

# Clinical and functional evaluation of primary anterior cruciate ligament reconstruction by using allograft

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## Abstract

**Background.** The reconstruction of the anterior cruciate ligament (ACL) of the knee joint is the gold standard in complete ACL rupture treatment. One of the central discussion topics is choice of graft.

**Objectives.** To assess the outcome of treatment after primary ACL reconstruction using allograft.

**Material and methods.** The study was a retrospective cohort study. Out of 372 male patients who had undergone primary unilateral intra-articular ACL reconstruction using strict inclusion and exclusion criteria, 61 patients who qualified for the study took part. Group I was made up of 31 patients with allograft, while Group II consisted of 30 patients involved with autograft. The Lachman test, Pivot–Shift test, Lysholm Knee Scoring scale, and 2000 International Knee Documentation Committee (IKDC) were used to evaluate the results. Follow-up time was 18 months.

**Results.** The knee joint regained anterior stability in subjective and objective assessments in all the patients in both groups. The subjective results were the following: in Group I,  $96.6 \pm 3.08$  points on the Lysholm scale and  $94.79 \pm 6.53$  points on the IKDC 2000 scale, while in Group II,  $98.00 \pm 1.9$  points on the Lysholm scale and  $94.81 \pm 5.6$  points on the IKDC 2000 scale. The group comparison of the results of the IKDC 2000 and Lysholm Scale obtained postoperatively showed no statistically significant differences between the 2 groups.

**Conclusions.** Primary ACL reconstruction using an allograft is an effective procedure to counteract instability of the anterior knee joint. Comparative analysis of the results of primary ACL reconstruction in the treatment of anterior knee instability using autograft or allograft gives grounds for the possibility of individual selection of graft depending on what the patient's expectations are.

**Key words:** anterior cruciate ligament, allograft, autograft, ACL reconstruction, knee arthroscopy

## Cite as

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## Background

The anterior cruciate ligament (ACL) of the knee joint plays a complex and integral role in stabilizing the knee joint, and resisting anterior displacement and excessive rotation of the tibia relative to the femur.<sup>1</sup> Reconstruction of the ACL of the knee joint<sup>2</sup> followed by a postoperative physiotherapeutic procedure<sup>3</sup> is the standard ACL injury treatment for individuals wishing to return to high-level sports activities. There is no gold-standard treatment option; however, for ACL reconstruction, and when choosing the technique, the surgeon's experience and numerous patient-specific factors, as well as cost and efficacy, are taken into account.<sup>4,5</sup> Available graft options include autografts and allografts, but synthetic ligaments can also be used. The autograft choices are the patellar, hamstring and quadriceps tendons, where allografts include the quadriceps, patellar, Achilles, hamstring, anterior, and posterior tibialis tendons, and the fascia lata.<sup>5</sup> The advantages of allografts include active complications, reduced morbidity rate at the harvest site, a more rapid postoperative recovery, lower incidence of postoperative arthrofibrosis, and lower postoperative pain.<sup>4,6</sup> At the same time, the use of allografts may come with higher rates of rupture, limited availability, delayed healing, and ligamentization in comparison to autografts, as well as the prospect of disease transmission and high price.<sup>7–9</sup> The synthetic materials used in ACL reconstruction are utilized to improve the strength and stability of the graft immediately after the reconstruction, reduce donor site incidence of disease and diminish the potential for disease transmission.<sup>1–3</sup> Differences in the above factors also determine the differences in moving forward with postoperative and rehabilitation proceedings. This is applicable to the time to relieve the operated limb, the necessity and duration of using an orthosis device, the degree of limitation of mobility in the orthosis device, the duration of each stage of both supervised and unattended rehabilitation, and the time to return to work, sport and other physical activities.<sup>2,3</sup>

The objective of this study was to analyze the results of treatment after primary ACL reconstruction using allograft.

## Material and methods

The study had a retrospective design. The assessment was performed in patients who had undergone ACL reconstruction at the eMKaMED Medical Center in Wrocław, Poland. The study was carried out at the Center of Rehabilitation and Medical Education according to the ethical guidelines and principles of the Declaration of Helsinki. All the participants in the present study were informed of its intent and what its approach was. The study was approved by the Bioethics Committee of the Wrocław Medical University and written informed consent forms were

signed by all of the participants prior to commencement of the study.

