Subjective Evaluation of Function Following Moderately Accelerated Rehabilitation of Anterior Cruciate Ligament Reconstructed Knees

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Abstract: *Rehabilitation protocols following anterior cruciate ligament reconstructions have become increasingly aggressive in the past several years, preparing the patient to return to sport activities within 4 to 6 months. In 1989, we initiated a moderately accelerated protocol and were interested in the long-term effects of early weight bearing, immediate full motion, early incorporation of closed chain activities, and early return to sport. We received responses from 58 of 180 patients surveyed. All had undergone a bone-patellar tendon-bone autograft reconstruction procedure 12 to 21 months prior and had followed the rehabilitation protocol described. Results of the Lysholm Knee Scoring Scale and a questionnaire regarding preinjury and postinjury activity levels, pain and stability ratings, and current activity indicated that the majority of these patients had returned to sport and recreation and were participating at levels of moderate to high intensity with little or no difficulty.*

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ACL tears are one of the more prevalent injuries encountered in the sports medicine clinic. In recent years, surgical reconstruction procedures, and, consequently, rehabilitation protocols have undergone considerable change. A better understanding of graft fixation and revascularization, as well as less invasive, less traumatic surgical techniques, has allowed a more aggressive approach to the recovery of range of motion and quadriceps strength during the very immediate postoperative phases of rehabilitation.[7] Thus, an earlier return to functional activities is possible.

While there is a general trend toward an accelerated rehabilitation process, current protocols vary somewhat concerning the actual time when motion, weight bearing, and functional activities are allowed. There are numerous reports on the objective outcomes of these various rehabilitation protocols.[2-4,7] Objective measures usually include range of motion, knee-arthrometer measures of ligament stability, and isokinetic measures of quadriceps and hamstring peak torque and endurance. These measures are intended to lend credence to recovery methods and provide the physician, athletic trainer/therapist, and patient a means of estimating postoperative progress and a basis on which to determine return to functional activity. While we agree that this objective information is extremely important and necessary in tracking a postoperative course, we suggest that other measures such as pain, sensations of mechanical abnormalities (locking, catching, etc) and the patient's perception of knee stability, although subjective, might contribute as much or more to the patient's decision to resume his/her preinjury activity level.

Approximately three years ago, we began a more aggressive approach to ACL rehabilitation, ie, immediate full range of motion, immediate partial weight bearing, full weight bearing with crutches at 4 weeks, off crutches by 6 weeks, closed chain activities at 4 weeks, and a return to functional activities and sports by 6 months. (More recently, we have shortened these time frames.) Three years ago, this was considered an aggressive protocol in light of traditional beliefs that a maximal control of external forces was necessary to protect the integrity of the graft.[5] While the objective results during the standard follow-up of these patients (range of motion, isokinetic strength tests, and ligament laxity assessment) suggested that this protocol was not damaging and did facilitate a faster recovery, we were interested in the patients' assessments of their knee functions, as well as their activity levels 1 to 2 years after the procedure.

Materials and Methods

We surveyed 180 patients who had undergone a bone-patellar tendon-bone autograft reconstruction procedure between January and November 1990. All of these procedures were performed by one of two surgeons in one clinic, and all patients had followed the same rehabilitation protocol (Table 1). Although 74 patients responded, only the 58 who were at least one full year beyond surgery (range of 12 to 21 months, $\bar{x}$=16) were included in this study. The group consisted of 34 females and 24 males and ranged in age from 14 to 56 years ($\bar{x}$=29). Twenty-two of 58 had undergone meniscal repairs as well.

Table 1.—Modified Accelerated Rehabilitation Program

Time After Reconstruction	Rehabilitation Activities
Pre-op (7-10 days)	QF and HS isometrics; SLRs (all planes); HS stretch; ROM (A,AA and PROM); cryotherapy
2-3 days	Discharge from hospital. Prerequisites: 1) able to do SLR; 2) full extension; 3) 90° flexion desirable; 4) 20- to 30-lb weight-bearing, emphasis on heel-toe gait. Continue pre-op activities.
5-7 days	ROM-full extension; active-assisted flexion; strengthening: E-stim and/or biofeedback-assisted SLRs, partial weight-bearing (heel-toe gait); patellar mobilization; outpatient physical therapy 2/wk to 3/wk
10-14 days	ROM (0°-90°); bicycle for ROM only; SLRs with weights; Continue pre-op activities
2-4 weeks	ROM (0°-120°); multi-angle (90°-45°) isometric QF workout on Kin-Com; hydrotherapy (SLRs, ROM, gait training)
4-6 weeks	ROM (0°-140°); full weight-bearing with crutches as tolerated (wean from crutches when normal gait is possible); closed chain activities: Nordic track, Stair-master, mini-squats, step-ups; passive mode concentric QF/HS exercise on KIN-COM (90°-45°); Isotonic PREs with light weights (90°-45°); bicycle for conditioning
6-12 weeks	Increase isotonic PREs (QF and HS curls, leg press, hip, calf raises); eccentric HS on Kin-Com; proprioceptive training
3-4 months	KT-1000 evaluation; velocity mode on Kin-Com for QF and HS; continued closed chain activity; Proprioceptive training; sport cord running in pool (forward/backward); continue PREs; light running allowed
4-6 months	Isokinetic evaluation at 60°/s and 180°/s; KT-1000; in a functional brace begin agility workouts and sport-specific activities
6-8 months	Return to athletics with functional brace

