

Examination of Early Functional Recovery After ACL Reconstruction: Functional Milestone Achievement and Self-Reported Function

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Background: Few studies have documented early functional recovery after anterior cruciate ligament (ACL) reconstruction.

Purpose: To quantify the time to early functional milestone achievement and change in function over 12 weeks after ACL reconstruction and to identify demographic characteristic predictors of the outcomes.

Study Design: Prospective, longitudinal, observational study.

Level of Evidence: Level 4.

Methods: A total of 182 patients (95 females, 87 males; mean \pm SD age, 28 ± 12 years; mean \pm SD body mass index [BMI], 25 ± 4 kg/m²) who received primary, unilateral, ACL reconstruction were included. Testing occurred before surgery as well as 1, 2, 4, 8, and 12 weeks postsurgery. Outcomes included demographic characteristics, self-reported functional milestone achievements and responses on the Short Musculoskeletal Function Assessment (SMFA) questionnaire. Time to functional milestone achievement was calculated, and patients were categorized into “faster” or “prolonged” recovery groups based on the median value. Longitudinal change in SMFA subscale scores (daily activities and mobility) as well as demographic predictors of functional recovery group assignment and postsurgical change in SMFA subscale scores were examined.

Results: Median time for discontinuing narcotic pain medication was 9 days, while that for discontinuing crutches was 15 days. Time to return to work occurred at a median of 11 days, return to school at 7 days, and return to driving at 11 days. Both SMFA subscale scores significantly decreased (improved) over time, with the greatest change occurring between 1 and 4 weeks postsurgery. The demographic predictor of faster functional recovery for discontinuation of narcotic pain medication was surgery with allograft; those for return to work were higher age, male sex, decreasing BMI, and sedentary/light occupational demand; and those for return to driving were higher age, male sex, and surgery on the left side of the body.

Conclusion: Functional recovery occurs rapidly over the first month after ACL reconstruction for most patients. Nonmodifiable demographic characteristics may influence recovery time for specific functional milestones.

Clinical Relevance: Results can be used to counsel patients on early functional recovery after ACL reconstruction.

Keywords: ACL; outcomes; rehabilitation; return to work; return to driving

Anterior cruciate ligament (ACL) reconstruction ranks among the most common orthopaedic procedures. In the United States, approximately 75% of all people with ACL tears elect surgical reconstruction, increasing to 95% for those who are younger and more active.^{20,24,26,28} Because ACL reconstruction is such a prevalent surgery, a significant body of

literature has been devoted to examining long-term functional outcomes, including self-reported knee function, return-to-sport rates, and the development of knee osteoarthritis.^{1-5,7}

While the importance of long-term functional outcomes after ACL reconstruction is undeniable, early functional recovery can also be important to patients because of the immediate impact

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on their lives. For example, reduced knee function in the early postoperative period usually means a temporary loss of independence. Patients often report frustration with the extended rehabilitation process and have unrealistic expectations about recovery time frames.^{11,19} Moreover, they can feel challenged to stay motivated during rehabilitation and find that feedback on physical parameters is helpful.¹⁹ From this standpoint, identifying early functional milestones, setting realistic expectations for meeting these milestones, and providing feedback on progress may benefit the patient experience and adherence to ACL reconstruction rehabilitation programs.³⁰

Modern ACL reconstruction postoperative protocols emphasize early restoration of knee function by resolving deficits in knee range of motion, quadriceps weakness, and antalgic gait.^{12,23,32} Despite this emphasis, literature on early functional recovery after ACL reconstruction is surprisingly sparse. In terms of functional milestone achievement, studies have documented changes in pain after ACL reconstruction,²¹ not when narcotics are discontinued. Moreover, ACL reconstruction protocols often include targets for the discontinuation of crutches,^{23,32} but the time frame in which patients discontinue crutches has been reported limitedly.³³ Finally, few or no studies have reported the time frame for returning to work,^{17,31} returning to school, or returning to driving after ACL reconstruction. In terms of self-reported function, we identified only 1 study that examined longitudinal change in the early postoperative period after ACL reconstruction,¹⁰ but a preoperative baseline was not included for comparison.

