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The changing trends of the knee function after anterior and posterior cruciate ligaments reconstruction with all-inside arthroscopy technique

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We aimed to summarize the effectiveness and changing trends of reconstruction for the anterior cruciate ligament (ACL) and posterior cruciate ligament (PCL) injuries using all-inside arthroscope technique. Between May 2013 and May 2019, 29 patients with ACL and PCL ligaments rupture were included. All the patients were male, with a mean age of 25.2±2.9 years. The mean follow-up period was 2.4±0.7 years (Range, 2-4 years). Reconstruction surgery of the ACL and PCL ligaments was performed by using autologous hamstring tendon with all-inside arthroscopy technique. The anterior and posterior drawer test, Lachman test, Pivot-shift test, stress test, IKDC score, Lysholm score, Tenger score were analyzed clinically. At the last follow-up, the symptoms were improved significantly, the anterior drawer test was normal and 1 degree in 96.6%, posterior drawer test in 89.7%, pivot shift test in 96.6%, Lachman test in 93.1%, and stress test in 93.3%, the stability was improved significant($P<0.05$). The IKDC-2000 standard score was normal and near normal in 96.6%. The IKDC subjective score, Lysholm score, and Tenger scores results at the last follow-up were significantly improved when compared with those before operation ($P<0.05$). The changing trends of function evaluation score in the first six months were most obviously better, especially in the third month. All-inside arthroscopy technique is an effective procedure for the ACL and PCL ligaments injuries, and the first six months (especially the third month) after the reconstruction is the key period for a successful recovery. However, there was still a significant improvement at the later stage of rehabilitation.

Keywords: ACL, PCL, reconstruction, trend, rehabilitation, all-inside.

INTRODUCTION

Multi-ligament knee injury is defined as an episode where at least two of the four major ligaments of the knee: anterior cruciate ligament(ACL), posterior cruciate ligament(PCL), lateral collateral ligament as well as medial collateral ligament, and the multi-ligament knee injury incidence have been reported to be around 0.001%~0.013%[1]. The knee dislocation is often accompanied with severe soft tissue damage, but the ACL and PCL simultaneous injuries, with high disability, especially in patients with vascular or nerve injury[2-3], have been viewed as rare injuries.

On the one side, the scholars confirmed the efficacy of ACL or PCL reconstruction and emphasized the importance of postoperative functional rehabilitation[4,5], however, the changing trends of functional exercise of ACL or PCL were rarely reported, especially in both ACL and PCL simultaneous reconstruction. On the other side, the surgical time, grafts selection, and surgical methods of the ACL and PCL reconstruction were not to reach a consensus[6-8], we performed both ACL and PCL reconstruction simultaneously with all-inside arthroscopy technique which has several advantages.

The purpose of this study was to investigate the clinical efficacy and advantage of all-inside arthroscopy technique skills for both ACL and PCL reconstruction, and observe the changing trends in the two years after the surgery accompanied with rehabilitation exercise. Through this research, we develop more scientific and effective rehabilitation exercise schedule.

MATERIAL AND METHODS

1. Inclusion criteria:

1) Simultaneous rupture of both ACL and PCL injuries; 2) Patients between 18-34 years of age; 3)ACL and PCL injuries reconstruction with all-inside technique

was adopted; 4) Qualitative and complete evaluation data; 5) Retrospective analysis for research.

2. Exclusion criteria

1) Patients with history of previous knee surgery or deformity; 2) The fracture around knee joint; 3) Patients lost to follow up or cases with incomplete clinical data; 4) Loss of ability to reach postoperative rehabilitation exercise.

3. General information

A retrospective study was performed on 29 patients with ACL and PCL ruptures, all the cases were treated with all-inside arthroscopy surgery, between May 2013 and May 2019.The average age was 18-34 years (mean, 25.2±2.9 years). The causes were military training-sports activity and falling injury, and the time from injury to surgery was 4-6 weeks.

Physical examination was performed in our institute, radiological (X-ray and MRI) examination of injury knee were obtained. The anterior drawer test and Lachman test were positive in 29 cases. The posterior drawer test and pivot shift test were positive in 29 cases. Varus Stress Test were positive in 7 cases. Eversion Stress Test were positive in 8 cases. According to knee dislocation Walker anatomic classification[9]: the clinical data included type KD II injury (ACL and PCL ruptures) in 14 cases, type KD III M (ACL and PCL ruptures accompanied with MCL injury) in 8 cases, type KD III L (ACL and PCL ruptures accompanied with LCL injury) in 7 cases.

4. Surgery method

All the surgeries were performed by a single senior surgeon. The patients were positioned supine with the knee flexed to 90°using a side support attached to the operating table.

The surgeon performed an arthroscopy examination using 30° arthroscope with the knee in 90° of flexion after making the standard anterolateral and anteromedial portals. To improve the visualization, the stump of torn PCL was debrided from the tibia with a motorized shaver (ArthroCare Corporation, America), the footprint of the PCL was exposed. If the view was limited, posterolateral approach was performed.