Patients were separated into 2 research groups. The 1<sup>st</sup> group consisted of patients operated on using the allograft, the 2<sup>nd</sup> group included patients operated on using the autograft. Of the 372 primary ACL reconstruction procedures performed in this period, on 55 patients an allograft procedure was implemented, which represents 14.8% of all patients. A total of 299 patients were operated on with autografts, representing 80.4%. Eighteen patients (4.8%) were operated on using synthetic ligaments.

From the group of patients who underwent primary ACL reconstruction using autografts and allografts, patients were deemed eligible for the study based on the following criteria:

Inclusion criteria: knee instability confirmed with clinical examination; age 20–50 years; magnetic resonance imaging (MRI) confirmed the complete ACL rupture; no history of previous injuries to the operated limb; 1 stage surgery performed 6–9 weeks after initial injury; surgery performed by the same surgical team using the same method and the same rehabilitation program.

Exclusion criteria: patients operated on immediately after the injury; injuries involving multiple ligaments; accompanying injuries of menisci and cartilage surfaces requiring supply during surgery.

Thirty-six patients operated on with allograft met these criteria. During the study, 4 patients stopped reporting for follow-up examinations, and 1 patient after returning to physical exertion about 14 months after ACL reconstruction surgery suffered another injury with graft rupture. Ultimately, Group I consisted of 31 patients undergoing ACL reconstruction using an allograft, including 23 men and 8 women. The average age was 37.8 years. The left knee joint was operated on in 18 cases, the right knee joint in 13 cases.

From patients who met the above criteria and were undergoing ACL reconstruction using hamstrings, a control group was selected that was demographically and statistically similar to the research group. One patient did not report for the final follow-up examination 18 months after the surgery due to being abroad.

Group II of patients with hamstrings operated on consisted of 30 patients, including 23 men and 7 women. The average age was 30.4 years. Left knee joint was operated on in 14 cases, right knee joint in 16 cases.

## Surgical procedures

The arthroscopic procedure for reconstruction of the ACL was employed for all grafts. After ACL rupture was confirmed (Fig. 1), the autograft was dissected (Fig. 2,3) and drawn out (Fig. 4) or an allograft was prepared (Fig. 5).

The outside-in technique employing the transtibial technique was utilized for reconstruction. The tibial tunnel

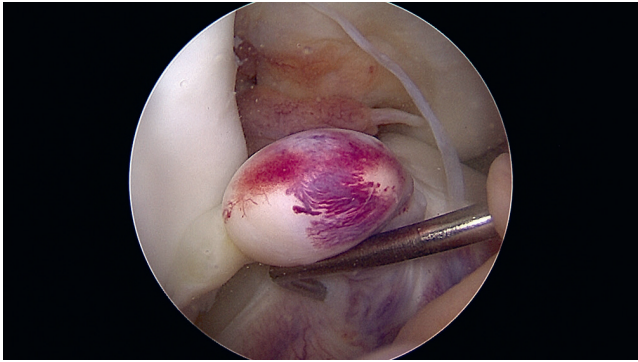


Fig. 1. Arthroscopic image. Right knee joint. View of complete rupture of the distal stump of anterior cruciate ligament