The purpose of this study was to quantify the time to early functional milestone achievement and change in function over 12 weeks after ACL reconstruction and to identify demographic characteristic predictors of the outcomes. Examining early functional recovery after ACL reconstruction is needed to fill a knowledge gap in the current literature so that clinicians can provide better counseling to patients.

METHODS

Study Design

This was a prospective, longitudinal, observational study. Data were collected before surgery as well as 1, 2, 4, 8, and 12 weeks postsurgery. Demographic characteristics were collected preoperatively. Questions about functional milestone achievement were administered at each time point by patient interview (in person or by phone) or on an electronic form.

Participants

Study participants were between 12 and 59 years of age (mean \pm SD, 28 \pm 12 years) who had received ACL reconstruction at a single institution between January 2012 and April 2014. Patients were excluded from participation if they were undergoing revision ACL reconstruction or had undergone prior surgical procedures on the operative knee. In addition, patients were excluded if they had concomitant procedures requiring protocol modifications (eg, meniscal repair, microfracture, or multiligament reconstruction). Adult patients gave written

informed consent on a form approved by the institutional review board, whereas minor patients gave written assent and a parent or guardian gave written consent on the same form.

Surgical Procedure

All surgical procedures were performed arthroscopically by 1 of 7 board-certified orthopaedic surgeons using autograft or allograft tissue. Surgical technique varied by surgeon preference and was not controlled for in this study. Autograft sources consisted of bone–patellar tendon–bone or semitendinosus and gracilis tendons; allograft sources consisted of the tibialis anterior, tibialis posterior, or Achilles tendon. All patients received a femoral nerve block prior to surgery using ultrasound guidance and 30 mL of 0.5% ropivacaine.

Postoperative Protocol

Standard procedure for discharge from postsurgical recovery included a review of written instructions on precautions due to anesthesia effects, immediate postsurgical pain management and activity, wound care, and bathing. Written instructions specific to early functional milestones were to avoid operating a motor vehicle for 24 hours after surgery or while taking narcotic pain medication. Return to work was allowed approximately 7 days after surgery, and weightbearing was allowed as tolerated with crutches. Postoperative bracing was based on surgeon preference and was not standardized. All patients received a prescription for an oxycodone-containing narcotic to be used as necessary for pain every 4 to 6 hours. Supplemental pain medications varied depending on surgeon preference.

All patients were referred to begin physical therapy 1 to 2 days after surgery. The ACL reconstruction rehabilitation protocol used at our facility and given to patients undergoing rehabilitation at outside facilities allows for immediate weightbearing as tolerated. The emphasis of the first 6 weeks of rehabilitation is on decreasing knee effusion, developing quadriceps control, and regaining full knee motion, specifically full knee extension within the first 2 weeks. The next 6 weeks of rehabilitation are focused on increasing lower extremity muscle strength, muscle endurance, and neuromuscular control. Patients were seen for regular follow-up visits with the surgeon or other medical staff, which were typically scheduled for 3 to 7 days and 2, 4, 8, and 12 weeks postsurgery. Patient and clinician discussion or decision-making related to functional milestone achievement were not monitored in this study.¹⁷

Demographic Characteristics

Variables collected were age, sex, height, weight, side of surgery, driving status (yes/no), graft source (autograft/allograft), graft type, concomitant procedures (eg, partial meniscectomy or abrasion chondroplasty), work status, occupation, and patient-reported occupational physical demands. Height and weight were used to compute body mass index (BMI). Work status was classified as full-time student, employed, or unemployed. For occupational physical demands,

patients indicated whether their work was mainly sedentary or had light, moderate, or high physical demands. Patients were not given specific instructions or definitions on how to classify their physical demands (eg, based on lifting amount or frequency, standing duration, stooping).

Measures of Functional Recovery

Time from surgery until functional milestone achievement (discontinuation of narcotic pain medication and crutches as well as return to work, school, or driving) was calculated in days. These functional milestones were selected because they represent independence with key activities of daily living. At each testing time point, patients were asked the following questions: (1) Are you still using narcotic pain medications? If “no,” report the date you last used narcotic pain medications; (2) are you still using crutches? If “no,” report the date you last used crutches; (3) are you off work or school because of your knee surgery? If “no,” report the date that you returned to work or school; and (4) are you driving? If “yes,” report the date you returned to driving. Similar methodology has been used to report return to work after ACL reconstruction.¹⁷ Patients were only asked questions applicable to them. Once a functional milestone was met, the patient was not asked about it at subsequent testing sessions. Return to work or school was defined as the number of work or school days missed due to the recovery from surgery and not the number of days for full unrestricted return of all physical aspects associated with being an employee or student. The calculation did not take into account the number of nonwork or nonschool days missed, such as holidays.