An 4cm anteromedial oblique incision just over the pes anserinus was made, the semitendinousus and gracilis tendons were identified and harvested using a closed tendon stripper (Figure 1a). The graft was folded in half into four strands, with the length about 6-7cm, diameter7-9mm, the folded grafts were linked with two adjustable titanium plate (Arthrex, America, Figure 1b, 1c). In all cases, the graft was manually tensioned for about ten minutes. (Figure1d). The grafts length and diameter were measured and packed with sterile gauze.

An tibial aimer of PCL (Arthrex) was arthroscopically placed within the PCL footprint on the posterior tibia 16mm below the tibial plateau. A Flip Cutter reamer (Arthrex), with an open diameter matching the measured graft size, was drilled in an outside-in fashion through the tibia tunnel guide from the tibia cortex into the joint cavity. Once inside the joint cavity, the FlipCutter was opened and a socket about 25-27mm long was created in a retrograde fashion. The drill was then placed back

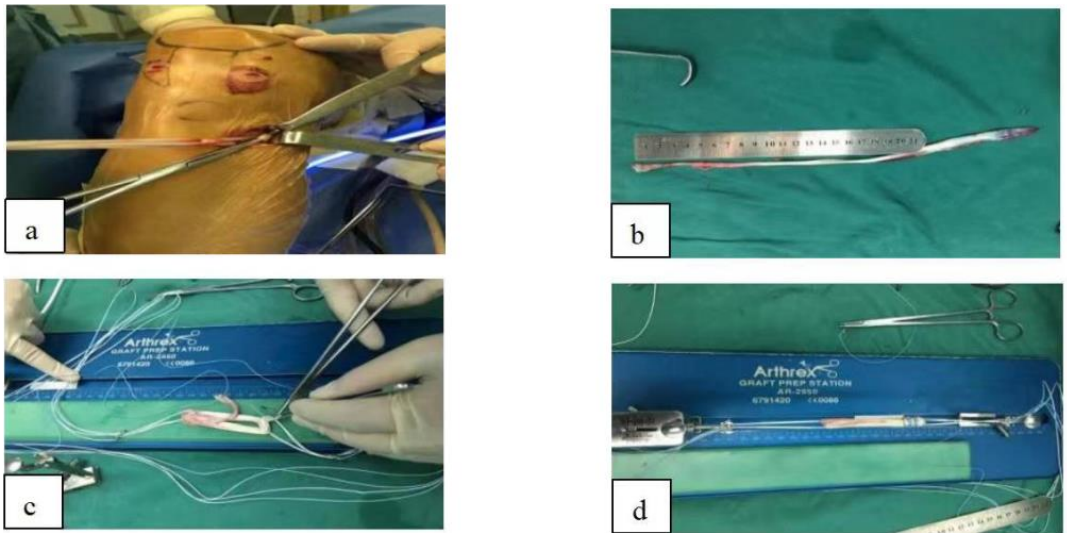

Figure 1a. — Tendon was harvested with stripper; b: Gracilis tendon about 26cm c: Folded graft linked with adjustable titanium plate; d: The graft was tensioned.

