

Postoperative Therapeutic Effect of ACL Reconstruction at Different Periods

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Abstract

Objective: To analyze postoperative therapeutic effects of patients with fractured anterior cruciate ligament (ACL) that underwent autologous tendon reconstruction at early and late period. **Methods:** A total of 60 patients underwent autologous tendon reconstruction were enrolled and retrospectively analyzed via arthroscopes from December, 2015 to December, 2017 in our hospital, in which 30 patients treated with ACL reconstruction within 6 weeks of injury were selected as the early reconstruction group (Group A), and the other 30 cases with ACL reconstruction between 6 weeks and 6 months were as late reconstruction group (Group B); the therapeutic effect of early and late ACL reconstruction was analyzed by recording and comparing of several indexes, such as knee Lysholm score, knee IKDC score, intraoperative hemorrhage, operation time, pre- and post-operative range of motion (ROM) of the knee, etc. **Results:** The pre- and post-operative Lysholm scores and IKDC scores were compared between the two groups, without statistically significant results ($P > 0.05$). The knee ROM scores of the late reconstruction group were higher than those of the early group ($P < 0.05$), and the intraoperative blood loss in the late stage was less than that in the early group ($P < 0.05$), which exhibits that the short-term clinical efficacy of early and late arthroscopic autologous tendon reconstruction for knee ACL injury was similar, but the late reconstruction group was with less intraoperative bleeding, and better post-operative joint mobility recovery; in conclusion, it is recommended that patients can be operated between 6 weeks and 6 months after injury.

Keywords

Arthroscopes, Anterior Cruciate Ligament Reconstruction

1. Introduction

ACL is a main structure preventing anterior tibial movement, and ACL injury

refers to the rupture of ACL due to intense exercise or other external factors, resulting in instability of knee joint structure. In recent years, with the elevation of traffic accidents in China and the development of competitive sports, the incidence of ACL injury increases year by year. After ACL injury, the knee weakened, which seriously impacts on the patient's motor function; usually, it cannot heal itself; if treated late, the function of the knee joint will be in danger. At present, the most common and effective method is arthroscopic ACL reconstruction, but there still remains controversy over the best time to operate after injury, and some reported that delayed reconstruction of ACL will lead to an increase of the incidence of meniscus and cartilage injury as well as muscle strength loss. The incidence of knee joint osteoarthritis increases to about 15% - 20% after ACL tearing [1], and will induce 10% to 50% of patients with varying degrees of meniscus tearing when the ACL is torn [2] [3] [4]. In contrast, early ACL reconstruction can lead to joint fibrosis and joint stiffness, affecting later knee motion function recovery. Therefore, the best operation time of ACL reconstruction through clinical retrospective analysis was discussed in this paper.

2. Research Subjects

2.1. Data and Methods

Totally, 60 patients with autologous tendon reconstruction in our hospital in December 2017 were enrolled and underwent arthroscopes for retrospective analysis. Inclusion criteria: 1) preoperative MRI diagnosed of ACL rupture and further diagnosed of ACL fracture in intraoperative knee arthroscopy; 2) single knee joint injury, the offside knee joint is normal; 3) cooperation of postoperative rehabilitation; 4) postoperative follow-up over 12 months; 5) patients aged 20 - 50. Exclusion criteria: 1) patients combined with other knee joint ligament rupture; 2) combined with lower limb fracture or severe soft tissue injury; 3) patients with history of knee surgery; 4) patients who could not cooperate with the completion of rehabilitation after surgery; 5) less than 12 months of follow-up time, or incomplete follow-up.

2.2. Patient Grouping

All eligible patients were numbered, and each group was randomly selected from 30 patients. The patients were divided into 2 groups by the operation time after the injury patients applied ACL reconstruction within 6 weeks of injury were as the early group (Group A), and the other with ACL reconstruction between 6 weeks and 6 months were as late group (Group B); then the two groups of patients with knee Lysholm score, knee LKDC score, knee activity, intraoperative bleeding amount, as well as clinical indexes, such as operation time and thigh circumference margin were compared with, and all the patients were informed consent to experiment and treatment.

2.3. Basic Situation of the Patient

There were 30 cases of early reconstruction in two groups, including 18 males,

12 females, 8 cases of meniscus injury (26.7%) with average age of 34.4 ± 3.6 years, involving 15 cases of traffic accidents, 10 sports injury and others 5 cases. In the late reconstruction group, there were 30 cases, including 17 males, 13 females, of which 10 meniscus injury (33.3%) with average age of 36.2 ± 3.8 years, the cause of injury: 18 traffic accidents, 8 sports injury, others 4 cases; and no significant statistical difference in age and sex between the two groups ($P > 0.05$).