Self-reported function was assessed using the Short Musculoskeletal Function Assessment (SMFA) questionnaire at all time points except 2 weeks postoperatively. The SMFA consists of 46 items that can be scored for multiple subscales.²⁹ Subscale scores range from 0 to 100, with higher scores indicating more difficulty. The subscales analyzed in this study were daily activities and mobility. The daily activities subscale asks patients how much difficulty they had over the past week with 10 tasks, such as driving, housework, regular work, and going out independently. The mobility subscale asks patients how much difficulty they had over the past week with 9 tasks, such as bathing, climbing stairs, walking, and pivoting. The SMFA has been shown to be responsive to change over time after musculoskeletal injury.^{6,9,29}

Data Management and Statistical Methods

Statistical analysis was performed using SAS Enterprise Guide software (v 5.1; SAS). Patients who met eligibility criteria and had no more than 1 missing functional milestone response were included in the study sample. Demographic characteristics were compared between the study sample and patients excluded from analysis using independent-samples *t* tests or chi-square analysis, as appropriate.

Descriptive statistics were generated for the functional recovery measures. Data were inspected visually and tested for normality

with the Shapiro-Wilk test. All functional milestone achievement data were found to have nonnormal distribution, generally with right (positive) skew. Thus, the nonparametric Wilcoxon signed rank test was used to compare achievement of each functional milestone against the median benchmark for that milestone. Scores on the SMFA subscales (daily activities and mobility) were also inspected and tested for normality at each time point and found to have nonnormal distribution at more than 1 time point. Thus, the nonparametric Friedman test was used to examine change over time in postsurgical SMFA subscale scores. Only patients with a complete set of SMFA subscale scores were analyzed. Effect sizes (Cohen *d*) estimated the magnitude of change in SMFA subscale scores compared with the preoperative score and with the score from the prior time point.

Logistic regression analysis was used to identify demographic characteristic predictors of functional milestone achievement. For each functional milestone, patients were coded as “1” if the milestone was achieved less than or equal to the median value (faster recovery) and “0” if the milestone was achieved greater than the median value (prolonged recovery). Demographic characteristic predictors included in all models were age, sex, BMI, graft source, and concomitant surgical procedures. In addition, occupational physical demand was included in the model for return to work, and side of surgery (left/right) was included in the model for return to driving.^{14,31} Dummy coding for categorical variables was “0” for males, allografts, no concomitant surgical procedures, sedentary/light occupational physical demand, and left-side surgery; the converse classification was coded as “1.” An odds ratio (OR) was computed for variables in the model and represented the ratio of odds for faster recovery to the odds for prolonged recovery. An OR greater than 1 implied that a categorical variable coded as 1 or a higher value of a continuous variable was associated with increased odds of faster recovery. An OR less than 1 implied that a categorical variable coded as 1 or a higher value of a continuous variable was associated with decreased odds of faster recovery; however, to aid the interpretation of an OR less than 1, the inverse of the OR was computed and the narrative adjusted to reference increased odds of faster recovery.²⁷ Linear regression analysis was used to identify demographic characteristic predictors of the postsurgical change in SMFA subscale scores (12 weeks-1 week postsurgery). For all regression models, the criterion for entry was $P \leq 0.05$ and the criterion for removal was $P > 0.10$.

A *P* value < 0.05 was considered statistically significant for the analyses. However, due to the large number of tests comparing functional milestone achievement against the median benchmark, a Bonferonni correction was made (0.05/5), resulting in $P < 0.01$ for this analysis.

