

Rehabilitation After Anterior Cruciate Ligament Reconstruction By Autograft

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Abstract

Anterior Cruciate Ligament reconstruction was done by vascularised Patellar tendon graft as per the technique described by Noyes et al and McIntosh. The period of rehabilitation was divided into four stages - Stage-I- immobilisation, Stage-II- Mobilisation of the knee joint, Stage-III, gradual activity and Stage-IV Normal activity. Strenuous activity was allowed after one year. There were 17 excellent, 8 good, 2 fair and 3 poor results. Two had graft failure and one had partial stiffness of the knee joint. Subjectively, only one patient had recurrence of symptoms following rupture of the graft. Twenty eight patients were satisfied with the functional results.

Introduction

The cruciate ligaments are often damaged as part of complex injury of the knee joint or as an isolated injury. The disability following cruciate ligament injuries is dependent upon the amount of instability it produces. A multiple ligament injury is bound to produce severe instability. But an isolated injury of cruciate ligament is not severely unstable at the time of injury. However, as time passes, other structure providing anteroposterior stability becomes lax and a progressive instability occurs. Therefore, any cruciate ligament injury whether isolated or associated with other ligament and capsule injuries should be repaired. The ligament is successfully repaired if either of the two attachments are

torn. The results of repair of midsubstance tear has been poor. They require augmentation of the repair with some living tissue i.e. patellar tendon, fascia lata or a prosthetic ligament. One may choose to reconstruct these tears primarily. The other group that require reconstruction is the one which has been diagnosed late, following arthroscopy/ Arthrotomy for increasing discomfort in the knee joint or a meniscus injury. In these cases the cruciate ligament stumps are absorbed, thus making the repair impossible. Till recently reconstruction of the cruciate ligaments was a frustrating affair. The range of movement often does not return to normal, thereby, denying the patient the advantage of a successful repair. The reconstruction itself may fail usually by rupture of the reconstructed ligament. In the recent years there has been changes in the understanding of the healing of the reconstructed ligaments promising these active, young and otherwise healthy patients return of the previous level of activity enabling them to go for competitive sport and other strenuous

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TABLE I - MODE OF INJURY

CAUSE	NO. OF PATIENTS
Sports & Athletics	7
Road Traffic Accidents	12
Construction site accidents	6
Incidental fall	5
Total	30

activity.

Material and Methods

We have so far operated 30 patients with old cruciate ligament injury who did not get their ligaments repaired at the time of initial injury for one reason or the other. There were only 2 females in the series. The age ranged from 18 to 45 years, with an average of 28 years. The mode of injury has been shown in Table I, the majority being road traffic accidents rather than sports injuries. There were 5 sportsmen in the series and sustained the injury while playing. All others were active young people with hectic life, 3 of them are recruits in the armed forces who had to undergo hectic physical training. All These patients were symptomatic and complained of the knee giving way either on walking on smooth surface or attempted running. The isolated cruciate ligaments injuries, though they had clinical evidence of varying degree, they complained of discomfort and occasional pain while walking or running. They were not grossly incapacitated.

After clinical examination, a routine radiograph was obtained to exclude any bony injury and avulsion of the either ends of

cruciate ligaments. The cases with gross osteoarthritis were excluded, though there were 4 cases with minor O.A. changes in the series. The radiograph also gave the idea

TABLE II - ASSOCIATED INJURY

INJURY	NO. OF PATIENTS
Medial meniscus	12
Lateral meniscus	9
Both menisci	3
Posterior cruciate ligament	7
Medial collat. Ligament	3
Lateral collat. Ligament	2
Fracture lateral condyle	1

as to length of the patellar tendon available and the length of the graft required.

A preliminary arthroscopy was done in all the cases to confirm the diagnosis and to look for additional injuries i.e. meniscus injury and intramuscular injuries. The list of associated injuries are shown in Table II. There were 3 cases who had tear of both menisci. The injury to the collateral ligaments were not very marked so as to require a reconstruction of these ligaments. Anterior cruciate ligament was reconstructed with autograft using medial one third of vascularised patellar tendon¹² the upper end being fixed by 'over the top' technique with modification as suggested by W Muller (1983).

