

Outcomes of Anterior Cruciate Ligament Reconstruction in Patients Older Than 50 Years and Younger Than 30 Years

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Background: Few studies have compared the outcomes of anterior cruciate ligament (ACL) reconstruction between older patients and younger patients.

Purpose: To evaluate the clinical and functional outcomes of ACL reconstruction with autologous hamstring tendon in patients >50 years and <30 years. It was hypothesized that the outcomes would be comparable between these age groups.

Study Design: Cohort study; Level of evidence, 3.

Methods: Patients >50 years (older group) or <30 years (younger group) who underwent ACL reconstruction surgery with autologous hamstring tendon between 2012 and 2015 at the authors' hospital were retrospectively enrolled in this study. All patients had a minimum of 2 years of follow-up. Intraoperative findings, including cartilage and meniscal injury, were recorded, and clinical and functional outcomes were evaluated using the International Knee Documentation Committee (IKDC), Lysholm, and Tegner activity scores. We used the paired-samples *t* test for statistical analysis between the 2 age groups.

Results: A total of 67 patients and 459 patients were included in the older and younger groups, respectively. Both groups achieved significant preoperative to postoperative improvement in IKDC (older group, from 41.4 to 88.9; younger group, from 49 to 91.2), Lysholm (older group, from 49.8 to 86.1; younger group, from 50.2 to 91.8), and Tegner (older group, from 2.7 to 4.4; younger group, from 4.6 to 6.9) ($P < .05$ for all) scores. The change in Tegner score from preinjury to postoperatively was not statistically significant in the older group (from 4.5 to 4.4; $P = .471$), although it was significant in the younger group (from 7.5 to 6.9; $P < .05$). No between-group differences were noted in preoperative or postoperative IKDC or Lysholm scores. Both age groups reached a high rate of return to sports activity, and no major complications or ACL retears were noted in either group.

Conclusion: Comparable results after ACL reconstruction were achieved in patients >50 years compared with patients <30 years, with a high rate of return to sports activity and a low rate of complications at the 2-year follow-up. The younger group returned to a higher Tegner score, while the older group did not.

Keywords: anterior cruciate ligament; ACL; older patients; ACL reconstruction

One of the most successful and commonly performed surgeries, anterior cruciate ligament (ACL) reconstruction (ACLR) is performed >200,000 times in the United States annually.^{8,12,26} When compared with nonoperative treatment, it has been shown to be successful in active young patients in restoring knee stability and lowering the progression of cartilage injury breakdown.^{11,24} Historically, patients >40 years with ACL insufficiency had undergone nonoperative treatment, with fair outcomes.^{5,6,17,27} However, several studies have shown that nonoperative treatment may lead to residual instability or secondary damage,

and patients may need to modify their lifestyle.^{4,14,15,23} Moreover, because of a longer life expectancy and more prevalent participation in sports activity in the middle-aged to senior population, ACL injuries have become more prevalent, and ACLR has become more commonly performed in these age demographics in recent decades.^{2,3,26,28} Several studies have shown satisfactory outcomes of ACLR in patients aged >40 years.^{19,20,26,28} To our knowledge, few studies have compared the outcomes of ACLR between older and younger patients.^{7-9,16,25}

The aim of our study was to evaluate the clinical and functional outcomes of ACLR in patients from 2 different age groups: <30 years and >50 years. We hypothesized that the clinical and functional postoperative outcomes would be comparable between these groups.

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METHODS

After receiving the ethics committee approval for this study, we retrospectively analyzed the data of patients who underwent ACLR at our hospital between 2012 and 2015. The diagnosis of ACL rupture was made through history taking, physical examination, and magnetic resonance imaging (MRI). We included patients who met the following criteria: (1) aged >50 or <30 years, (2) uninjured contralateral leg, and (3) persistent symptoms of instability after nonoperative treatment for at least 1 month. Exclusion criteria included inflammatory disease, multiligament injury, or <2 years of follow-up postoperatively. All patients underwent physical examination and radiography at every outpatient follow-up visit. The radiographic degree of osteoarthritis was graded according to the Ahlback classification¹ and was recorded preoperatively and postoperatively.