RESULTS

Data collection time points were a mean \pm SD 22 \pm 17 days before surgery and 8 \pm 3, 14 \pm 3, 24 \pm 5, 46 \pm 6, and 90 \pm 10 days postsurgery. A total of 250 patients were enrolled in the

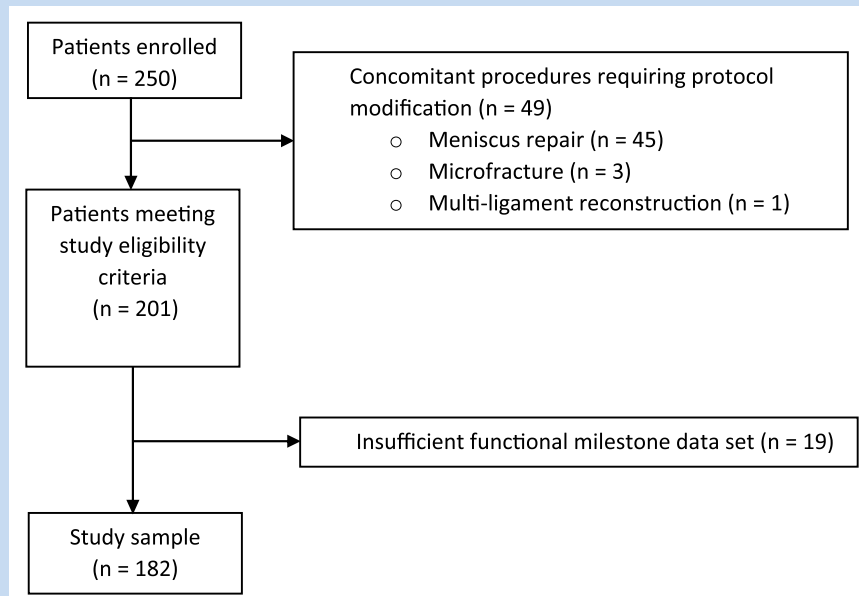


Figure 1. Participant flow diagram.

study. Of these, 49 patients were excluded from analysis due to concomitant procedures that required protocol modifications. An additional 19 patients were excluded from analysis because of incomplete functional milestone data. Therefore, the study sample consisted of 182 patients (87 males, 95 females) (Figure 1). Demographic information for the study sample and patients excluded from analysis can be found in Table 1. There was a significant difference in surgical side and graft source between patients in the study sample and those excluded from analysis ($P < 0.05$). However, the group of patients included in the study sample represented a more equal distribution in surgical side and graft source than those excluded.

The study sample was nearly equally composed for sex (48% males). Most had ACL reconstruction with an autograft (85%), and patients with an autograft were younger than those with an allograft (25 ± 11 vs 44 ± 7 years, respectively). Fifty-six percent of patients had isolated ACL reconstruction, and the remainder received concomitant surgical procedures not requiring a postoperative protocol modification. Regarding occupation, distribution was fairly evenly divided between full-time student (44.5%) and employed (53.8%) categories. Of participants who identified as being employed full-time, 58% classified their occupational physical demands as sedentary/light and 42% as medium/heavy.

Histograms showing the time to achievement of each functional milestone can be found in Figure 2. Median times for achieving each functional milestone were less than 16 days. Return to school was the first functional milestone achieved, with a median of 7 days, in which 100% of the eligible patients (ie, full-time students) had returned by 4 weeks. In contrast, 14% and 27% of eligible patients required more than 4 weeks to

discontinue crutches and return to moderate/heavy work, respectively.

Scores on the SMFA mobility and daily activities subscales can be found in Table 2. Scores on both SMFA subscales significantly decreased (improved) over time ($P < 0.01$) and significantly changed at each time point ($P < 0.01$). Based on the magnitude of the effect sizes, the largest improvement in SMFA scores occurred between 1 and 4 weeks postsurgery for both the daily activities ($d = 1.92$) and mobility ($d = 1.61$) subscales. Scores on both SMFA subscales were not better than presurgery values until 8 weeks postsurgery. The amount of change between 1 and 12 weeks postsurgery was 59.3 points (SD, 16.9 points) and 45.4 points (SD, 13.9 points) for the daily activities and mobility subscales, respectively.