REHABILITATION & PHYSIOTHERAPY PROTOCOL :-

The period of rehabilitation and physiotherapy is divided into 4 stages and is stretched over a period of one year. The aim is to protect the graft when it is weak without loosing knee movement and then gradually condition the graft so as to make it able to withstand the stress and strain of contact sports.

TABLE III- SCHEME OF REHABILITATION

Stage I-4 to 6 weeks (In P.O.P. Cylinder)

1. Static Quadriceps & hamstring muscle exercise
2. Straight leg raising exercises
3. Non weight bearing crutch walking
4. Electrical stimulation (occasional)

Stage II - upto 3 months (range of motion)

1. Range of motion exercise
2. Static quadriceps & hamstrings muscles exercise
3. Straight leg raising exercises.
4. Non weight bearing crutchwalking.
5. Electrical stimulation.

Stage III - upto one year (Gradual activity)

1. Gradual weight bearing
2. Range of motion exercises.
3. Static and resisted quadriceps exercises.
4. Bicycling, rowing, kneeling, prone lying exercises.
5. Jogging (6 months onward)

Stage IV - Beyond one year (Normal activity)

1. Graduated sporting activity
2. Static & resisted quadriceps exercises.

STAGE -I : This is spread over a period from the day of operation till about 4 to 6 wks. Here the graft is protected in P.O.P. cylinder at about 45 degrees flexion of the knee joint. The aim is to keep the quadriceps and the hamstrings active.

Weight bearing is not allowed during this stage (Table III).

STAGE -II : The aim is to gain the range of motion of the knee joint and the strength of the muscles. It extends upto about three months after operation. As the graft is still weak, it still needs protection. Hence weight bearing is not allowed (Table III).

STAGE - III : The next 9 months (i.e. 3 months to one year post operative) is condi-

tioning of the graft by allowing graduated activities of daily living. This also includes gain of range of motion if the recovery is not complete in stage II using more strenuous exercises i.e. kneeling squatting or slings and further gain in muscle power by use of isotonic exercise. (Table III).

STAGE - IV : After one year the patient is exposed to more severe stress by graduated return to strenuous physical activity or contact sports. (Table III).

Results

The results of the procedure were assessed periodically on the basis of OAK (Orthopaedic study group of the knee of the Swiss Orthopaedic Society¹⁴, knee evaluation score. They were also assessed subjectively with regard to patients assessment of the results and their ability to go back to previous level of activity. Some patients had undergone arthroscopy for further evaluation of the status of the reconstructed ligaments. The period of follow up ranged from 1 to 6 years.

The knee score before operation ranged between 40 to 60 with missing points. Following reconstruction it improved with a gain of 30 to 50 points. There were 17 excellent, 8 good, 2 fair and 3 poor results as per the scoring. The score attained at the end of 1 year did not deteriorate significantly in subsequent follow ups and suggesting that there were no deterioration of the results after one year.

The knee giving way which was present in 25 cases, disappeared in all cases after reconstruction except the one who had graft failure and did not agree for reparation. He also had positive pivot shift. Anterior stability had significantly improved. In Lachman test the anterior displacement of tibia was less than 5mm in 22 cases, 5 mm in 6 cases and more than 5 mm in 2 cases. On the other hand drawers test showed 5 mm to 10 mm displacement of tibia in 25 cases,