All patients underwent ACLR with autologous hamstring tendon from the ipsilateral knee. The surgery was performed by 1 of 3 experienced orthopaedic surgeons at our hospital (W.L.Y., K.Y.H., Y.S.C.). The femur side was fixed with either an interference screw (HA Interference Screw; Smith & Nephew) or button (Endobutton; Smith & Nephew). The tibia side was fixed with an interference screw (HA Interference Screw). Meniscal or cartilage lesions were examined arthroscopically during the operation. Cartilage lesions were graded according to the Outerbridge classification. Chondral lesions were treated either with debridement if the lesion was low grade (Outerbridge grade 1 or 2) or with microfracture if it was of high grade (Outerbridge classification grade 3 or 4). Meniscal lesions were treated with either partial meniscectomy or meniscal repair.

All patients underwent the same rehabilitation protocol. Isometric quadriceps activation was performed immediately after surgery was performed. Patients were restricted to partial weightbearing with crutch assistance for 4 to 6 weeks postoperatively. Passive range of motion (ROM) exercises were performed 4 weeks after surgery, followed by active ROM exercises. Participating in sports activities with lower physical demands, such as jogging or swimming, was allowed 6 months after surgery. Contact sports or pivoting movements such as basketball or judo were allowed 9 months postoperatively.

Clinical and functional outcomes were evaluated through chart review and a questionnaire before surgery and then at every follow-up after 1 year postoperatively. The preoperative physical examination included the

anterior drawer test, Lachman test, varus/valgus stress test, pivot-shift test, and McMurray test. All patients underwent radiography (standing knee anteroposterior, lateral, merchant) and MRI study before surgery. During the preoperative and postoperative questionnaire, patients completed the Lysholm score, Tegner activity score, and International Knee Documentation Committee (IKDC) subjective score, administered independently by a doctor specializing in orthopaedics (C.J.W., C.P.Y., S.S.C., C.H.C.). Finally, any postoperative complications were recorded.

The paired-samples *t* test was used for statistical analysis between the younger and older groups. Statistical significance was set at $P < .05$.

RESULTS

Enrolled in this study were 526 patients: 67 patients aged >50 years and 459 patients aged <30 years. All patients had a minimum of 2 years of follow-up (mean, 28.9 months; range, 24-58 months). Regarding preoperative osteoarthritis grading, 8 patients in the older group were grade 3 and no patients in the younger group had high-grade osteoarthritis. Detailed patient data are listed in Table 1.

Regarding the arthroscopic findings of meniscal and cartilage lesions in the older group, 60 of 67 patients (89.6%) had cartilage lesions and 49 (73.1%) had meniscal lesions (33 of them were degenerative tears). In the younger group, 107 of 459 patients (23.3%) had cartilage lesions and 203 (44.2%) had meniscal injuries (Table 2). The rate of meniscal and cartilage injuries was significantly higher in the older group ($P < .05$).

Detailed outcome scores are listed in Table 3 and Figure 1. Both groups achieved statistically significant improvement in all 3 outcome measures from preoperatively to postoperatively ($P < .05$ for all). The change in Tegner score from preinjury to postoperatively was not statistically significant in the older group (from 4.5 to 4.4; $P = .471$), although it was significant in the younger group (from 7.5 to 6.9; $P < .05$).

In the older group, 58 of 67 patients (86.6%) returned to sports activity, with 36 returning to the same level of sports activity as before injury and 22 returning to a lower level of sports activity. In the younger group, 427 of 459 patients (93.0%) returned to sports activity: 302 returned to sports activity at the same level and 125 returned to sports activity at a lower level.

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Ethical approval for this study was obtained from Chang Gung Medical Foundation (reference No. 201701549B0).

TABLE 1
Patient Data (N = 526)

	Age <30 y, n = 459	Age >50 y, n = 67
Age, y, mean (range)	23.5 (18-30)	56.6 (50-67)
Sex, male/female, n	262:197	34:33
Injury side, left/right, n	248:211	29:38
Time from injury to surgery, mo, mean (range)	4.1 (1-8)	16.1 (9-23)
Preoperative Ahlback classification, n (%)		
Grade 0	387 (84.3)	8 (11.9)
Grade 1	72 (15.7)	22 (32.8)
Grade 2	0 (0)	29 (43.3)
Grade 3	0 (0)	8 (11.9)
Grade 4	0 (0)	0 (0)
Follow-up time, mo, mean (range)	28.3 (24-49)	30.2 (25-58)

TABLE 2
Intraoperative Findings of Associated Injuries^a

	Age <30 y	Age >50 y
Cartilage lesion	107 (23.3)	60 (89.6)
Grade 1	73 (15.9)	19 (28.4)
Grade 2	28 (6.1)	26 (38.8)
Grade 3	6 (1.3)	13 (19.4)
Grade 4	0 (0)	2 (3.0)
Meniscal lesion	203 (44.2)	49 (73.1)
Medial	85 (18.5)	28 (41.8)
Lateral	71 (15.5)	11 (16.4)
Both	47 (10.2)	10 (14.9)

^aData are presented as n (%).