Fig. 4. Cleaned hamstring tendons

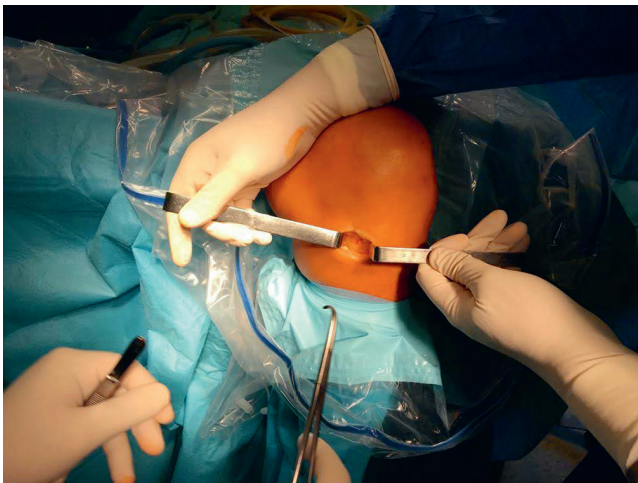


Fig. 2. Intraoperative picture. Left knee joint. Hamstring tendon preparations

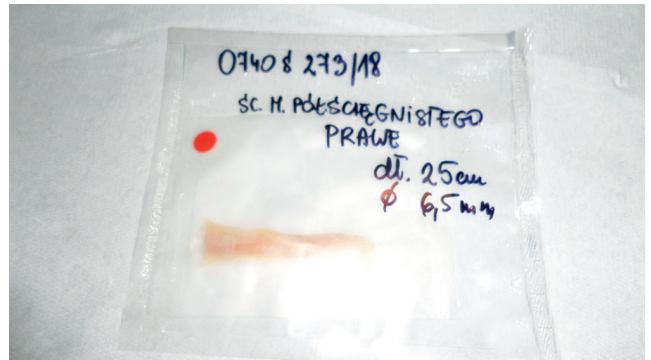


Fig. 5. Freezer allograft from Achilles tendon



Fig. 3. Intraoperative picture. Left knee joint. Isolated tendon, cut off from distal insertion

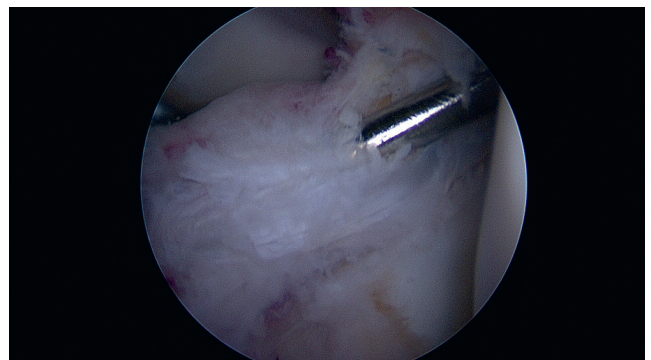


Fig. 6. Arthroscopic image. Left knee joint. K-wire coming out of the tibial footprint

guide pin was placed at the center of the ACL footprint using an ACL guide set at about 65° to the tibial plateau on the sagittal plane (Fig. 6). Then, the guide pin was then over-reamed with a drill. In the next step, a guide pin was drilled from the isometric point across the femur and out the lateral thigh. The autograft/allograft was inserted

through the tunnels and fixed on the femoral side with an interference screw and tensioned (Fig. 7,8). Fixation on the tibial side was performed using an interference screw at 20° of flexion with a posterior drawer force applied to the tibia.

### Choosing the type of transplant by the patient

After qualifying the patient for surgical treatment based on the above criteria and their consent to this method of treatment, the choice of graft was discussed with the patient. The final decision with regard to the graft was made by the patient after the operating physician presented



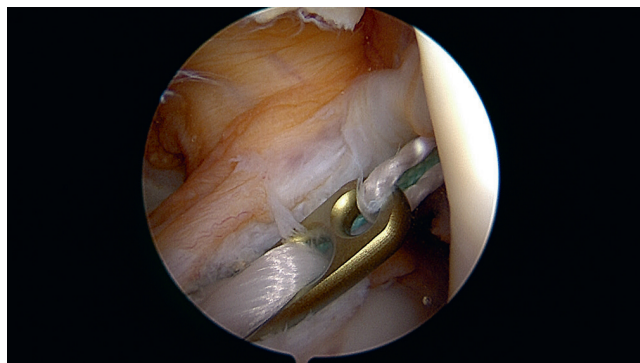


Fig. 7. Arthroscopic image. Left knee joint. View of the Endobutton and loop pull graft into the femoral canal

