

Effectiveness of Accelerated Rehabilitation for Arthroscopic Anterior Cruciate Ligament (ACL) Reconstruction in Football Players

Safaa Sayed*

Rheumatology and Rehabilitation Department, Faculty of Medicine, Cairo University, Egypt

*Corresponding author: Safaa Sayed, Rheumatology and Rehabilitation Department, Faculty of Medicine, Cairo University, Egypt, Tel: 2020101411027; E-mail: dr.safaasayed@gmail.com

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Introduction

Anterior cruciate ligament (ACL) injury in professional athletes can cause long lay-off from sports and may be career threatening [1]. On average, one player will suffer an ACL injury every second season in a professional men's football team squad [2]. Serious injuries have not dropped in men's professional football in the past decade, and prevention of ACL injury is a priority area within sports medicine research [1]. Despite significant advances in the diagnostics and treatment of knee injuries over the last decade, several challenges related to 'return to sport' remain largely unknown. UN-answered questions regarding the optimal timing to return, the type of training that should be used, the measurements that can support the decision-making process and how to optimally prepare athletes for competition without risking re-injury, still exist [3].

Knee injury is a 3-fold potential risk factor for developing osteoarthritis (OA) in retired professional football players under the age of 60 [4]. ACL injury, especially with concomitant meniscal or other ligamentous pathology, predisposes the knee to an increased risk of OA. Alone ACL reconstruction has not been shown to reduce the risk of future OA; weight management, avoidance of excessive musculoskeletal loading and strength training are further important strategies [5].

The speed and safety with which an athlete returns to sports (or regains the pre-injury level of function) depends on many factors including the rehabilitation protocol [6]. Despite anticipation of positive surgical results based on current technical methodology, even well-performed ACL surgery can result in a poor outcome if rehabilitation is not conducted appropriately. Arthrofibrosis may occur with an acute repair of the ACL and is associated with a much higher incidence of postoperative motion deficits. Although the time from injury is important, the condition of the knee is more crucial for surgical timing [7]. ACL reconstruction ensures structural ligament repair, whereas rehabilitation protects and maintains the ligament repair and the physical and psychological state and performance capabilities of the athlete. There is consensus about ACL reconstruction techniques; however, worldwide rehabilitation protocols post-ACL reconstruction lack agreement which led to uncertainties and diverse approaches [8].

Rehabilitation is an important part of the treatment and return to high level of athletic activity has been an indicator of success [9]. Rehabilitation concepts after ACL reconstruction continue to advance rapidly [10]. Early intensive rehabilitation approach may lead to faster functional recovery without complications compared to conventional rehabilitation treatment [11]. Key features of a successful rehabilitation program are pain control, improved range of motion (ROM) and quadriceps strengthening [12]. Open and closed kinetic chain exercises

can be used to effectively and safely strengthen the quadriceps after ACL reconstruction without causing excessive ACL strain or patellofemoral joint stress [13]. The quadriceps is critical to dynamic joint stability, and its weakness is related to poor functional outcomes, thus identifying strategies to minimize quadriceps weakness following ACL injury and reconstruction is of great clinical interest [14]. Full active and passive extension immediately after ACL reconstruction may increase the knee laxity [15], however, it appears that knee braces are not needed after ACL reconstruction with the patellar tendon graft. [16]. Both open and closed kinetic chain exercises have similar effects on the healing response of the ACL-reconstructed knee and play a beneficial role in early rehabilitation [17]. Isometric quadriceps exercises and straight leg raises can be safely prescribed during the first two postoperative weeks and confer advantages for faster recovery of knee ROM and stability [18].

Even though, ACL rehabilitation protocols differ, what remains the same is the outcome that every sports medicine specialist tries to achieve. The obtaining full ROM, especially hyperextension and acceptable quadriceps muscle strength before surgery, determine surgical timing and are primary goals of early postoperative rehabilitation [7,19]. Knee impairments and disability to perform activities of daily living following ACL injury or reconstruction may be assessed by the Lysholm knee score [20].

The aim of this study was to evaluate the effectiveness and outcome of an accelerated rehabilitation program for 6 month in football players undergoing arthroscopic ACL reconstruction.

Subject and Method

This study included 50 consecutive male football players with ACL instability who were operated arthroscopically at Saudi German hospital, Riyadh, KSA and completed blinded follow-up program for 6 months in the orthopedics surgery and rehabilitation departments. During the first 6 weeks, patients performed daily 1 hour session and thereafter on an alternating day basis, in the gymnasium with underwater exercises in a pool three times/week. All patients had unilateral ACL injury without other ligamentous injuries or history of previous knee surgery. Evaluation of the knee performance, function and stability included the International Knee Documentation Committee (IKDC) score [21,22] and Lysholm knee scale [23].