Demographic predictors of functional milestone achievement can be found in Table 3. Multiple significant demographic predictors were identified for faster recovery on return to work and return to driving. For return to work, the OR was positive for age and negative for sex, BMI, and occupational demand. After conversion, the odds of faster return to work were increased with each year increase in age (OR, 1.08), male sex (OR, 6.25), each unit decrease in BMI (OR, 1.18), and sedentary/light occupational demand (OR, 7.69). For return to driving, the OR was positive for age and negative for sex and side of surgery. After conversion, the odds of faster return to driving increased with each year increase in age (OR, 1.06), male sex (OR, 3.33), and surgery on the left side (OR, 4.06). Finally, graft source was identified as a demographic characteristic of interest for discontinuation of narcotic pain medication (OR, 0.43; $P = 0.05$). With conversion, odds for faster discontinuation of pain medicine was increased 2.33 times for allograft compared with

Table 1. Demographic information for participants enrolled in the study

Variable	Study Sample (n = 182)	Excluded From Participation (n = 68)
Age, y, mean (SD)	28.2 (12.5)	25.3 (10.9)
BMI, kg/m ² , mean (SD)	25.5 (4.3)	25.7 (5.6)
Sex, n		
Male	87	38
Female	95	30
Surgical side, ^a n		
Right	86	42
Left	96	26
Occupation, n		
Full-time student	81	35
Employed	98	33
Unemployed	3	0
Driving status		
Drove prior to surgery	154	54
Did not drive prior to surgery	28	14
Graft source, ^a n		
Allograft	28	5
Autograft	154	63
Autograft type, n		
Bone–patellar tendon–bone	84	29
Semitendinosus and gracilis	70	34
Procedures, n		
Isolated ACL reconstruction	102	10
Concomitant procedures without protocol modification	80	9
Concomitant procedures with protocol modification	0	49

ACL, anterior cruciate ligament; BMI, body mass index.

^aSignificant difference between the study sample and those excluded, $P < 0.05$.

autograft. Table 4 compares functional milestone achievement for demographic characteristics found to be significant predictors of faster recovery. No demographic characteristics were found to be significant predictors of the postsurgical change in SMFA subscale scores.

DISCUSSION

This study examined early functional recovery after ACL reconstruction and the contribution of patient demographic characteristics. Each of the selected early functional milestones