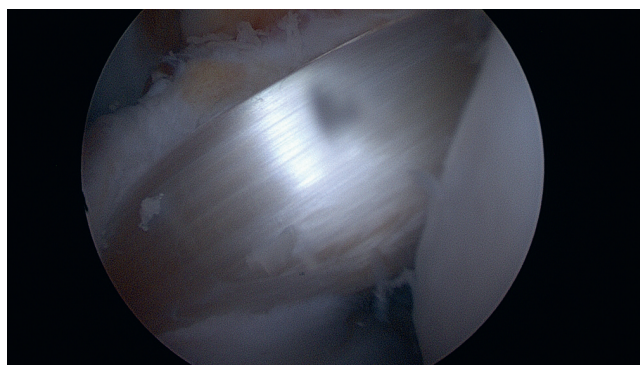


Fig. 8. Arthroscopic image. Left knee joint. View of fixed allograft

the available options along with their advantages and disadvantages. The graft was attached using a Smith–Nephew Endobutton (Smith & Nephew, Warsaw, USA) on the femoral and the Biomet ComposiTCP30 (Zimmer Biomet, Warsaw, USA) interference screw was placed in the tibia.

## Evaluation methods

The first limb evaluated was a non-traumatic limb in order to assess its range of motion and stability, and to familiarize the patient with the examination technique.

Postoperative control examination took place on days 7, 14 and 28 after surgery. Stitches were removed during examination (in the case of reconstruction using the allograft usually on day 7, in the case of autografts on day 14). Stress relief and the use of orthosis were recommended for a period of 3 weeks, increasing the range of flexion in the orthosis in a 30°–60°–90° schedule every 7 days. The active range of motion (ROM) of the knee was measured bilaterally using a standard goniometer.<sup>10</sup> Anterior knee stability was evaluated manually using the Lachman test and anterior drawer test, in accordance with the ligament examination section of the 2000 International Knee Documentation Committee (IKDC).<sup>11</sup> The inter-limb difference in anterior tibial dislocation obtained from the Lachman test and anterior drawer test was rated as normal (0; 0–2 mm), nearly normal (1+; 3–5 mm), abnormal (2+; 6–10 mm), or severely abnormal (3+; >10 mm).<sup>11</sup> Anterolateral rotational knee

stability was assessed manually with the Pivot–Shift test. The Pivot–Shift test was considered negative when, according to the ligament examination section of the 2000 IKDC, the anterolateral rotational dislocation of the tibia relative to the femur was equal in both lower limbs and positive when the difference between the limbs was rated as + (glide), ++ (clunk) or +++ (gross).

## Statistical analysis

Statistical analysis was performed using the TIBCO Statistica™ program (TIBCO Software Inc., Palo Alto, USA) and Microsoft Office Excel 365 Personal (Microsoft Corporation, Redmond, USA).

In the case of the characteristics of the tested material and analysis of the so-called feelings of “giving-way”, Lachman test, anterior drawer and Pivot–Shift test results, and in the analysis of postoperative complications, the number of patients (n) who obtained a given result in particular examined groups were determined. The percentage of the study group in which patients who obtained a given result was calculated through a comparison of the results between the study groups.

The arithmetic mean ( $\bar{x}$ ) and  $\pm$  standard deviation (SD) were calculated for the following parameters tested: active range of extension and flexion in the operated and non-operated limb [°], total number of points obtained on the Lysholm scale in the operated limb (n points) and total number of points obtained in the IKDC 2000 (n points). The Shapiro–Wilk test was performed to examine the normality of the distribution of the analyzed parameters. In the comparison of the values of the active range of extension and flexion obtained in the operated and non-operated limb, a parametric t-test was used for dependent groups. In comparison, within the same group, of the values of the active range of extension and flexion in the operated and non-operated limb scale obtained at particular intervals, a one-way analysis of variance (ANOVA) variance analysis was used followed by Tukey's post hoc test. To compare the examined groups, the values of the active range of extension and flexion in the operated and non-operated limb, the number of points obtained on the Lysholm scale in the operated limb and the number of points obtained in the IKDC 2000 at the same intervals parametric t-test for independent groups was used.