QF = quadriceps femoris muscle
HS = hamstring muscle
SLR = straight leg raise
ROM = range of motion
PRE = progressive resistive exercise

The survey included the Lysholm scale[9] (Table 2) and an additional short questionnaire designed by us to assess preinjury and postinjury activity levels and current pain and stability ratings during both daily activities and recreational activities (Table 3).

Results

The preinjury activity level of this group was generally high. Of the 58 patients, 27 (46%) were level 5 or 4 (regular organized sport, training and/or competitive participation), 30 (52%) were level 3 or 2 (regular runner/walker/sport participant), and only 1 (2%) indicated that she engaged in absolutely no physical activity.

Postoperative data indicated that 41 patients (71%) returned to their preinjury activity level and 2 (3%) actually increased their activity. Of the 15 patients who indicated a decrease in activity, 8 dropped one level, 4 dropped two levels, and 3 dropped three levels.

The Lysholm knee function score had a mean of 87±11, (range, 55 to 100). Eighteen (31%) had an excellent function score (95 points), 22 (38%) had a good function score (84-94 points) and 18 (31%) had a score of less than 84 points with deficits resulting from primarily high intensity activity. The distribution of ratings across each Lysholm factor is presented in Table 4.

Pain ratings were low during both daily (2±1.4) and recreational activity (2.5±1.6). Stability ratings were good during both daily (1.9±1.6) and recreational (2.6±2) activities.

Patients had continued a regular strengthening program for an average of 8.5±3.5 months (range, 1 to 12) and were involved in a variety of activities at the time of the survey. Twenty (34%) had returned to team sports (11 on a competitive level), 36 (62%) were involved in such individual activities as racquetball, cycling, tennis, snow and water skiing, running, aerobics, and hiking. Only 2 (3%) individuals were not involved in any activity, and one of these patients had been inactive even prior to the injury.

Discussion

Following an ACL injury and reconstruction, the return to functional activities is a primary goal of both the clinical staff and the patient. Surgical advances along with accelerated rehabilitation procedures have made it possible to meet the physical criteria to return to sport and recreational activities within a 4- to 6-month period. Objective measures of strength and stability might allow an early return, but, for a successful return, the patient must regain confidence and actually feel that the knee is stable, strong, and capable of performing.

As noted, the preinjury activity levels of this group were generally high, with all but one individual involved in some degree of recreational or competitive physical activity. Our 74% return to preinjury activity level is encouraging in light of Engebretsen et al's[1] report of a 64% return observed in a similar 1- to 2-year follow-up of the patellar tendon augmentation method. Our rehabilitation protocol, however, was much more aggressive than that used by Engebretsen et al, and this might have accounted for the difference. Other studies have reported return to preinjury activity rates of 18% to 77%, but the follow-up periods ranged from 5 to 16

years, and the reconstruction and rehabilitation methods differed.[1,4,6,7]

The majority of patients (69%) rated their knee function good to excellent (84-100). The remaining 31% reported scores that would be considered moderate to low function (<84), but the deficits were generally reflective of function during "severe exertion." Therefore, although these patients were reportedly symptomatic, they were symptomatic as a result of moderate to high intensity activities, eg, running, cycling, hiking, skiing, and team sports. The average score for our study population was 87. Other accounts of postoperative Lysholm scores report averages of 81-88 at a similar follow-up date.[1,6] It is difficult to compare these reports because they represent different operative and rehabilitation methods; but, it does appear that our protocol resulted in an equal or better than average functional rating.

Our patients' subjective ratings of their pain and stability on the two different instruments were in agreement. On our instrument, pain ratings were low, averaging 2 and 2.5, respectively, during daily and recreational activities. Stability ratings were very good, averaging 1.9 and 2.6 during daily and recreational activities. Lysholm pain and stability ratings were consistent (pain: $\bar{x}$=20, "inconstant/slight"; stability: $\bar{x}$=20, "rarely with athletics or other severe exertion") and indicated that patients were functioning at a generally pain-free and stable level 1 to 1½ years following ACL reconstruction. More importantly, 35% were participating in team sports (more than half at a competitive level), and 62% were participating in individual sports, some of which would be considered moderate to high intensity (racquetball, snow and water skiing). Only 2 individuals (3%) considered themselves inactive.