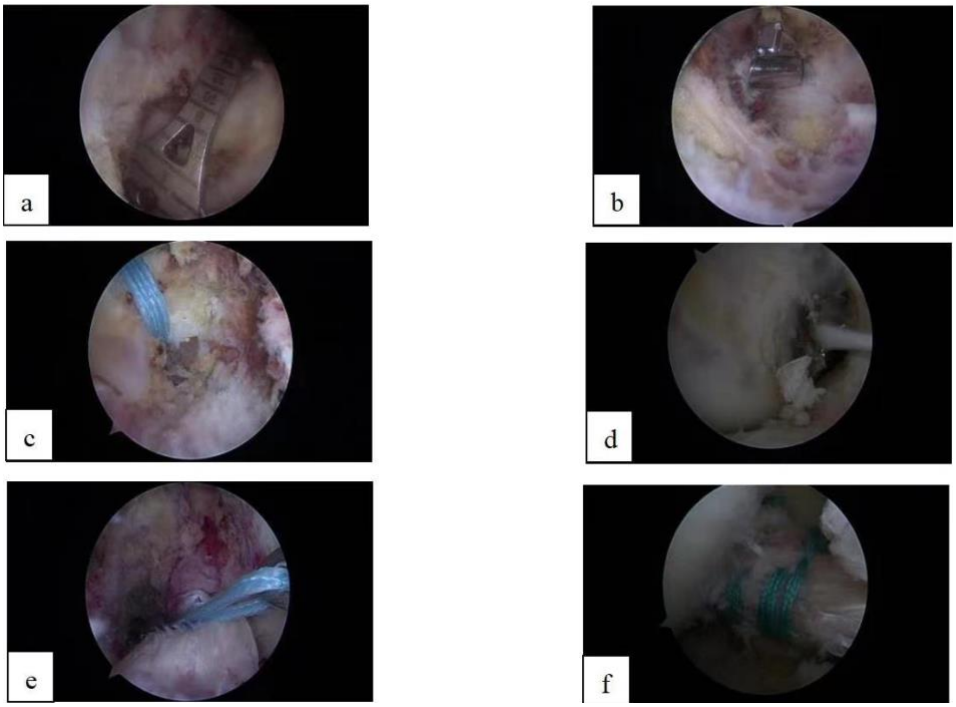

Figure 2. — PCL reconstruction a: An Arthrex Tibial PCL aimer (Arthrex) was arthroscopically placed within the PCL footprint on the posterior tibia 16mm below the tibial plateau; b: 25-27mm long tibial socket creation was achieved by a flexible reamer; c: A wire was passed through the socket; d: A guide pin was placed within the PCL footprint on the femoral side; e: Femoral socket creation was achieved by flexible reamer; f: The PCL graft after reconstruction.

into the joint, closed, and removed completely, a graft-passing wire was through the hole created in the tibia cortex and exited through the AM portal.

A femoral tunnel aimer (Arthrex) was placed within the PCL footprint on the intercondylar fossa, a Flip Cutter reamer (Arthrex), with an open diameter matching the measured graft size, was drilled in an outside-in fashion through the femoral tunnel guide from the lateral femoral cortex into the joint cavity. Once inside the joint cavity, the FlipCutter was opened and a socket about 25-27mm long was created in a retrograde fashion.

The prepared PCL graft was linked with the EndoButton and passed retrograde through the tibial tunnel back into joint cavity and then into the femoral tunnel.The fixation device was pulled to secure the button on the tibial and femur cortex (Figure 2a-f).

A femoral tunnel guide (Arthrex) was arthroscopically placed within the ACL footprint on the intercondylar fossa through the anteromedial portal, a spade drill in an inside-out fashion through the femoral guide was from the medial side of intercondylar fossa to the lateral femoral cortex, the femoral tunnel guide was removed, and then the socket about 20-25mm long was created by a femoral drill(The femoral drill with a diameter matching the graft was drilled in an inside-out fashion through the spade drill). A graft-passing wire was through the hole created in the femoral cortex and exited through the AM portal.

The ACL footprint on the tibia was preserved so that the graft tunnel can be entirely within the footprint. A tibia aimer of ACL was placed within the ACL footprint of tibial plateau. A FlipCutter reamer (Arthrex) matching the measured graft size was drilled in an outside-in fashion through the tibia tunnel guide from the lateral tibia cortex into the joint. Once inside the joint, the FlipCutter was opened and a larger-diameter socket about was created in a retrograde fashion to the desired length, a wire was passed through the hole created in the tibial cortex and exited through the AM portal.

The graft was pulled into the socket through the AM portal with the graft-passing wire, fixation was performed using the Endobutton device on the femoral side and tibial side. The fixation device was pulled to secure the button on the tibial and femur cortex.

The leg was brought through a full range of motion to ensure that there was no impingement of the graft in extension. Appropriate tension of the graft was assessed by bringing the leg into extension, knee stability was confirmed by performing the Lachman and flexion-rotation drawer tests.(Figure 3a-h)