## Results

### Clinical evaluation results

Comparison of clinical tests in individual groups confirming clinical status before surgery is shown in Fig. 9. The results of knee “giving way”, the Lachman test, anterior drawer test, and Pivot–Shift test were negative in all cases after operation, meaning the knee was stable in both groups

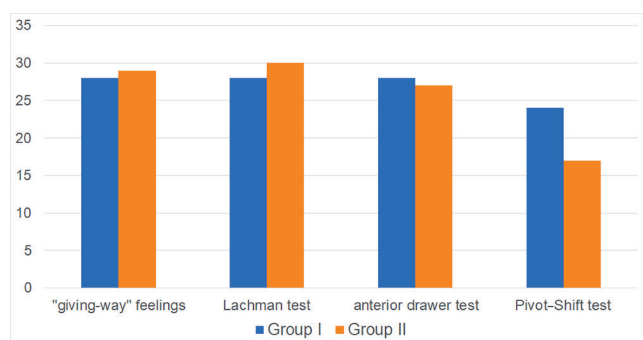


Fig. 9. Comparison of the results of "giving-way", Lachman test, anterior drawer test, and Pivot-Shift test in Group I and II before surgery index

in all cases. Statistically significant results were found in all tests comparing preoperative examination with examinations after 3, 6 and 18 months after surgery. No statistically significant differences were found when comparing results in an intergroup of 3, 6 and 18 months after reconstruction and in intergroups in identical study periods.

In Group I, the ROM of active knee extension before ACL reconstruction was statistically significantly lower ( $p = 0.005$ ) in the operated limb ( $x = 1.61 \pm 3.00^\circ$ ) compared to the non-operated limb ( $x = 0.00 \pm 0.00^\circ$ ). In the comparison of the obtained active extension range values in the operated limb in Group I, it was noted that there was a statistically significant difference in subsequent measurements ( $p \leq 0.001$ ) (Table 1).

In Group I, before surgery, the ROM of the active knee flexion in the operated limb ( $x = 113.23 \pm 8.32^\circ$ ) was statistically significantly smaller ( $p = 0.001$ ) than in the non-operated limb ( $x = 134.19 \pm 3.19^\circ$ ) as well as at 3 ( $p \leq 0.001$ ) and 6 ( $p \leq 0.001$ ) months after reconstruction. Also, the ROM in the 18<sup>th</sup> month after reconstruction was statistically significantly lower ( $p = 0.031$ ) than in the non-operated limb.

However, such a small difference in obtained values should not be regarded as being of clinical significance (Table 1).

In Group II before ACL reconstruction, the ROM of active extension in the operated limb ( $x = 2.07 \pm 3.08^\circ$ ) was statistically significantly lower ( $p \leq 0.001$ ) than in the non-operated limb ( $x = 0.00 \pm 0.00^\circ$ ). In the studies, ROM was comparable to the non-operated limb within 3, 6 and 18 months after surgery (Table 1).

In Group II before ACL reconstruction, the ROM of active flexion in the operated limb ( $x = 111.33 \pm 10.82^\circ$ ) was statistically significantly lower ( $p \leq 0.001$ ) than in the non-operated limb ( $x = 132.83 \pm 2.84^\circ$ ); similarly, within 3 and 6 months after the operation, there were no statistically significant differences ( $p = 0.129$ ) only after 18 months (Table 1).

The range of active extension movement in the operated limb in Group I statistically significantly increased in the 3<sup>rd</sup> month from the reconstruction of the ACL compared to the result obtained before the surgery ( $p \leq 0.001$ ). Between 3 and 6 months after surgery, the range of extension movement did not change statistically ( $p = 0.998$ ). There were no statistically significant differences between 6 and 18 months after surgery ( $p = 1.000$ ) (Table 2).

The ROM of active flexion in the operated limb in Group I demonstrated a statistically significant increase in the 3<sup>rd</sup> month after reconstruction of the ACL, compared to the result obtained before the surgery ( $p \leq 0.001$ ), and similarly, between 3 and 6 months ( $p \leq 0.001$ ) and between 6 and 18 months ( $p = 0.012$ ) (Table 2).

The ROM of active extension in the operated limb in Group II was statistically significantly larger ( $p = 0.003$ ) within 3 months after ACL reconstruction compared to the ROM before reconstruction. There were no significant changes in the operated limb from 3 months to 18 months after surgery (Table 2).