2.4. Patient Informed Consent

This study was approved by the Medical Ethics Committee of the hospital. All patients signed informed consent before surgery.

3. Therapeutic Method

3.1. Surgical Methods

All patients were applied epidural anesthesia, and completely operated by senior surgeons in the same group, after successful anesthesia, the patient was in prostration with a pneumatic tourniquet on the thigh of the affected limb, then routine disinfection, paving, connecting the arthroscopic system and dialogued successfully, elevating the influenced limbs, expelling blood with repellent belt, tourniquet inflation, intraoperative pressure maintained 55 Kpa. The affected limb knees 90 degrees, with the patellar ligament next to do 0.5 cm straight incision to the joint sac, then rinse liquid (0.9% saline 6000 ml) perfusion joint cavity; the planning system cleared the field of operation, explored anterior, posterior cruciate ligament, medial and lateral menisci, and diagnosed and repaired or removed the damaged menisci (see **Figure 1**). On the medial side of the tibial nodule of the affected knee, about 3 - 4 cm incision was made, and the femoral thin muscle and semitendinosus were cut and dissociated in turn, the tendon was removed and woven, the prepared ligament was stacked into 4 bundles; the tibial end and femur diameter were measured with the sleeve; the value was recorded, and the ligament was wound with saline gauze for preparation. The ACL locator locates the posterior cruciate ligament intercondylar stop point (see **Figure 2**), drilling into the guide needle and expanding the bone tunnel next to the tibial nodule, the position of the guide needle can be seen under the scope, and then the guide needle is positioned and the bone tunnel is expanded with the posterior lateral condyle of the femur, and the position of the bone tunnel can be seen under the scope, and the braided ligament will be connected to the locking belt loop (see **Figure 3**). The femur side is fixed with a loop titanium plate, the tibia side with interfacial screws, the knee joint of the patients is repeatedly activated to observe whether there is intercondylar fossa, if there is, applying intercondylar fossa plasty; the front and rear drawer experiments are negative, the lateral stress test is negative, the knee joint is stable, the wound is stitched by layer and the gauze bandage is pressurized, recorded the transoperative bleeding amount and returned to the ward.

The surgical procedure is as shown in **Figures 1-4**.

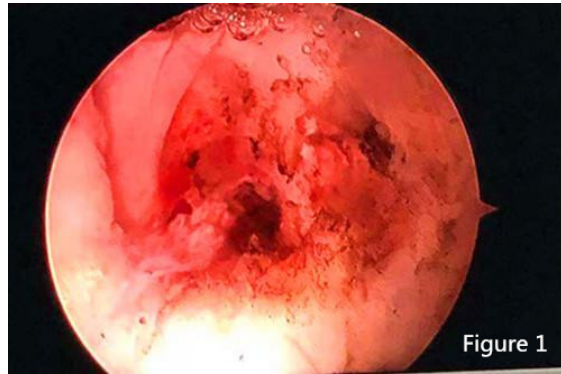


Figure 1. The anterior cruciate ligament rupture.

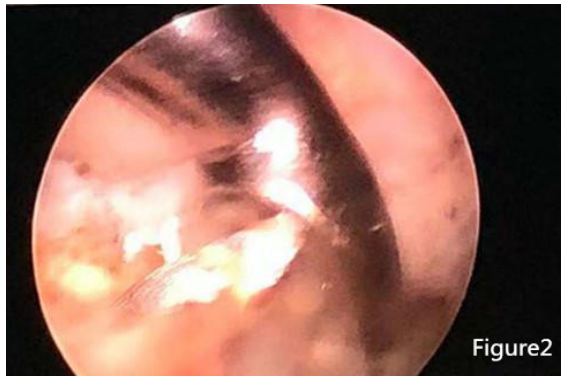


Figure 2. Anterior cruciate ligament humerus stop positioning.

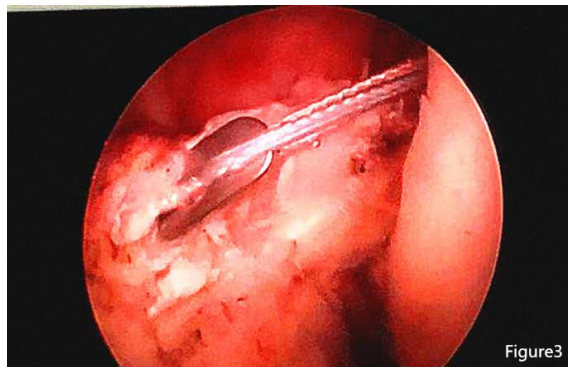


Figure 3. Implanted reconstruction ligament.