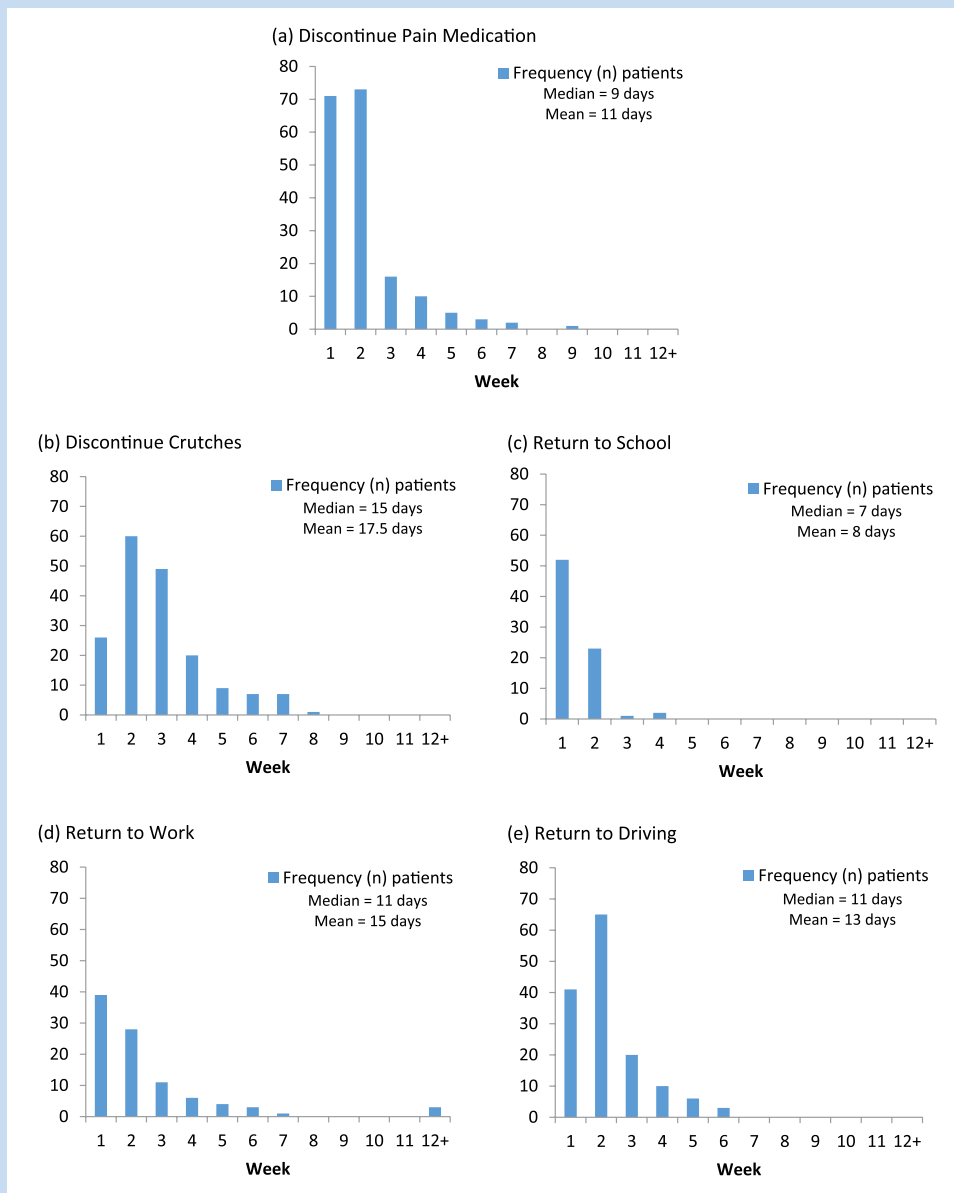


Figure 2. Frequency (n) of patients who achieved functional milestones each week after surgery: (a) discontinue pain medication, (b) discontinue crutches, (c) return to school, (d) return to work, and (e) return to driving.

was achieved at a median 15 days postsurgery or less; however, some patients took longer than 1 month to achieve the functional milestones, with the exception of return to school. In addition, self-reported function improved over 12 weeks postsurgery, with the largest magnitude of improvement seen within the first month postsurgery. Demographic predictors of faster recovery were found for discontinuing narcotic pain medications, return to work, and return to driving. No demographic predictors were found for the change in self-report of function. Taken together, the findings show that

functional recovery occurs rapidly in the first month after ACL reconstruction, and demographic characteristics can influence recovery on specific functional milestones. Study results may be used by clinicians in preoperative counseling to guide expectations with regard to functional recovery after ACL reconstruction, which may increase overall patient satisfaction.²⁵ In addition, the data could be reinforced when setting functional goals during postoperative rehabilitation. Setting and achieving goals during rehabilitation has been shown to increase motivation and may increase adherence to rehabilitation.³¹

Table 2. Short Musculoskeletal Function Assessment (SMFA) subscale scores and effect sizes at each testing time point^a

SMFA Subscale	Presurgery	Postsurgery			
		1 Week	4 Weeks	8 Weeks	12 Weeks
Daily activities, mean (SD)	24.3 (17.5)	66.7 (18.9) ^{b,c}	33.3 (15.8) ^{b,c}	19.2 (14.2) ^{b,c}	9.4 (8.3) ^{b,c}
Effect size for daily activities		Presurgery to 1 week $d = 2.33$	Presurgery to 4 weeks $d = 0.54$	Presurgery to 8 weeks $d = -0.32$	Presurgery to 12 weeks $d = -1.09$
			1 week to 4 weeks $d = -1.92$	4 weeks to 8 weeks $d = -0.94$	8 weeks to 12 weeks $d = -0.84$
Mobility, mean (SD)	32.0 (17.8)	58.8 (13.5) ^{b,c}	36.7 (13.8) ^c	21.7 (13.3) ^{b,c}	13.7 (11.6) ^{b,c}
Effect size for mobility		Presurgery to 1 week $d = 1.70$	Presurgery to 4 weeks $d = 0.30$	Presurgery to 8 weeks $d = -0.66$	Presurgery to 12 weeks $d = -1.21$
			1 week to 4 weeks $d = -1.61$	4 weeks to 8 weeks $d = -1.11$	8 weeks to 12 weeks $d = -0.64$

^aA negative effect size indicates a decrease (improvement) in score.

^bSignificant difference from presurgical score.

^cSignificant difference from previous time point.