Preoperatively, the patients were educated about the type of surgery and rehabilitation. Before surgery, full knee range of motion, reduced knee effusion, normal gait, good leg control and the maintenance of the quadriceps muscle strength were considered. The performed exercises included knee extensions, quadriceps sets, heel props, standing extension habit, wall slide and heel slide, straight leg raises

and gait training. Arthroscopic ACL reconstruction was carried out under general or spinal anaesthesia.

Postoperatively, an anti-embolism stocking is initially placed on the ACL-reconstructed leg along with a Cryo/Cuff used till discharge. During hospital stay, the ACL-reconstructed knee is then placed in a continuous passive movement (CPM) machine to elevate the foot above the heart. The CPM is utilized all the time except when doing exercises for slow gradual assisted flexion to reach 125 degree. Exercises were performed gradually for 1 hour when the patient was awake. Heel slide and hyperextension including heel prop and towel stretch exercises were performed. Heel prop exercises involve propping the heel on a rolled towel and then placing a 2.5-pound weight just distal to the incision of the knee surgery for a 10-min period. Following heel raises, the patient flexes the knee to a height of several inches and then relaxes it, allowing it to fall into hyperextension 5 times. To complete the extension exercises, 10 towel stretches were performed in combination with active heel raises to demonstrate quadriceps control. Crutches used until the patient is able to go up and downstairs. The patient is discharged when he can demonstrate full extension, 115 degree of flexion, and is able to lift the ACL-reconstructed leg independently i.e. (with his quadriceps muscle contraction) alone.

After hospital discharge, patients were instructed to minimize swelling by limiting out-of-bed activities for the first 5 days after surgery and using the Cryo/Cuff and CPM at all times when not performing exercises. The patients performed the exercises in the gymnasium on an alternating day basis and under water 3 times/week. Patients were instructed to conduct the exercises daily at home. High repetitions of step-up exercises on a step box, closed kinetic chain exercises as squats and open kinetic chain exercises, as quadriceps extension were performed and body weight shift (from side to side and forward-backward), balance and stretching exercises were included. Light sport activities and straight line running were allowed 2 months after surgery. If swelling occurred in the ACL-reconstructed knee or the ROM of the knee decreased at any time, the activity was reduced until full ROM was re-established. After 3 months, in order to return to competitions, strengthening exercises were advanced. Increasing the

activity level by sport training and drills such as kicking a ball and shooting, was allowed when there was full knee hyperextension and the patient was able to sit on their heels comfortably. Functional progression of sports agility and return to competitive sports were initiated after 4 months when more than 70% of the strength of the preoperative normal leg value was returned. By 6 weeks and again 6 months after surgery, patients would participate in the subjective and objective postoperative clinical evaluations and questionnaires using IKDC score and Lysholm scale. Lysholm knee scale was considered excellent when >85%, very-good when >75%, good if >65%, fair if >60% and poor when <60%. All patients gave informed consent and the study was approved by the Institutional Ethical Committee.

Statistical analysis: Analysis of data was performed with a statistical package for the social sciences (SPSS) IBM Statistics 20.0 (soft 32.com server) version 18. Data were presented as mean ± standard deviation and percentage. Mann-Whitney test was used for analysis of two non-parametric quantitative data. Results were considered significant at p<0.05.

Results

The 50 male football players had a mean age at the time of surgery of 24.5 ± 4.1 years. The mean postoperative hospital stay was 3.2 ± 1.2 days. The left side was involved in 78% and the right in 12% of the patients. The mean duration of the period passed between the injury and the surgical intervention was 9.7 ± 3.4 months (range 6-18 months). Eight patients (16%) had combined ACL tear with meniscal injury; the medial meniscus was injured in 7 knees and the lateral in 3 knees; a partial meniscectomy was performed for them at the time of ACL reconstruction. None of patients used a brace postoperatively.

Follow up of the accelerated rehabilitation program was well tolerated by all the patients. The mean IKDC score after 6 weeks was 56.8 ± 11.3 and significantly increased at 6 months (93.2 ± 9.7) (p<0.0001). The Lysholm knee scale significantly improved after 6 months (90.7 ± 9.7 %) compared to results after 6 weeks (72.7 ± 14.5 %) (p<0.0001) (Table 1, Figure 1).