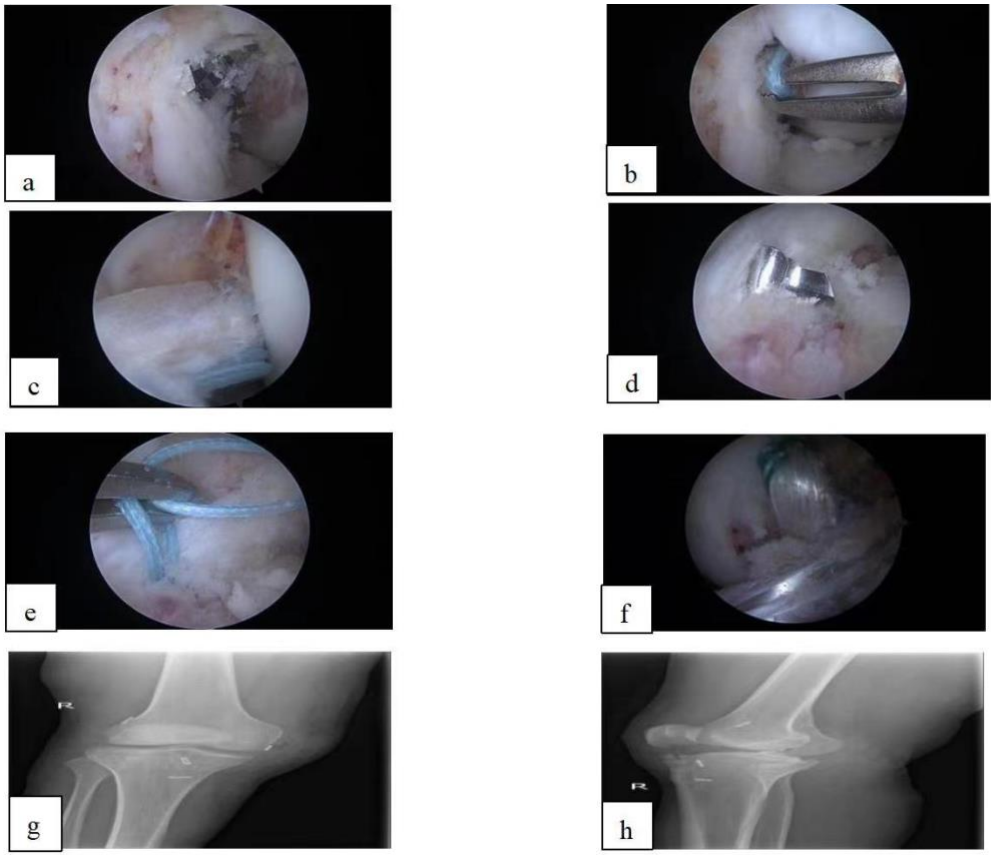

Figure 3. — ACL reconstruction. a: A flexible reamer with the same diameter as the graft; b,c: Femoral socket making. d: Tibial socket creation of ACL was achieved by flexible reamer; e: The wires were passed through the socket. f: The ACL and PCL after reconstruction. g.h: X-ray film after the operation.

For type KD III M injuries, exposure of the MCL was achieved through knee medial approach. If the MCL structure was preserved, suture anchor was applied and fixed at femoral or tibia insertion point of the knee. Transverse tears around the joint space were sutured directly. For type KD III L injuries, fibular capitulum was achieved through the knee lateral approach, the common peroneal nerve was exposed and protected carefully. For avulsion fracture of fibular capitulum, suture anchor was applied and fixed at fibular capitulum, if it can't be sutured, the fibular capitulum should be drilled from the anterior side to the posterior side, graft for knee LCL complex reconstruction was applied to restore the knee stability, the femoral side fixation was treated with compression screw.

Meniscal tear was treated with arthroscopic meniscal suture method. If the meniscus could not be sutured, partial meniscectomy as little as possible was only performed. There was no complete meniscal resection. The small avulsion fracture was removed, the large avulsion fracture was fixed with screw.

The patients must elevate the injured limb and apply a cold compress for about 3 days to reduce swelling and pain symptoms.

1-2 weeks after the operation, the knee was fixed at full knee extension with a brace, isometric quadriceps muscle contraction and knee motion training exercises were mainly performed by the patients.

3-4 weeks after the operation, the injured leg was in an extended position with a brace all day, the patients performed isometric quadriceps muscle contraction and straight-leg lifting exercises, after activation of injured limb muscles, knee motion training exercise was performed to obtain a range from 0°to 90°under protection.

5-6 weeks after the operation: isometric quadriceps muscle contraction and straight-leg lifting exercises were performed as before, after activation of injured limb muscles, knee motion training exercise was performed to obtain a range from 0°to 120°under protection, patients were advised to partial weight bearing on the injured limb, the brace was removed this period.

7-12 weeks after the operation, full protected weight bearing was advised under the protection. Isometric quadriceps muscle contraction, straight-leg lifting and knee range of motion exercises were performed as before. Strength training was carried out 3-15 months after the operation.

12-24 weeks: The patients performed mainly on strength training after activation of injured limb muscles, knee range of motion training was carried out daily.

6-15 months: The patients performed mainly on strength training after activation of injured limb.

Isometric quadriceps muscle contraction: this exercise was performed by the patients for five seconds a time, five times a group, two groups a day.

Straight-leg lifting exercise: patients kept the operated leg straight and raised the injured leg to about 45 degree for two seconds, and then lowered slowly to the bed, five times a group, two groups a day, five days a week.

Knee motion training(≤90°): the patients sat on the edge of the bed with the operated leg straight and parallel to the floor, the distal end of injured leg was supported by the healthy one and flexed to 90°gradually. The training was performed by the patients five times a group, two groups a day, four days a week.

Knee motion training(>90°), all of them remained in supine position, patients raised the injured leg straight and then bent the knee joint gradually, the two hands held the ankle (or you can also wrap a towel around the ankle) to make the distal end of the injured leg close to the torso.

Strength training items: from 9 months to 15 months after the operation, the patients were advised to perform one leg squat against the wall exercise 4 days a week, 3 groups a day and 10 times a group.

Follow-up evaluations were performed after the operation.The anterior-posterior stability of the knee was performed using Lachman test, anterior-posterior drawer test, and pivot shift test. The anterior drawer test was performed at knee flexion of 90°, and the positive classification compared with the healthy side was graded according to the extent of anterior and posterior translation: degree 1: 1-5mm; degree 2: 6-10mm; and degree 3: greater than 10mm. Knee medial-lateral stability was measured at 30°flexion, from its most varus to its most valgus position and grouped into three degrees: degree 1: greater than 1-5mm; degree 2, 6-10mm; and degree 3: greater than 10mm.