Table 1. Comparative analysis values of the measurement of the active flexion and extension in the operated and non-operated limb in Group I and II before reconstruction of the ACL and 3, 6 and 18 months after surgery

Variable	Group I			Group II		
	operated limb	non-operated limb	p-value	operated limb	non-operated limb	p-value
Extension [°]						
Before surgery	1.61 ± 3.00	0.00 ± 0.00	0.005	2.07 ± 3.08	0.00 ± 0.00	≤ 0.001
3 months after surgery	0.45 ± 1.31	0.00 ± 0.00	0.065	0.40 ± 1.30	0.00 ± 0.00	0.103
6 months after surgery	0.06 ± 0.36	0.00 ± 0.00	0.325	0.33 ± 1.27	0.00 ± 0.00	0.161
18 months after surgery	0.00 ± 0.00	0.00 ± 0.00	1.000	0.00 ± 0.00	0.00 ± 0.00	0.161
p-value	≤ 0.001	1.000	–	≤ 0.001	1.000	–
Flexion [°]						
Before surgery	113.23 ± 8.32	134.19 ± 3.19	≤ 0.001	111.33 ± 10.82	132.83 ± 2.84	≤ 0.001
3 months after surgery	121.94 ± 10.46	134.19 ± 3.19	≤ 0.001	114.50 ± 16.10	132.83 ± 2.84	≤ 0.001
6 months after surgery	128.55 ± 5.80	134.19 ± 3.19	≤ 0.001	126.00 ± 7.36	132.83 ± 2.84	≤ 0.001
18 months after surgery	133.23 ± 4.75	134.19 ± 3.19	0.031	131.67 ± 5.62	132.83 ± 2.84	0.129
p-value	≤ 0.001	1.000	–	≤ 0.001	1.000	–

Values expressed as the arithmetic mean and ±SD.

**Table 2.** Statistical significance analysis results of the measurement of the active flexion and extension in the operated limb in Group I and II at particular time intervals

Variable	Before surgery		3 months after surgery		6 months after surgery		18 months after surgery	
	Group I	Group II	Group I	Group II	Group I	Group II	Group I	Group II
Extension								
Before surgery	–	–	≤0.001	0.003	≤0.001	0.002	≤0.001	≤0.001
3 months after surgery	≤0.001	0.003	–	–	0.998	0.999	1.000	0.941
6 months after surgery	≤0.001	0.002	0.998	0.999	–	–	0.998	0.974
18 months after surgery	≤0.001	≤0.001	1.000	0.941	0.998	0.974	–	–
Flexion								
Before surgery	–	–	≤0.001	0.665	≤0.001	≤0.001	≤0.001	≤0.001
3 months after surgery	≤0.001	0.665	–	–	≤0.001	≤0.001	≤0.001	≤0.001
6 months after surgery	≤0.001	≤0.001	≤0.001	≤0.001	–	–	0.012	0.179
18 months after surgery	≤0.001	≤0.001	≤0.001	≤0.001	0.012	0.179	–	–

Values expressed as p (level of statistical significance).

**Table 3.** The value of anterior tibial translation in the operated limb in individual study groups between measurements and comparison between study groups

Anterior tibial translation [mm]			
Variable	Group I	Group II	p-value
Before surgery	7.30 ±2.57	7.67 ±2.55	0.571
3 months after surgery	1.81 ±0.70	1.65 ±0.70	0.009
6 months after surgery	1.83 ±0.66	1.58 ±0.65	0.020
18 months after surgery	1.79 ±0.72	1.66 ±0.74	0.021
p-value	≤0.001	≤0.001	–

Values expressed as the arithmetic mean and ±SD.

**Table 4.** The results of the comparative analysis of the value of the anterior tibial shift relative to the thigh in the operated limb in Group I and II between individual measurements

Anterior tibial translation [mm]								
Variable	before surgery		3 months after surgery		6 months after surgery		18 months after surgery	
	Group I	Group II	Group I	Group II	Group I	Group II	Group I	Group II
Before surgery	–	–	≤0.001	≤0.001	≤0.001	≤0.001	≤0.001	≤0.001
3 months after surgery	≤0.001	≤0.001	–	–	1.000	1.000	1.000	1.000
6 months after surgery	≤0.001	≤0.001	1.000	1.000	–	–	1.000	1.000
18 months after surgery	≤0.001	≤0.001	1.000	1.000	1.000	1.000	–	–

A comparison ROM of flexion in the operated limb in Group II showed a statistically significant difference in the measurements taken ( $p \leq 0.001$ ) (Table 2).