Postoperative ACL reconstruction evaluation		Accelerated rehabilitation (50 patients)	
	6th week	6th month	Sig. (p)
Lysholm knee scale	72.7 ± 14.5	90.7 ± 9.7	<0.0001
IKDC score	56.8 ± 11.3	93.2 ± 9.7	<0.0001

ACL: Anterior cruciate ligament; IKDC: International Knee Documentation Committee. Bold values are significant at p<0.05.

Table 1: Knee evaluation post ACL reconstruction accelerated rehabilitation in football players according to the IKDC and Lysholm knee scale at 6 weeks and 6 months postoperative.

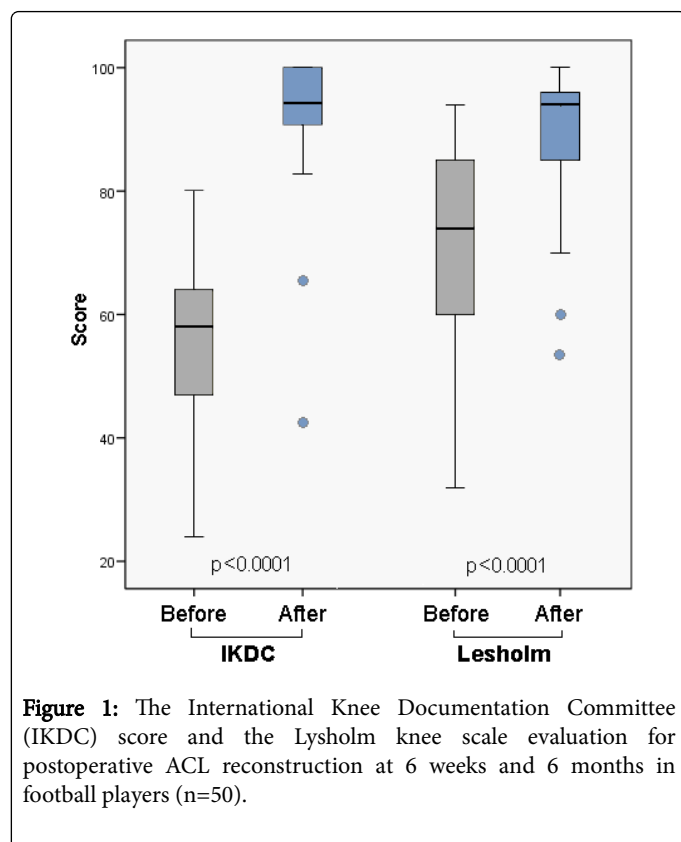


Figure 1: The International Knee Documentation Committee (IKDC) score and the Lysholm knee scale evaluation for postoperative ACL reconstruction at 6 weeks and 6 months in football players (n=50).

There was a remarkable improvement in all measured parameters and a fast recovery of the operated knee towards normal in 96% of the postoperative ACL reconstruction patients. According to the Lysholm knee scale, the results at 6th week postoperative were excellent in 16%, very-good in 30%, good in 24%, fair in 8% and poor in 22% of the patients. After 6 months, the results were excellent in 76%, very-good in 16%, good in 4% of patients and remained poor in 4%.

The scores were lower in those who had an associated partial meniscectomy (8 patients). At 6 weeks, the IKDC score was 55.1 ± 10.2 and the Lysholm knee scale was (65.5 ± 11.7) compared to those with isolated ACL tear (57 ± 11.6 and 74.04 ± 14.7 respectively) ($p=0.6$ and $p=0.1$). While at 6 months, the IKDC was 89.9 ± 11.8 and Lysholm 82 ± 7.1 compared to those with ACL tear only; IKDC 93.8 ± 9.2 and Lysholm 92.4 ± 9.3 ($p=0.4$ and $p=0.003$ respectively). Two of the patients with a combined injury required an arthroscopic ACL revision later on. Only 27 patients (54%) returned to play football regularly while 23 decided to play infrequently and not participate in any future competitions.

Discussion

In the present study, 50 male football players that underwent ACL reconstruction performed an accelerated rehabilitation program for 6 months. It has been reported that accelerated rehabilitation may continue for 4–5 months and a non-accelerated training program would last for 8 months until the final goals were reached [24]. Although surgical stability is easily reproducible, long-term patient satisfaction is difficult to guarantee [7] and a golden standard rehabilitation has not been established for post ACL reconstruction patients [25]. There is controversy related to the type of ACL

reconstruction procedure, best timing 'early or late', rate of return to sports and rate of developing OA. It has been reported that comparable results were found for bone-patellar tendon-bone or hamstring reconstruction. Functional recovery was similar between single and double-bundle techniques and there was no difference between early and delayed reconstruction. However, using auto grafts yielded better results than allografts. 82% of patients were able to return to some kind of sport participation. 28% of patients presented radiological signs of OA with a follow-up of minimum 10 years [26].