IKDC-2000 standard and subjective score, Lysholm score, and Tenger score were used for the the knee function evaluation. The knee function was classified by IKDC standards: normal, nearly normal, abnormal, and severely abnormal. The Subjective Knee Evaluation Form included symptoms (pain, swelling, interlocking, and soft leg), sports and daily activity, current knee function, and previous knee function before injury (not included in the total score), which included 18 subjects. The total score is 100, which means normal daily activity, unrestricted exercise and no symptoms. Lysholm score system includes pain, knee stability, interlocking, swelling, stair-climbing, crouch, limp, crutches using or not eight items. The total score is 100 points, excellence grade: ≥95 points, good grade:85-94 points, fair grade: 65-84 points, poor grade: <6.

All statistical analysis were performed using SPSS version 13.0. Quantitative data were presented as mean and standard deviation, chi-square test and repeated measure analysis of variance were used for comparison before and two years after the surgery results, $P<0.05$ was considered as significant difference.

RESULTS

Physical examination of the knee was performed after the anesthesia. The patients on the table with both feet hanging down freely and knees/hips flexed at 90°. The surgeon holds the proximal tibia and performs a push and pull for 2 to 3 cycles in 1s, the anterior and posterior translation laxity between tibial plateau and femoral condyles compared with the contralateral knee greater than 10mm was considered positive.

Among all the ACL rupture cases, tibial end avulsion of the ACL were 11 cases, femoral end avulsion were 17 cases, mid-substance tears was 1 case. Femoral end avulsion of PCL were 18 cases, and tibial end avulsion were 11 cases.

The average length of semitendinosus and gracilis tendon was about 27mm and 25mm, respectively, and the length and diameter of the grafts folded into four strands was about 6-7cm and 7-9 mm, respectively. The grafts were pulled into the bone socket, all the grafts were in close contact with border of the sockets. The tension of the grafts was normal after locking the plates on both sides.

The mean±SD of operation time was about 94.2±16.3 minutes (Range from 70 to 130 minutes), the mean±SD of bleeding volume during the operation was about 76.4±20.7 ml (Range from 50 to 160ml). There were no complications such as infection, hematoma, vessel injury after the operation.

The patients were followed up for 2.4±0.7 years (range, 2-4 years). The symptoms of pain, swelling

Table I. — IKDC-2000 standard score comparison between pre-operation and two years after the surgery.

	Pre-operation				Two years after the operation			
Items	A	B	C	D	A	B	C	D
Subjective evaluation	0	1	9	19	27	2	0	0
Symptoms	0	1	5	23	27	1	1	0
Range of motion	0	3	2	24	26	2	1	0
Ligament test	0	1	2	26	27	2	0	0
X-ray	0	8	7	14	28	1	0	0
Function Examination	0	1	2	26	28	1	0	0
Over assessment	0	1	2	26	27	1	1	0

Note A: normal; B: nearly normal; C: abnormal; D:severely abnormal. IKDC: International Knee Documentation Committee.

Table II. — IKDC subjective score comparison between pre-operation and two years after the operation.

Item	Pre-operation	Two years after the operation	P
IKDC subjective score	31.6±2.3	90.9±0.4	<0.05

Table III. — Stability examination comparison between pre-operation and post-operation two years after the surgery.

	Relaxation degree				Relaxation degree			
Relaxation degree	Normal	I	II	III	Normal	I	II	III
Items	Pre-operation				Two years after the operation			
Lachman test	0	1	13	15	15	12	2	0
Anterior drawer test	0	1	11	17	19	9	1	0
Pivot-shift test	0	2	7	20	18	10	1	0
Posterior drawer test	0	0	14	15	14	12	2	1
Stress test	0	0	9	6	12	2	1	0

Table IV. — Lysholm score and Tenger score comparison between pre-operation and post-operation two years after the surgery.

Item	**Pre-operation**	**Two years after the operation**	**P**
Lysholm score	37.9±2.1	90.6±0.5	<0.05
Tenger score	3.2±0.2	7.1±0.1	<0.05

and flexion limitation of the knee were improved significantly at the last follow-up.

Post-operative function status of the patients based on IKDC subjective, Lysholm score, Tenger score, which showed significant improvement compared with the preoperative score.

28 patients(96.6%) were normal and 1 degree in anterior drawer test; 26 patients(89.7%) were normal and 1 degree in posterior drawer test; 28 patients(96.6%) were normal and 1 degree in pivot-shift test; 27 patients (93.1%) were normal and 1 degree in Lachman test. stress test results of 14 patients(93.3%) were rated as normal and 1 degree (Table III).

The results of IKDC-2000 standard score between preoperative and postoperative were shown in Table 1, the rates of normal and near normal were up to 96.6% two years after operation (28/29), the clinical efficacy was improved significantly compared with the score before operation (Table I).

The mean±SD of IKDC-2000 subjective score was improved from (31.6±2.3) to post-operation (90.9±0.4), the statistical difference was significant (P<0.05, Table II). The most noticeable changes of the function were detected in the first six months, especially in the third month, and the increasing incidence have leveled off obviously in the ninth month (Figure 4-6).