In Group I, the tibial translation in the operated limb was  $x = 7.30 \pm 2.57$  mm. After the ACL reconstruction, the translation statistically significantly decreased and amounted to  $x = 1.81 \pm 0.70$  mm when measured 3 months after the ACL reconstruction. In the following months, the anterior displacement of the tibia relative to the thigh was comparable at 6 and 18 months (Table 3).

In Group II, the anterior displacement in the operated limb was  $x = 7.67 \pm 2.55$  mm. After the ACL reconstruction, displacement statistically significantly decreased  $1.65 \pm 0.70$  mm when measured 3 months after the ACL

reconstruction. In the following months, the anterior displacement was comparable at 6 months and at 18 months after reconstruction.

By comparing the results of the tibial translation, statistical significance was demonstrated between surgical and postoperative treatment, while no statistical differences were found when comparing studies in a given research period both in Group I and II (Tables 3 and 4).

## Functional assessment results

Within 18 months of the reconstruction of the ACL, the average total number of points obtained on the Lysholm Group I scale was  $96.97 \pm 3.04$  points. In Group II, patients

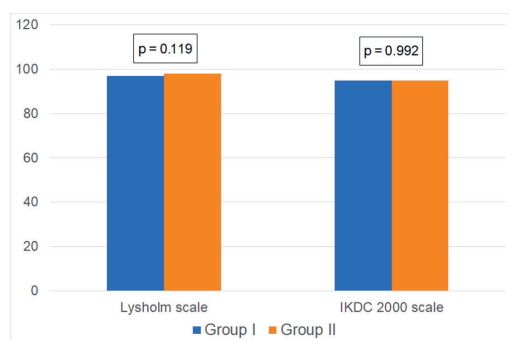


Fig. 10. Comparative analysis of the total number of points on the Lysholm scale and on the IKDC 2000 scale obtained in Group I and Group II

obtained an average of  $98.00 \pm 1.91$  points in the same period since surgery (Fig. 10). A comparative analysis of the results of the functional assessment based on the Lysholm scale did not show statistically significant differences ( $p = 0.119$ ).

Within 18 months of the reconstruction of the ACL, the average total number of points on the IKDC 2000 scale obtained in Group I was  $94.79 \pm 6.54$  points. In Group II, patients obtained an average of  $94.81 \pm 5.63$  points in the same period since surgery (Fig. 10). A comparative analysis of the results of the functional assessment did not show statistically significant differences between the examined groups ( $p = 0.992$ ).

## Discussion

Knee injuries are one of the most common injuries experienced during physical activity, resulting in the need for surgical treatment and a prolonged interruption in the ability to play sports.<sup>3,4</sup>

Statistics and numbers demonstrate the scale of the problem. In the USA alone, the number of cruciate ligament injuries is estimated to be at 250,000 per year, and the cost of diagnosis, treatment and rehabilitation is \$3 trillion.<sup>12,13</sup> No data could be found regarding the number of reconstructions of the ACL in Poland.

Many reports show different views of the researchers regarding the right time for surgical treatment, selection and method of graft attachment, method of bone canal preparation, or postoperative rehabilitation.<sup>10,11,14–22</sup>

The choice of surgical technique and method of graft attachment is usually the responsibility of the surgeon, depending on their preferences and previous experience.<sup>23</sup>

The choice of graft used as a transplant for reconstruction of the ACL also largely depends on the patient's choice and expectations. However, it should be taken into account that according to statistical studies, 74% of patients choose the transplant depending on the doctor's recommendation.<sup>24</sup>

Autograft effects described by other researchers<sup>25</sup> and also observed among patients at the medical center

in Wrocław, mainly related to their data collection, sparked the search for an alternative to a transplant autograft. The number of reports regarding the use of allografts in orthopedics is increasing. Up to 5 million allografts were performed in the USA in the last decade.<sup>25,26</sup>