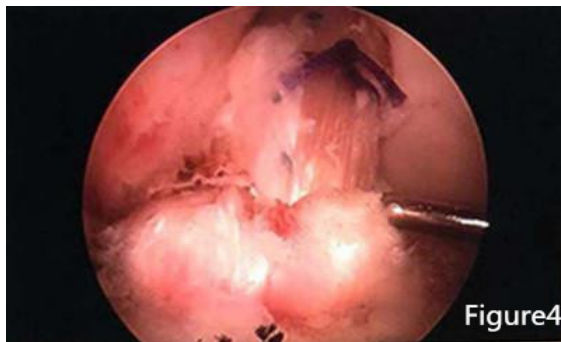


Figure 4. Check implant ligament stability.

3.2. Postoperative Rehabilitation Program

Inform patient of postoperative rehabilitation plan, please Rehabilitation Department Physician cooperates in guiding the patient for rehabilitation training:

On the first 1 - 2 days after operation, the patient began to exercise the toes and ankles under the guidance of a rehabilitation doctor (20 activities every half hour).

From 3 days to 4 weeks after surgery, the muscle strength of the muscles around the knee joint was gradually exercised under the protection of the knee brace (0° - 90°), and the ankle joint was active. Muscle exercises mainly exercise quadriceps and hamstrings, patients on their own muscle contraction and relaxation alternately.

4 - 6 weeks after the operation: The affected limb was gradually loaded under the protection of a brace; the knee joint movement exercise was started. 6 weeks later, the knee motion reached 120° .

7 - 12 weeks after surgery: Remove the brace and start walking slowly and squatting.

12 weeks later: Gradually resume daily work and start moderate exercise, but avoid strenuous exercise.

4. Evaluation Index

4.1. Record Indicator

The operative time, intraoperative blood loss, IKDC score, Lysholm score, and range of motion of the knee joint before and after arthroscopic reconstruction of the anterior cruciate ligament with autologous tendon were recorded.

4.2. Joint Stability Examination

Anterior drawer test, Lachman test under local anesthesia.

5. Statistical Analysis

Statistical analysis was performed by SPSS 17.0 software (IBM Corporation, USA). The operative time, intraoperative blood loss, knee Lysholm score, IKDC score, and knee joint mobility were compared between the two groups. The results were expressed as mean \pm standard deviation ($x \pm s$)'s formal representation, the data between groups are represented by independent samples *t* Test for comparative analysis to $P < 0.05$ indicated that the difference was statistically significant, and gender, cause of injury, etc. were compared by chi-square test for difference.

6. Results

6.1. Perioperative Index

Intraoperative blood loss, operative time, knee motion, preoperative and post-operative 3 month thigh circumference difference comparing **Table 1** below, the

Table 1. Comparison of general conditions between the two groups of patients during perioperative period.

	Group A	Group B	t	p
volume of bleeding (ml)	76.38 ± 10.59	68.57 ± 8.28	3.4	0.01
time of surgery (min)	61.28 ± 3.54	59.73 ± 3.10	1.92	0.58
preoperative knee mobility	104.23 ± 6.45	104.07 ± 4.03	0.12	0.91
knee joint motion 3 months after operation	124.80 ± 3.54	126.90 ± 1.90	3.21	0.02
preoperative thigh circumference	2.01 ± 0.67	1.78 ± 0.60	1.48	0.14
thigh circumference 3 months after surgery	1.52 ± 0.58	1.31 ± 0.46	1.73	0.09

difference in operative time and thigh circumference between the two groups (P average > 0.05), the difference was not statistically significant, but the amount of intraoperative blood loss was lower in the late reconstruction group than in the early reconstruction group, and the knee joint mobility was higher in the late group than in the early group at 3 months after surgery ($P < 0.05$).

6.2. Lysholm Score and IKDC Score

The Lysholm scores and IKDC scores of the two groups before surgery, 3 months after surgery, and 12 months after surgery are shown in **Table 2** and **Table 3** (P all > 0.05) the difference was not statistically significant.

As shown in the above table, the results of the preoperative and postoperative comparisons between the two groups of patients suggest that the intraoperative blood loss in the late reconstruction group was lower than that in the early reconstruction group ($P < 0.05$), and the knee joint mobility in the late group was higher than that in the early group ($P < 0.05$). The Lysholm score and IKDC score were compared between the two groups before surgery, 3 months after surgery, and 12 months after surgery ($P > 0.05$), the difference was not statistically significant. There were no postoperative complications such as joint infection and redness in both groups. One patient in the late stage group was found to have the stump attached to the posterior cruciate ligament after anterior cruciate ligament rupture.