Median values and ranges for functional milestone achievement in this study can give clinicians and patients a better understanding about the timelines for early functional recovery. Patients discontinued narcotic pain medication at a median of 9 days postsurgery, with a maximum of 44 days postsurgery for any patient. We are unaware of previous studies reporting this outcome. Graft source was the only demographic characteristic found to predict pain medication duration; however, our study did not track frequency or morphine-equivalent doses. Additional research is needed to determine possible reasons for prolonged use and to establish a recommended prescribing regimen to manage pain effectively after ACL reconstruction. We found that crutches were discontinued at a median 15 days postsurgery; another study³³ reported that crutches were discontinued on average more than 20 days after ACL reconstruction. These findings suggest that independent gait can take longer than the 2-week target in published protocols.^{8,18}

The median time for return to work in our study was 11 days postsurgery compared with an average of 11 to 15 weeks postsurgery in previous studies.^{17,31} However, most of our sample classified their occupational physical demands as sedentary/light, which would facilitate a faster return to work. Return to work was relatively fast for employees with medium

and heavy occupational physical demands compared with other studies.^{17,31} Patients were not given specific parameters for defining their occupational demand, so it is unknown how the classification of medium and heavy occupational physical demand in this study compares with other studies. Return to school was achieved in the fastest median time (1 week postsurgery) of all functional milestones, and all patients met the milestone within 1 month postsurgery. This result supports the 2-week target for return to school in a published protocol.⁸ We advise caution when interpreting the findings for return to work and school, as patients were not asked to define their status (eg, limited vs full return), and once the functional milestone was met, were not asked about it again, making it possible that some patients reverted in status.

In this study, the median time for return to driving was 11 days, but further analysis showed values of 10 days after left-sided surgery and 13 days after right-sided surgery. Previous studies have found that brake response times return to normal at 1 to 2 weeks after surgery to the left lower extremity and 3 to 6 weeks after surgery to the right lower extremity.^{14,15,22} We recognize that patients with right-sided ACL reconstruction may need to drive soon after surgery due to a lack of other transportation options, but clinicians should formally educate them about safety concerns for potentially driving before

Table 3. Demographic predictors for each functional milestone

Functional Milestone	Recovery Group (n)		Predictors in Model		Odds Ratio [CI]	P Value			
	Faster	Slower							
Discontinue pain medicine	92	90	Graft source		0.43 [0.18, 1.0]	0.05			
Discontinue crutches	93	89							
Return to work	52	43	Step 1	Occupational demand	0.12 [0.05, 0.31]	<0.01			
			Step 2	Sex	0.33 [0.13, 0.87]	<0.03			
				Occupational demand	0.14 [0.05, 0.36]	<0.01			
			Step 3	Age	1.06 [1.0, 1.12]	0.03			
				Sex	0.26 [0.09, 0.73]	0.01			
				Occupational demand	0.15 [0.05, 0.39]	<0.01			
			Step 4	Age	1.08 [1.0, 1.1]	0.02			
				Sex	0.16 [0.05, 0.53]	<0.01			
				Body mass index	0.85 [0.74, 0.98]	0.02			
				Occupational demand	0.13 [0.05, 0.38]	<0.01			
			Return to school	52	26				
			Return to driving	87	67	Step 1	Age	1.06 [1.02, 1.09]	<0.01
Step 2	Side of surgery	0.32 [0.16, 0.65]				<0.01			
	Age	1.05 [1.02, 1.09]				<0.01			
Step 3	Sex	0.30 [0.14, 0.65]				<0.01			
	Side of surgery	4.06 [1.89, 8.72]				<0.01			
	Age	1.06 [1.02, 1.09]				<0.01			

braking ability is fully restored and the need for cautious driving.

Findings of a large improvement in self-reported function in the first month postsurgery with smaller gains up to 12 weeks postsurgery mirrors the results of a previous study.¹⁰ Our study included a presurgical time point, which helped show that it took until 8 weeks postsurgery for function to improve on presurgical values. Providing this information to patients during presurgical counseling may be useful as they can estimate their early postsurgical functional status based on presurgical functional status. Scores on both subscales of the SMFA were near normative levels at 12 weeks postsurgery.¹³ Reaching normative levels on the SMFA subscales takes longer than the time to reach early functional milestones because SMFA subscales encompass a broad spectrum of functional activities.