The Achilles tendon and posterior (TP) and anterior (TA) tendons were used for an allograft. However, a small group of patients and a short observation period did not permit a comparison of their treatment results within the research group. Results published by other researchers show comparable results of treatment using allogeneic Achilles, ST, TA, and TP allografts. They also emphasize the fact that this gives greater freedom in the size of allograft.<sup>27</sup>

The average age of patients in the allograft group was 37.8 years, and 30.4 years in the autograft group. This is in line with the observations of other authors that the allograft is more often chosen by patients over 35 years of age who no longer compete in sports.<sup>28</sup> A more recent meta-analysis by Kaeding et al. observed the increase in the average age of patients operated on using the allograft, starting at 30 years of age during the years 2002–2003 to almost 40 years of age during the years 2008–2009, which, however, also significantly correlated with the decrease in graft bursts – from 11.7% during the years 2002–2003 to 3.7% during the years 2008–2009.<sup>29</sup>

The team at the medical center prepared the tibial canal with the outside-in technique, and the femoral canal was drilled with the transtibial technique. The treatment results in both groups show that it is a repeatable and effective surgical technique. This is in line with the observations of other researchers, showing comparatively good treatment results with this method with the technique of drilling through an additional medial portal.<sup>30–32</sup> However, other authors have indicated better treatment results in patients whose femoral canal was drilled through the medial portal.<sup>33</sup> Despite the use of the same surgical technique and the use of the same fixation methods, the average time of surgery in both groups was different. These data show that the selection of the graft for reconstruction had a direct impact on surgery duration. This difference is due to the need to take graft when using autografts. This coincides with the observations of other authors.<sup>16,25,34</sup> Based on the studies of Ericson et al. and Balasch et al.,<sup>35,36</sup> a Rolimeter was used for the quantitative study of anterior tibial displacement. In our opinion, this examination does not affect the choice of surgical technique, method of attachment or type of graft. It is useful in assessing postoperative improvement in knee stability. It can also be helpful in assessing the patient after re-injury to the knee after ACL reconstruction. The increase in tibial anterior translation after injury compared to the results of post-reconstruction control tests may be evidence of graft damage, which is difficult to assess with MRI.

In both groups, the range of active extension and flexion of the preoperative limb was similar and statistically



different from the range of the non-operated limb. In both groups, during control tests after 3, 6 and 18 months, statistically significant improvement in the ROM was observed, both in terms of extension and flexion. In the group of allografts and autografts in a study after 18 months, there was a smaller range of flexion of the operated to non-operated limb, but it was not clinically significant.

Analysis of the knee joint stability assessment using Lachman, front drawer, Pivot–Shift, and Rolimeter tests showed that proper knee joint stability was obtained in both groups. There was no difference in the results obtained between the 2 groups. Similar observations in their meta-analyses were described by Bottoni et al. and Jia et al.<sup>37,38</sup>

Subjective assessment of knee function in patients from both groups was made using the Lysholm scale and IKDC 2000. Comparative analysis did not show significant differences between the results of patients operated on using allografts and the results of patients operated on using autografts. Good subjective postoperative results were shown.

Our method was limited by the lack of biomechanical tests and a short observation period. In the future, our research requires a longer period of observation and analysis of possible issues of re-tearing of the graft and weakening of the flexor strength of the operated limb after primary reconstruction of ACL using hamstrings.


Today, many studies are underway to highlight genetic predisposition to cruciate ligament injuries. The ACL “suture” techniques require further research and more material. Research on the use of scaffolds, stem cells, platelet rich plasma, and xenografts are also setting new trends. All these current trends in the development of ACL surgery will allow for a more personalized method of surgical treatment, which will probably be presented to the patient as the choice of “à la carte” method of treatment.

## Conclusions

Primary ACL reconstruction using an allograft is an effective method to treat instability of the anterior knee joint. Comparative analysis of the results of primary ACL reconstruction in the treatment of anterior knee instability using autograft and allograft justifies the possibility of individual selection of the graft depending on the patient's expectations.

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