7. Discussion

The anterior cruciate ligament (ACL) is an important structure that controls the forward stability and rotational stability of the knee joint. It causes anterior instability and rotational instability of the knee joint after injury [5] [6] [7]. The instability of the knee joint after ACL rupture not only affects daily activities and sports, but also causes damage to the soft tissues of the knee joint and changes in the force lines of the lower extremities, which in turn leads to secondary meniscal injury and synovitis. It has been found that earlier surgery can reduce the

Table 2. Comparison of Lysholm scores before and after treatment in two groups of patients.

	Lysholm score			
	Group A	Group B	t	p
before reconstruction	47.73 ± 8.65	49.76 ± 7.39	1.06	0.29
3 months after reconstruction	87.73 ± 3.57	88.56 ± 2.52	1.14	0.25
12 months after reconstruction	93.17 ± 1.72	92.71 ± 2.04	0.99	0.32

Table 3. Comparison of IKDC scores before and after treatment in two groups of patients.

	IKDC score			
	Group A	Group B	t	p
before reconstruction	52.53 ± 5.97	56.95 ± 6.02	3.06	0.78
3 months after reconstruction	87.90 ± 2.97	87.59 ± 2.39	0.49	0.62
12 months after reconstruction	92.83 ± 3.00	93.22 ± 1.87	0.66	0.50

occurrence of inflammation and further reduce the probability of knee osteoarthritis [8]. Many scholars believe that when ACL rupture occurs, ACL reconstruction should be given in time to reduce the occurrence of secondary meniscal injury, cartilage degenerative changes and chronic synovitis and other complications [9] [10] [11].

In this study, we compared the clinical efficacy of arthroscopic autologous tendon reconstruction surgery for ACL rupture in patients with early and late post-injury, and found that patients in the late reconstruction group had a better recovery of joint mobility than the early group ($P < 0.05$). Laird *et al.* [12] [13] The study pointed out that when the human body is injured, the body will stimulate the corresponding inflammatory response to resist the damage suffered by the body, and the continuous high-intensity inflammatory response will cause the body to feel pain and affect postoperative recovery. Another scholar in the study of ACL reconstruction patients with postoperative pain and swelling factors, pointed out that ACL rupture early ACL reconstruction patients, reconstruction surgery intensified the original injury [14] [15]. It can be speculated that early ACL reconstruction surgery may further stimulate and exacerbate the original unresolved inflammatory response, which in turn results in higher postoperative knee motion in the late reconstruction group.

Additionally, in clinical practice, we found that patients in the early reconstruction group had more intraoperative blood loss than those in the late reconstruction group ($P < 0.05$). Hemorrhage in the joint cavity of patients in the early reconstruction group affected the operative field, resulting in prolonged operative time, increased surgical risk, and patients were more prone to knee joint adhesions after early surgery, and severely affected the recovery of knee joint function.

This study found that although the early and late reconstruction groups had different advantages and disadvantages during the perioperative period, the knee function of both groups could be restored to normal after ACL reconstruction and postoperative rehabilitation. Lysholm scores and IKDC scores before, 3, and 12 months after surgery in both groups in this study (P average > 0.05). The difference was not statistically significant, indicating that there was no significant difference in postoperative knee function between the two groups.

MRI is the most accurate imaging method for clinical diagnosis of ACL injury. It has the advantages of non-invasiveness, small radiation, etc. It can detect combined injuries such as bone contusion and meniscus injury in time. The accuracy of MRI in the diagnosis of ACL injury is 90% - 100%. In this study, all patients in the early group underwent MRI after injury. In the late group, some patients did not undergo MRI in time after injury, so ACL and meniscus injuries were not diagnosed in time. In this study, one patient in the late group had ACL rupture followed by attachment to the posterior cruciate ligament, which was easily missed during the examination. Therefore, knee arthroscopy should be alert to the possibility of intrasynovial rupture or reattachment of the broken end, we must use the hook carefully repeated exploration in order to confirm the diagnosis.

Of course, there are still many deficiencies in this study, such as the inclusion of a small number of comparative samples, and the lack of comparative analysis of postoperative long-term efficacy, etc., some patients in the late group did not perform MRI in a timely manner, resulting in the failure to further analyze the meniscus loss and other influencing factors; in the future will be further included in more patients for long-term follow-up, and further observation of whether the merger of other intra-articular injuries affect the patient's recovery.

8. Conclusion

In summary, early and late arthroscopic autologous tendon reconstruction surgery for knee ACL injury has similar clinical outcomes. However, patients with late reconstructive surgery have less intraoperative blood loss and higher postoperative knee motion. Therefore, from the aspects of postoperative recovery and efficacy, we recommend that these patients undergo ACL reconstruction surgery from 6 weeks to 6 months after injury.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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