Nonmodifiable patient demographic characteristics were found to be associated with recovery time for discontinuing pain

medication, return to work, and return to driving. Shorter duration of narcotic pain medication use was predicted by surgery with allograft. Faster return to work was predicted by higher age, male sex, lower BMI, and sedentary/light occupational demand; faster return to driving was also predicted by higher age and male sex, in addition to surgery on the left side. These nonmodifiable factors may help clinicians identify patients with a higher risk for delayed recovery. Professionals should consider modifying preoperative counseling accordingly to establish realistic expectations while preparing those more likely to have a delay in milestone achievement and educating those more likely to push functional limitations. Interestingly, demographic characteristics were not found to be significant predictors of the change in self-reported function. The possible disconnect between demographic characteristics predicting specific functional milestone achievement and not self-reported function may be because the SMFA subscales encompass a wide

Table 4. Median (range) days to functional milestone achievement

Demographic Characteristic	Discontinue Pain Medicine	Return to Work	Return to Driving
Sex			
Female		14 (1-85), n = 43	12 (0-38), n = 71
Male		7 (1-78), ^a n = 52	11 (3-42), ^a n = 77
Side of surgery			
Right			13 (3-42), n = 67
Left			10 (0-35), ^a n = 81
Graft source			
Allograft	6.5 (1-20), ^a n = 28		
Autograft	10 (1-57), n = 153		
Occupational demand			
Sedentary/light		7 (1-34), ^a n = 55	
Medium/heavy		16 (1-85), n = 38	

^aAll group comparisons $P < 0.05$.

range of activities. A previous study found age to be a significant predictor of change on the International Knee Documentation Committee questionnaire in an ACL reconstruction population over the same time period.¹⁰ A possible reason for the difference in results between studies is that the self-reported measure was different across studies.

The main strength of this study is the longitudinal data collection on functional milestone achievement and self-reported function in the early period after ACL reconstruction. Previous studies on functional recovery after ACL reconstruction have focused on pain management, provider recommendations for return to work, safety concerns for return to driving, and rehabilitation goals for return to weightbearing without crutches.^{18,22,24,32,33} No studies have asked patients directly when they discontinued narcotic pain medication and crutches as well as when they returned to work, school, or driving. This study calculated the number of days for actual milestone achievement regardless of provider instruction or possible patient noncompliance with rehabilitation. This study adds to the small body of literature on the topic.

A limitation of the study is that clinician recommendations for functional milestone achievement were not controlled. Although clinician recommendations can influence the timing of functional milestone achievement, patients do not always follow clinician recommendations. Another limitation is the criteria used for reporting of milestone achievement. Few studies report when patients actually return to specific activities regardless of clinician counseling or safety concerns.¹⁷ The methodology used in this study did not count for nonwork or nonschool days

missed, such as holidays, and would not account for patients who achieved a milestone only to revert back at a later date. Patients were not queried about possible lapses in milestone achievement at subsequent visits; however, this would be recommended for future research. The primary method of data collection was patient self-report, and recall bias is possible. However, recall bias was minimized by contacting patients multiple times over the course of the study. The number of rehabilitation visits was also not controlled for, and it is possible that more or fewer rehabilitation visits could influence knee impairment resolution and functional recovery outcomes in the early postoperative period, although a study comparing 4 to 17 rehabilitation visits after ACL reconstruction found no difference in knee impairment outcomes at 12 weeks postsurgery.¹⁶ Per our protocol, patients generally receive 1 to 2 visits per week for the first 12 weeks after ACL reconstruction; thus, we estimate the mean number of visits to fall between 12 and 24. Finally, the criteria for classification of occupational physical demands were not controlled. Our study did not define the strenuousness of occupational physical demands before having participants self-select a category, which could introduce bias from under- or overestimating occupational physical demands.

CONCLUSION

Functional recovery is rapid in the first 12 weeks after ACL reconstruction for most patients. Sex, work physical demand, side of surgery, and graft source were found to influence recovery for specific functional milestones. Results of this study

can be used to counsel patients on expectations for early functional recovery after ACL reconstruction; this may improve rehabilitation adherence and surgical satisfaction.

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