Advances in the knowledge of anatomy, surgical techniques and fixation devices have led to the improvement of ACL reconstruction over the past 10 years. Double bundle and anatomical single bundle ACL reconstruction (that restores more closely the normal anatomy of the ACL) are becoming popular. However, no significant differences in the clinical outcomes and stability after ACL reconstruction according to the type of graft or fixation device have been reported [27].

It is known that ACL reconstruction needs to be combined with detailed postoperative rehabilitation in order for patients to return to their pre-injury activity levels. Also the rehabilitation process is as important as the reconstruction surgery. But postoperative ACL rehabilitation protocols have not been standardized yet [8]. There was a remarkable improvement in all symptoms, signs and parameters of knee evaluation scores at 6 weeks and 6 months. Results were lower in those who had an associated partial meniscectomy (8 patients) and two of them required an arthroscopic ACL revision. Excellent results and normal or near normal function on follow up after ACL reconstruction have been reported [28,29]. It has been stated that less joint effusion was noted after 8 weeks in ACL reconstruction patients performing underwater exercises compared to those exercising only in the gymnasium [30]. Lower subjective scores post ACL reconstruction are related to the lack of normal knee ROM, partial or total medial or lateral meniscectomy and articular cartilage damage [7]. Improvements in muscle function are achieved by appropriate training and it is unclear whether muscle function can fully recover after ACL injury. Moreover, the role of reconstructive surgery in restoring muscle function has not been established [24].

In the present study, different exercises were included in the program and none of the patients used a brace postoperatively during early phase of rehabilitation. Although all tested exercises tested were suitable for rehabilitation after ACL reconstruction, the straight leg raise and squat on one leg are preferable for quadriceps training in the early phases to protect the graft from excessive strain [31]. In an accelerated protocol without postoperative bracing, the most important aims to facilitate an uncomplicated rehabilitation course are reduction of pain, swelling and inflammation and regaining ROM, strength and neuromuscular control [6]. Twenty-seven (54%) of the football players returned to play football regularly while 46% decided not to participate in any future competitions. Similarly, it was reported that 43% of the players were able to return to play at the same performance level, 27% couldn't perform at a level attained before their ACL tear and 30% were unable to return to play at all due to fear of re-injury or further damage. While technical aspects of ACL reconstruction and the ensuing rehabilitation have been studied extensively, psychological factors influencing the ability to return to play are underestimated [32].

In a study on professional Tunisian football players, the ACL surgical reconstruction led to a muscle deficit and to bilateral proprioceptive disruption at 15 degrees of knee flexion. It has also been

reported that playing football appears to influence the isokinetic strength profile in sportsmen after ACL repair [33].

The IKDC scale gave poor to good results in young, active people with functional instability of the knee who underwent surgical ACL reconstruction after 1 year without rehabilitation. It was concluded that surgical treatment cannot give satisfactory results without intensive and comprehensive rehabilitation. The goals should be not only recover a full ROM and muscle strength, but also neuromuscular and proprioceptual re-education [34].

Czuppon et al stated that there is a weak evidence suggesting variables associated with return to sport including higher quadriceps strength, less effusion, less pain, greater tibial rotation, higher athletic confidence, higher preoperative knee self-efficacy, lower kinesiophobia and higher preoperative self-motivation. Ensuring that athletes are physically and psychologically capable of sports participation may reduce re-injury rates and the need for subsequent surgery [35]. In order to prepare football players to compete after ACL reconstruction, the goal is to re-integrate them gradually into the game. For an efficient return to competitive football, injury-prevention education should be part of this process to maximize the chance of a durable career and decrease the risk of re-injury [3].

Limitations of Our Study

16% of patients had other injuries (meniscal injury) a part from the ACL.

The fact that the left side was involved in 78% and the Rt 12% of the subjects, could have an influence in the evaluation of the results.

ACL injury, its treatment, and its rehabilitation continue to be an area of interest to both clinicians and researchers. Surgical procedures have been refined, and rehabilitation programs are constantly being evaluated and updated to minimize morbidity and allow the safest, most predictable return to activity.

In conclusion, the accelerated rehabilitation is well tolerated and effective in football players undergoing arthroscopic ACL reconstruction and ensures a fast safe return to their previous normal activities. Patients with combined meniscal tear have a worse prognosis and chance to resume playing.

Conflicts of interest

None

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