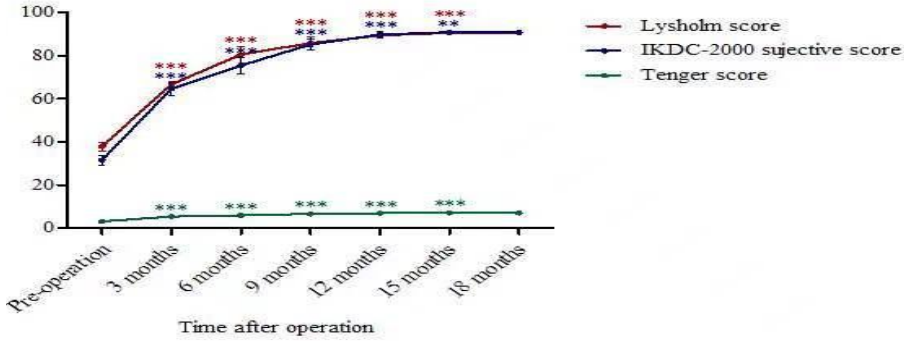

Figure 4. — The changing trends of Lysholm score, IKDC-2000 Subjective score and Tenger score from three to eighteen months.

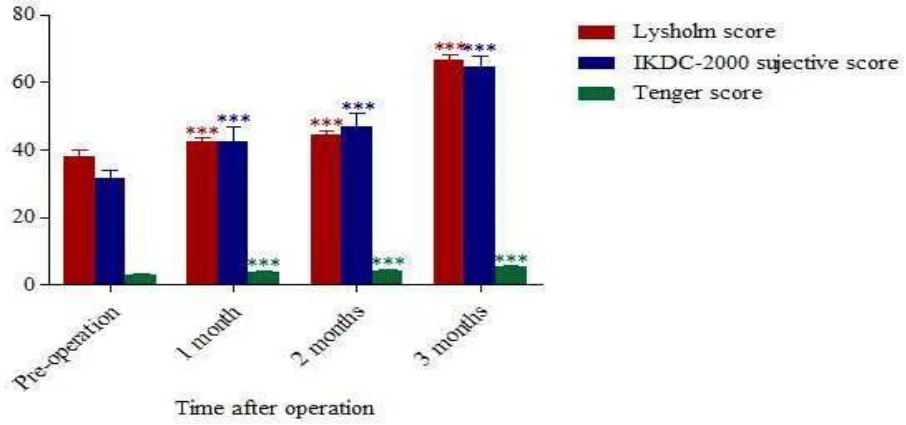

Figure 5. — The results of Lysholm score, IKDC-2000 subjective score and Tenger score from one to three months.

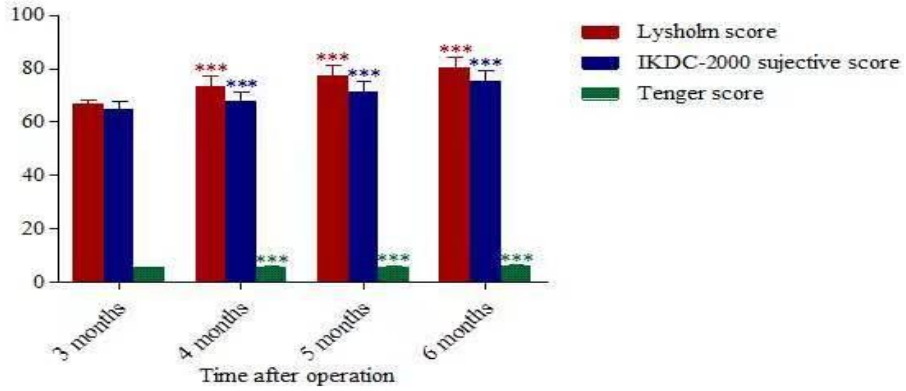

Figure 6. — The results of Lysholm score, IKDC-2000 subjective score and Tenger score from four to six months.

The mean±SD of Lysholm score was improved from (37.9±2.1) to (90.6±0.5) (P<0.05; **Table** IV), the statistical difference was significant. The difference was most pronounced in the first six months, especially in the third month, and the changes leveled off obviously in the ninth month (Figure 4-6).

Tenger score was significantly increased from pre-operation (3.2±0.2) to post-operation (7.1±0.1) (P<0.05; Table IV). The difference was most significant in the first three months, especially in the first month, the changes leveled off in the third month (Figure 4-6).

DISCUSSION

Graft selection for ACL and PCL remained a challenge Allografts and autografts were commonly used for

ACL and PCL reconstruction[10-11] . We agreed with this a higher prevalence for autografts, allografts can be considered a suitable alternative to autografts[12]. In our research, we selected autologous hamstring tendon, and rejection and infectious diseases cases complications were not found after the operation. Meanwhile, tendon-bone healing proceeded fast during the procedure, the patients didn't need to worry about a bigger financial burden.