TABLE 3
Comparison of Outcome Scores Between Groups^a

	Age <30 y	Age >50 y	<i>P</i>
Lysholm score			
Preop	50.2 (18-70)	49.8 (30-65)	.081
Postop	91.8 (80-100)	86.1 (60-100)	.317
IKDC score			
Preop	49.0 (33-72)	41.4 (23-60.9)	.445
Postop	91.2 (83.9-100)	88.9 (71.3-100)	.113
Tegner score			
Preinjury	7.5 (4-10)	4.5 (3-8)	<.05
Preop	4.6 (1-7)	2.7 (0-6)	<.05
Postop	6.9 (3-9)	4.4 (3-7)	<.05

^aData are presented as mean (range). Bolded *P* values indicate a statistically significant difference between groups (*P* < .05). IKDC, International Knee Documentation Committee; Postop, postoperative; Preop, preoperative.

No major complications or retears were observed during the follow-up period in either group. Superficial infection at the graft site was noted in 3 patients (4.5%) in the older group and in 11 patients (2.4%) in the younger group, all treated with oral antibiotics with total recovery. No deterioration of osteoarthritis was noted on radiography in all patients during the entire follow-up period.

DISCUSSION

Our study revealed that patients >50 years who underwent ACLR had significant improvement in IKDC (from 41.4 to 88.9), Lysholm (from 49.8 to 86.1), and Tegner (from 2.7 to 4.4) scores (*P* < .05 for all). In addition, 86.6% of them returned to sports activity at the same or lower level as before injury. Similarly, patients <30 years had significant improvement on all 3 scores (IKDC, from 49 to 91.2; Lysholm, from 50.2 to 91.8; and Tegner, from 4.6 to 6.9; *P* < .05 for all), and 93.0% returned to sports activity eventually. However, the older patients had better postoperative recovery of their preinjury Tegner score (from 4.5 to 4.4, *P* = .471) compared with the younger patients (from 7.5 to 6.9, *P* < .05). Our findings indicate that in selected and active older patients, outcomes after ACLR can be comparable to those of patients <30 years.

In recent decades, there has been a tendency toward performing ACLR in patients >40 years.^{2-4,26,28} Studies have shown that the procedure in patients >50 years of age yields favorable outcomes and good knee stability.^{3,10,13,27} Toanen et al²⁶ studied the outcomes of 12 patients who were >60 years of age after ACLR and found good functional recovery, with 83% returning to sports activities. Baker et al² reported on 13 patients >60 years of age who underwent ACLR surgery with good to excellent subjective outcomes with no residual instability and all patients returning to sports or exercise postoperatively. These studies and our current research suggest that chronologic age should no longer be considered a contraindication for ACLR surgery.²⁶

Several studies have focused on comparing the outcomes of ACLR in different age groups.^{16,18} Kim et al¹⁸ compared knee strength and stability after ACLR in patients >50 years and <40 years of age. They concluded that older patients receiving ACLR surgery had comparable results of knee strength, anteroposterior laxity, and IKDC score to younger patients. However, younger patients had better IKDC scores than older patients. Iorio et al¹⁶ compared the outcome of ACLR in patients >50 years and <40 years of age and found no statistical significance in IKDC, Lysholm, and Tegner scores between the 2 groups. However, the KT-

