.9 ± 7.4 years; distribution by gender in the group was: 78 % of male patients, 22 % of female patients. Five patients were unavailable for communication and control examinations in the postoperative period. At 24 months postoperatively, 14 out of 50 patients experienced minor pain and discomfort (1–2 points by pain VAS scores) in the anterior knee joint during exercise.

The indicators were assessed using the Lysholm Knee Questionnaire and IKDC-2000 scales before and after surgical treatment, and in 24 months after the operation, the residual Lachman index was measured using CT-1000.

The average Lysholm Knee Questionnaire score was 70.2 ± 11.6 points before the surgery and 94.3 ± 8.7 points after the surgery. The average value on the IKDC-2000 scale before the surgery was 68.6 ± 8.7 points, after the surgery it was 91.5 ± 8.2 points. CT-1000 according to the results of the surgical treatment was 3.4 ± 1.2 mm.

Autograft rupture within 2 years after the surgery was observed in 3 out of 50 patients, which was 6 %.

*Evaluation*

Summing up, the results of the operations performed in the two groups can be assessed as good, no statistically significant differences were found, which indicates that the autograft from the tendon of the long peroneal muscle is an alternative option for the primary restoration of the ACL, which allows preserving the dynamic stabilizers of the knee joint. There was no tendency towards formation of flat foot.

## DISCUSSION

Surgical technique, mechanical features, long-term results when using autografts from the tendons of the gracilis and semitendinosus muscles and from the patellar tendon with two bone blocks are well studied, which is why the use of these types of grafts is predictable and gives good postoperative results [5, 17–20]. However, the question of the biomechanics of the knee joint after the surgery remains open. For example, harvesting an autograft using stabilizers of the knee joint can in future have negative effect on the knee function and the function of the entire lower limb: weakening of the strength of the flexors and extensors of the lower leg can lead to a decrease in the functional parameters of the knee joint in the postoperative period; and risks of damage to the graft are also possible [21]. Undoubtedly, the anatomical formation of bone canals and full rehabilitation reduce the risks, but the search and use of alternative autografts could possibly have some effect on reducing postoperative risks associated with the biomechanics of the knee joint itself. One of the alternative and, in some way, underestimated grafts, in our opinion, is the tendon of the long leg peroneal

muscle. This graft has been used for more than 10 years; but it has not become "popular" among surgeons. There are not many works on the study and application of this graft. So, in some studies, mid-term results were assessed after arthroscopic repair of the ACL using an autograft from the tendon of the long peroneal muscle in groups of patients [15, 16, 22]. The results were rated as good and excellent, and there was a high rating of patient satisfaction with the results of the operation. There was no negative effect on the function of the foot and the ankle joint in the postoperative period. The authors of the studies recommend this graft for primary ACL repair. On the contrary, in the study of Angthong C. et al. the authors point to changes in the function of the ankle and foot in the postoperative period, which affects the quality of life of patients; as a result, the authors recommend using this autograft as an alternative, for example, in revision ACL reconstruction [23]. According to our observations, there were no changes in the function of the ankle joint and foot (development of instability of the ankle joint or the formation of flat foot) in the patients of the study group, the most common complaint after the operation was edema in the graft harvesting area, which in the vast majority of cases got resolved in a year after the operation. It is noteworthy that, according to our observations (the observations are not included into the work), the resolution of the edema occurred faster with active rehabilitation program under the supervision of a rehabilitation doctor and exercise therapy instructor. It is believed that harvesting the tendon of the long peroneal muscle does not lead to formation of instability of the ankle joint, since this structure is not a stabilizer of the joint; it is possible that the function of the tendon is partially preserved when the distal fragment is sutured to the tendon of the short peroneal muscle. The colleagues using this graft since 1997 reported partial regeneration of the tendon of the long peroneal muscle in the late postoperative period based on a control MRI study of the ankle joints and lower legs performed to compare the regenerative potential of the harvested tendon [24]. Song X. et al. gave an assessment of the thickness of the graft, where the average values of the doubled tendon varied within 8.3 mm; in combination with the length of the graft these indicators allow preoperative planning with a high "guarantee" of obtaining a graft with good qualities [25]. In another study, the average graft diameter was 8.56 mm; and using the method proposed by the authors, it is possible to determine the approximate graft diameter at the preoperative planning stage [26]. According to our observations, the thickness of the double folded graft varied and was on average 7.9 mm, but we did not reveal a correlation between such anthropometric parameters as height, weight, and age of the patient, which makes it impossible to conduct preoperative planning. However, it is likely that the diameter of the graft may depend on physical activity (the more athletic the person is, the thicker the graft is). The ease and speed of graft harvesting also requires attention, which affects the duration of the operation. A neurological complication was observed twice in our practice despite the uniform technique and the use of anatomical landmarks; it was probably caused by the anatomical features of n.suralis: during a year the patients had paresthesia and impaired tactile and temperature sensitivity in the region of the lateral surface of the 5th metatarsal bone with a tendency to gradual but incomplete regression of symptoms. These complications were associated with the individual topographic features of n.suralis. In our opinion, to prevent such complications, one should strictly observe the anatomical landmarks, follow the surgical technique, minimize the use of sharp clamps, and be vigilant when suturing the fascia and skin. In a study by Bi M. et al. the authors use the anterior portion of the tendon of the long peroneal muscle, folded four times, thereby preserving the portion of the tendon, avoiding a complete harvest of the tendon. Postoperative results were rated as excellent, with good functional parameters of both the knee and ankle joints in the postoperative period [16]. In our practice, we did not adhere to this technique; in order to preserve the partial function of the tendon of the long peroneal muscle, we sutured the distal fragment with a biodegradable thread to the tendon of the short peroneal muscle.

In the work of Kozhevnikov E.V. et al [27] arthroscopic repair of the ACL was performed in a group of 50 patients, 17 patients were available for postoperative follow-up, the authors obtained excellent postoperative results; the anatomical experiment revealed that the strength parameters of a double folded autograft from the tendon of the peroneus longus muscle correspond to a quadruple folded autograft from the tendons of the gracilis and semitendinosus muscles. The authors point out the advantage of this autograft in the form of intact dynamic stabilizers of the knee joint. However, in this study there is no comparison group, the group of patients is non-homogeneous in terms of concomitant intra-articular pathology, which could, like in our study, affect the final result.

## CONCLUSION

Results of the conducted study indicate that there was no significant difference in the treatment outcomes of patients in the study and control groups. So, it is possible to use autografts from the tendon of peroneus longus muscle in primary arthroscopic repair of the anterior cruciate ligament. There was no negative effect of harvesting of this graft on the ankle function and development of longitudinal-transverse flat foot in 24 months after the operation.

**Limitations of the study** This study included non-homogenous groups of patients in age, gender, anthropometric data, and concomitant injuries of the knee joint structures. For instance, the actions regarding pathology of the meniscus – suture or resection – can influence the final index "residual Lachman". Autografts used in two groups of patients also have differences (type of the graft, peculiarities of ligamentization, mechanical properties), which could affect the results and the course of the study. Further study is required in the groups of patients homogenous according to meniscus pathology, hypermobility and other indices.

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