In terms of patient satisfaction, patients' satisfaction and ability to perform sports activities in Endobutton was better than the Rigidfix[13]. For the number of the graft[14,15], fixation technique, such as Rigifix and Endobuton technique, demands two autografts for one ligament reconstruction[16], four autografts are required for ACL and PCL reconstruction simultaneously, if the ACL and PCL injuries are accompanied with lateral collateral ligament and medial collateral ligament problems, it is hard to finish the operation at the same time. During our procedure, the semitendinousus and gracilis tendon were harvested, the tendon graft folded in half into four strands, and linked with adjustable loop devices[17]. The four strands graft can afford the length and diameter of ACL or PCL reconstruction requirement, autologous hamstring on the one side can afford the grafts requirement of ACL and PCL reconstruction simultaneously. If ACL and PCL reconstruction, accompanied with the lateral collateral ligament, was injured at the same time, autologous hamstring on the other side can be harvested for the lateral collateral ligament graft requirement.

Thomas E Moran et al concluded that no significant differences in strength assessments or patient-reported outcomes at 6 months postoperatively in Flexible Versus Rigid Reaming Systems for Independent Femoral Tunnel making research[18], some researchers confirmed that the flexible reamer system can be considered a safe and effective method for reconstruction surgery[19]. For Flexible reamer in our research, no associated complications were found , in addition to its safeness, we found some other advantages: (1) All-inside arthroscopic operation become possible. (2) The incision is small. (3) The socket is created precisely according to the length and diameter of the graft. (4) The bone can be preserved to the greatest extent. (5) The grafts are in close contact with border of the sockets and tendon-bone healing proceed quickly, and because of this, windshield wiper effect can be avoided effectively.

A two years long-term follow-up after operation revealed that, according to drawer test, Lachman test and pivot shift test, the normal and nearly normal proportion were more than 90%. IKDC 2000 evaluation score showed the normal and nearly normal proportion were up to 96.6%, the outcome was improved significantly compared with pre-operation status. Our studies are in line with previous results, IKDC subjective score, Lysholm score, and Tenger score results were improved significantly, the outcome was equal to or better than staged reconstruction of multiple ligament injuries.

According to the changes trend of the knee function after reconstruction for ACL and PCL injuries using all-inside arthroscope technique, the most obvious improvement of knee function in all patients was in the first six months, especially in the third month. The increasing incidence have leveled off obviously in the ninth month, however, there was still a significant improvement from the ninth to the fifteenth month.

We insisted that rehabilitation from 1 to 6 months after the operation is the key period for the keen function recovery, and will influence the rehabilitation program later on, especially in the third month.

The patients mainly underwent muscle strength training and distance running from 12 to 15 months, during this period, the results of Lysholm score, KIDC-2000 subjective score, and tenger score were still significant. In the later stage of the rehabilitation, there was still significant improvement under the muscle strength training and moderate distance running. Patients and doctors can't relax themselves for knee function recovery and the later stage of the program.

The approach of reconstruction with autologous hamstring tendon using all-inside technique was applied to ACL and PCL ligaments injuries. According to our experience, key points and precautions of the operation should be noted.

(1) The patients were positioned supine with the knee flexed to 90° using a side support attached to the operating table. This position is not only the convenient way to operate but also the effective method to prevent postoperative infection.

(2) According to the evaluation standard for relaxation measurement, degree I, degree II and degree III were classified. The surgeons assess the necessity of lateral collateral ligament repair and reconstruction according to the relaxation classification.

(3) The graft tension and fixation sequence is as follows:anterolateral bundle of the PCL to restore the central pivot, posteromedial bundle of the PCL, ACL.

(4) A rounded posterior aspect and a reasonable distance about 16mm below the tibial plateau of the socket exist lead to less graft damage compared with the typical sharp edge of the bone tunnel exit.

(5) The posterior compartment of the knee has a complex anatomy structure of vessels and nerves which

are easily damaged. If the field of arthroscopy through anterior approach is limited, posteromedial approach should be performed to observe the anatomy structure of popliteal fossa directly. Posteromedial approach was performed in 25 cases, the surgeon can observe the anatomy structure of popliteal fossa directly and avoid the popliteal vessel and nerve injury.

(6) The depth of the socket is determined by the length of the graft, if the socket is too short, the graft can't be tensioned; if the socket is too long, the graft can't be in close contact with the border.

(7) One case regarding drill bit broken, it can be difficult to remove from the proximal femur. Special instrumentation was applied to enlarge the socket and the drill bit was taken out easily.