Table 2.—Lysholm Knee Scoring Scale[9]

Under each category, please mark the ONE item which best describes your current condition:

LIMP		
	None	**5**
	Slight/periodical	**3**
	Severe/constant	**0**
SUPPORT		
	None	**5**
	Stick/crutch	**2**
	Unable to bear weight	**0**
LOCKING		
	No locking/catching	**15**
	Catching/no locking	**10**
	Lock occasionally	**6**
	Lock frequently	**2**
	Locked joint (exam)	**0**
INSTABILITY		
	Never gives way	**25**
	Rarely during athletics or other severe exertion	**20**
	Frequently during athletics or other severe exertion (or incapable of participation)	**15**
	Occasionally in daily activities	**10**
	Often in daily activities	**5**
	Every step	**0**
PAIN		
	None	**25**
	Inconstant/slight during severe exertion	**20**
	Marked during severe exertion	**15**
	Marked on or after walking more than 1.5 miles	**10**
	Marked on or after walking less than 1.5 miles	**5**
	Constant	**0**
SWELLING		
	None	**10**
	On severe exertion	**6**
	On ordinary exertion	**2**
	Constant	**0**
STAIR-CLIMBING		
	No problem	**10**
	Slightly impaired	**6**
	One step at a time	**2**
	Impossible	**0**
SQUATTING		
	No problems	**5**
	Slightly impaired	**4**
	Not beyond 90°	**2**
	Impossible	**0**

Conclusion

The rehabilitation protocol that this group of patients followed was designed to prepare them physically for an early return to normal activity levels. The intent of this survey was to determine whether or not they actually had returned to the rigors of sport and recreation. The information obtained indicates that the majority of these people have returned and are participating at levels of moderate to high intensity with little or no difficulty.

For the orthopedic surgeon, ligament reconstruction is the most effective way to achieve normal knee biomechanics and avoid disabling articular changes. For many patients, it is, simply and

primarily, the most effective way to return to a physically active lifestyle. The clinician might determine postoperative progress and the ability to return to sport and play by measures of strength, range of motion, and ligament laxity. The patient, however, has the unique perspective of perception of function, and this too will be a factor in his/her decision to resume preinjury activity levels. Postoperative knee rehabilitation protocols continue to become more "accelerated," and patients are expected to progress quickly. Currently, we encourage full weight bearing at 2 to 3 weeks, off crutches as early as 4 weeks and return to sport as early as 4 months. In tracking the postoperative course, perhaps a periodic assessment of the patient's perception of joint function should accompany the traditional objective evaluations.

References

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Table 3.—Activity level, pain and stability questionnaire

1. Activity level before injury and surgery (circle one)
- **a. I do not participate in any sport or recreational activity on a regular basis.**
- **b. I participate regularly in recreational running and/or walking.**
- **c. I participate regularly in recreational running and/or walking and individual sports.**
- **d. I participate regularly in organized team sports and/or training.**
- **e. I participate regularly as a competitive athlete.**

2. Activity level now: (designate one of the above choices, ie, a-e) ____.

3. Estimate the pain you presently experience during normal daily activities:

1------2------3------4------5------6------7------8------9------10

no pain — **unbearable pain**

4. Estimate the pain you presently experience during recreational activities:

1------2------3------4------5------6------7------8------9------10

no pain — **unbearable pain**

5. Estimate how stable your knee feels during normal activity:

1------2------3------4------5------6------7------8------9------10

very stable — **very unstable**

6. Estimate how stable your knee feels during recreational activity:

1------2------3------4------5------6------7------8------9------10

very stable — **very unstable**

7. How long did you continue a regular strengthening program following your surgery?

8. List specific physical activities that you are now involved in on a regular basis.

Table 4.—Distribution of responses to Lysholm Items (n=58)

	Response Avg (possible)		Problems Indicated by Patient* None	Moderate	Significant
Limp	4.5	(5)	40	18	0
Support	5.0	(5)	58	0	0
Catching/Locking	14.0	(15)	45	13	0
Instability	21.0	(25)	37	12	9
Pain	20.0	(25)	50	7	1
Swelling	8.0	(10)	37	17	4
Squat	4.2	(5)	20	36	2
Stairs	8.7	(10)	42	14	2

***Problems**

None = patient indicated absolutely no deficiencies

Moderate = patient indicated rare or occasional problems during severe exertion or only slight impairments

Significant = patient indicated frequent problems, primarily during severe exertion