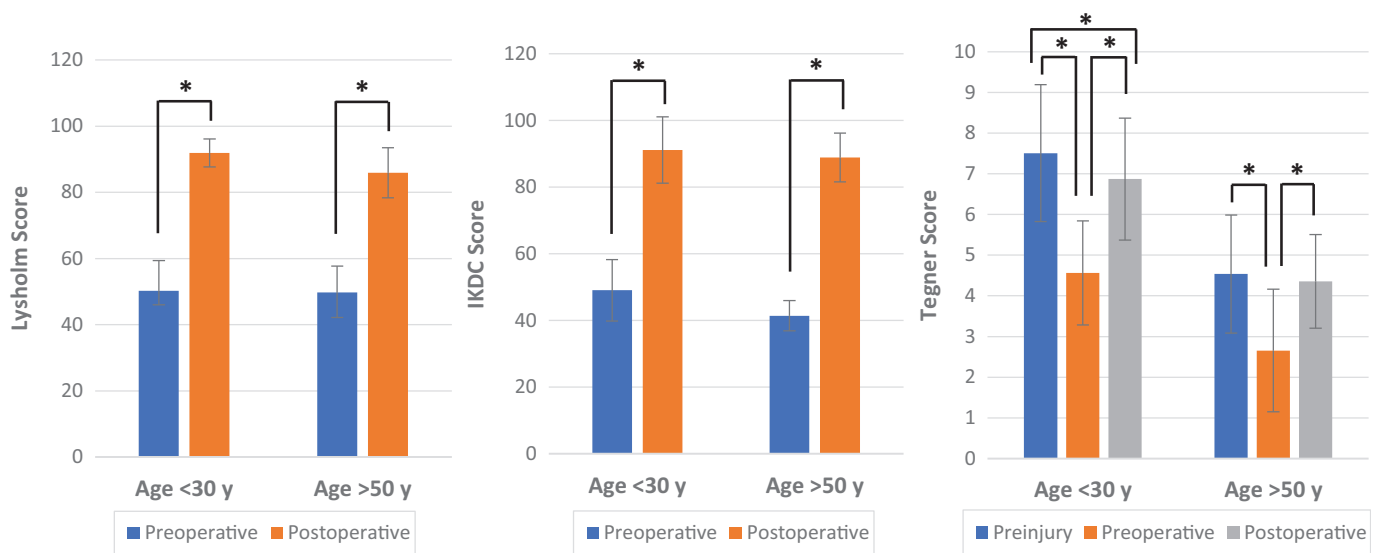


Figure 1. Comparison of outcome scores within groups. Data are presented as means, with error bars representing standard deviations. *Statistically significant difference ($P < .05$). IKDC, International Knee Documentation Committee.

1000 arthrometer evaluation showed a significantly lower side-to-side difference in the older group.

Preoperative articular degeneration is one factor that might influence the outcome of ACLR in older patients. Noyes and Barber-Westin²¹ and Stein et al²² concluded that preexisting cartilage lesions could increase the possibility of progressive articular degeneration or decrease the rate of satisfactory outcomes. Wolfson et al²⁹ concluded that patellofemoral arthritis may lead to poor outcomes for ACLR in patients >50 years. Blyth et al³ reported that patients >50 years of age with high-grade articular degeneration (Outerbridge grade 3 or 4) had poor outcomes. Toanen et al²⁶ collected data on 12 patients who were >60 years of age and underwent ACLR. Although good knee stability and satisfaction rates were achieved, patients with osteoarthritis higher than Ahlback stage 2 were excluded from the study. In our study, we did not exclude patients with high-grade osteoarthritis preoperatively. Fifteen of 67 patients (22.4%) had grade 3 or 4 cartilage lesions but without significantly poorer clinical and functional outcomes compared with those with low-grade lesion or without cartilage lesions. Although having only a small number of patients >50 years of age with high-grade cartilage lesions in our study may have led to a less strong evidence level, we still believe that in strictly selected and active older patients, preoperative high-grade articular degeneration should not be an absolute contraindication for ACLR.

The time from injury to surgery may also be a factor in the outcome after ACLR. The time from injury to surgery was noted to be longer in the older group when compared with the younger group (16.1 vs 4.1 months, $P < .05$). However, a longer time from injury to index surgery might predispose patients to more associated injuries, such as meniscal or cartilage injury.

The outcomes of ACLR are comparable in patients >50 years and <30 years. The reason for this result may be that older patients have a lower demand for sports activity, although these patients are already more functionally active compared with people of the same age. Preinjury Tegner score was much lower in the older group compared with the younger group; thus, it is easier to improve the lower preinjury Tegner score postoperatively for the >50-year age group. It can be assumed this is why we found a statistical significance between preinjury and postoperative Tegner scores in the younger patient group but not in the older patient group.

Limitations

A limitation of this study is that it is a retrospective study with a heterogeneous surgical technique. A longer follow-up time may be needed to clarify the possibility of ACLR retear and deterioration of arthritis. Moreover, a comparative study in those receiving meniscal debridement and meniscal repair is needed to further clarify the outcomes of ACLR in these patients. Further prospective studies may provide more powerful proof.

CONCLUSION

ACLR surgery in patients >50 years of age can lead to good clinical and functional outcomes with significant improvement in IKDC, Lysholm, and Tegner scores. It also results in comparable outcomes in patients <30 years of age. Older patients had better relative recovery in Tegner score than younger patients, which may be because of the lower preinjury Tegner score. We suggest that age and cartilage degeneration are not absolute contraindications to ACLR surgery.

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