(8) The plan of rehabilitation training should be established. Early rehabilitation on training is beneficial to the knee functional recovery and shorten the hospitalization time.The number of cases collected in this group were small and the follow-up time was short, its long-term efficacy and complications need to be further observed. Type KD II, type KD III and type KD IV knee multiple ligaments damage accompanied with vascular injury cases were not reported, its effectiveness of reconstructing the ACL and PCL injuries with autologous hamstring tendon using all-inside technique for these cases were not clear. The effectiveness of this technique stays in clinical observation. In the future, tendon-bone healing time and pathological changes should be further evaluate

REFERENCES

1. Ali AA, Abdelwahab MB. Short-Term Outcome of Multi-Ligament Knee Injury among Sudanese Patients. Open Access Maced J Med Sci. 2019 May 15;7(9):1486-1493.
2. Mardani-Kivi M, Karimi-Mobarakeh M, Hashemi-Motlagh K. Simultaneous arthroscopic ACL and PCL reconstruction using allograft Achilles tendon. J Clin Orthop Trauma. 2019 Oct;10(Suppl 1):S218-S221.
3. Moreno B, Vaz P, Melo B, Cunha M, Vaz R. Knee Dislocation With Vascular and Nerve Injury in a Professional Football Player: Return to Play. Cureus. 2022 Jan 25;14(1):e21607.
4. Mardani-Kivi M, Karimi-Mobarakeh M, Hashemi-Motlagh K. Simultaneous arthroscopic ACL and PCL reconstruction using allograft Achilles tendon. J Clin Orthop Trauma. 2019 Oct;10(Suppl 1):S218-S221.
5. Fanelli GC, Edson CJ. Arthroscopically assisted combined anterior and posterior cruciate ligament reconstruction in the multiple ligament injured knee: 2- to 10-year follow-up. Arthroscopy. 2002 Sep;18(7):703-14.
6. Johnson P, Mitchell SM, Görtz S. Graft Considerations in Posterior Cruciate Ligament Reconstruction. Curr Rev Musculoskelet Med. 2018 Sep;11(3):521-527.
7. Wang HD, Zhu YB, Wang TR, Zhang WF, Zhang YZ. Irradiated allograft versus autograft for anterior cruciate ligament reconstruction: A meta-analysis and systematic review of prospective studies. Int J Surg. 2018 Jan;49:45-55.
8. Lynch AD, Chmielewski T, Bailey L, et al. Current Concepts and Controversies in Rehabilitation After Surgery for Multiple Ligament Knee Injury. Curr Rev Musculoskelet Med. 2017 Sep;10(3):328-345.
9. Goebel CP, Domes C. Classifications in Brief: The Schenck Classification of Knee Dislocations. Clin Orthop Relat Res. 2020 Jun;478(6):1368-1372.
10. Widner M, Dunleavy M, Lynch S. Outcomes Following ACL Reconstruction Based on Graft Type: Are all Grafts Equivalent? Curr Rev Musculoskelet Med. 2019 Dec;12(4):460-465.
11. Figueroa F, Figueroa D, Calvo R, Vaisman A, Espregueira-Mendes J. Graft choice in combined anterior cruciate ligament and medial collateral ligament reconstruction. EFORT Open Rev. 2020 Apr 2;5(4):221-225.
12. Migliorini F, Pintore A, Oliva F, Eschweiler J, Bell A, Maffulli N. Allografts as alternative to autografts in primary posterior cruciate ligament reconstruction: a systematic review and meta-analysis. Knee Surg Sports Traumatol Arthrosc. 2022 Nov 30.
13. Mousavi H, Maleki A, Nobakht A. Comparative Study after Hamstring Anterior Cruciate Ligament Reconstruction with Endobutton and Rigidfix: A Clinical Trial Study. Adv Biomed Res. 2017 Nov 10;6:136.
14. Stannard JP, Stannard JT, Cook JL. Surgical Treatment of Combined ACL, PCL, and Lateral Side Injuries. Sports Med Arthrosc Rev. 2020 Sep;28(3):94-99.
15. Fanelli GC, Edson CJ. Combined ACL-PCL-Medial and Lateral Side Injuries (Global Laxity). Sports Med Arthrosc Rev. 2020 Sep;28(3):100-109.
16. Mousavi H, Maleki A, Nobakht A. Comparative Study after Hamstring Anterior Cruciate Ligament Reconstruction with Endobutton and Rigidfix: A Clinical Trial Study. Adv Biomed Res. 2017 Nov 10;6:136.
17. Ateschrang A, Ahrend MD, Ahmad S, et al. Kombinierte Rekonstruktion des hinteren und vorderen Kreuzbandes: Arthroskopische Versorgung mit dem GraftLink®-System [Combined posterior and anterior cruciate ligament reconstruction : Arthroscopic treatment with the GraftLink® system]. Oper Orthop Traumatol. 2019 Feb;31(1):20-35. German.
18. Moran TE, Ignozzi AJ, Taleghani ER, Bruce AS, Hart JM, Werner BC. Flexible Versus Rigid Reaming Systems for Independent Femoral Tunnel Reaming During ACL Reconstruction: Minimum 2-Year Clinical Outcomes. Orthop J Sports Med. 2022 Mar 16;10(3):23259671221083568.
19. Yoon KH, Kim JH, Kwon YB, Kim EJ, Lee SH, Kim SG. A two-portal technique using a flexible reamer system is a safe and effective method for transportal anterior cruciate ligament reconstruction. Arch Orthop Trauma Surg. 2020 Mar;140(3):383-390.