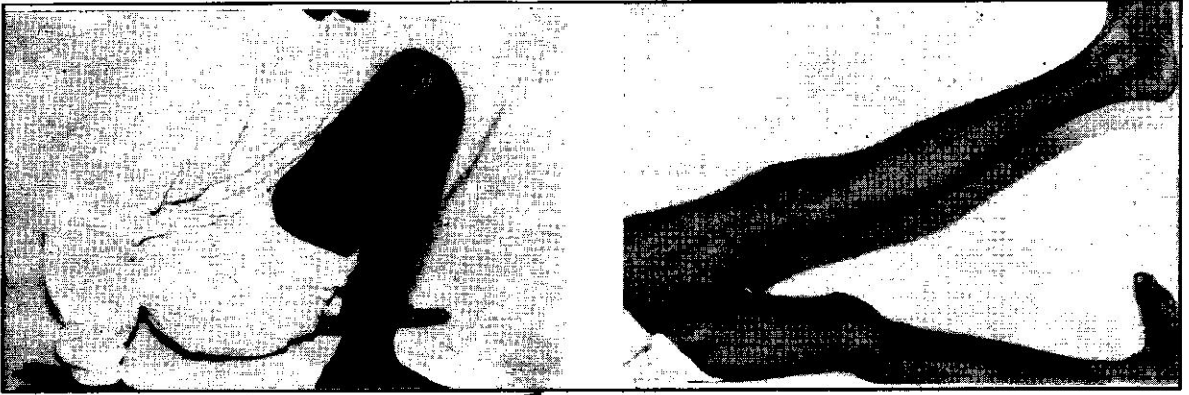


FIG. 1. Photograph showing recovery of full function with reasonable size of quadriceps muscle after ACL reconstruction and reinforcement of posterolateral complex. (From Ind. J. Orthop' 91 July, pp 108)

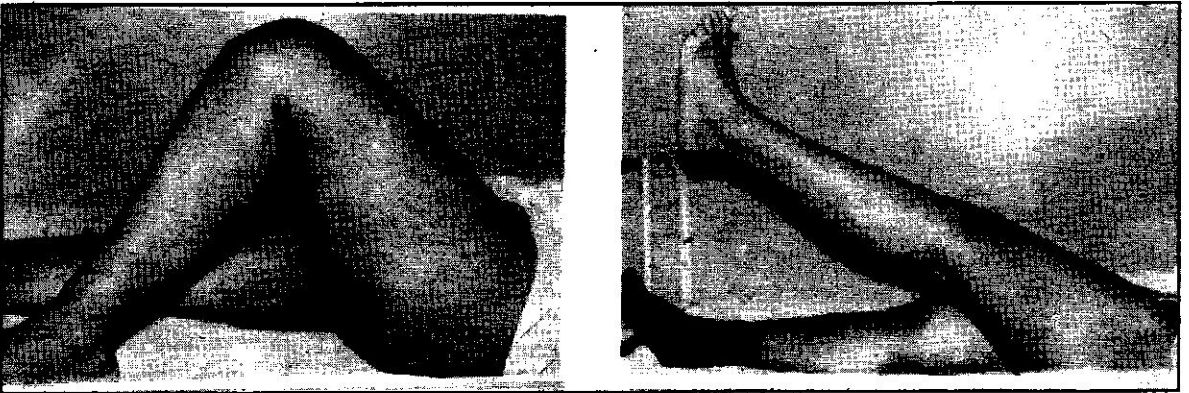


FIG. 2. Photograph showing incomplete recovery of the knee range of motion following reconstruction of ACL and repair of MCL. Note the size of quadriceps muscle.

thus suggesting that the knees were more stable in extension than in flexion. The range of motion was regained in almost all the cases except one who had flexion of 0 to 120 degrees. Limitation of the last 5 degrees of extension was seen in 8 cases where as 12 had limitation of last 5 degrees of flexion. Quadriceps muscle wasting was present in all the cases and ranged from 2 to 3.5 cm.

The recovery of the preinjury functional status is quite encouraging. Three of the 5 sportsmen have gone back to sports though none has gone back to competitive sports. The other two gave up sports because they

got some others means of livelihood. There were 8 heavy manual workers, they all have gone back to their previous work. For the sedentary workers i.e. remaining 17 which includes two housewives, the operation has been satisfactory and have been able to run and jog.

Five patients have undergone arthroscopy at 3 to 4 years after operation. The ligament was found intact with usual attachments. Medial meniscus degeneration was observed in 2 cases. The menisci which were excised (Partial meniscectomy) have regenerated, however, they do not look as smooth as the

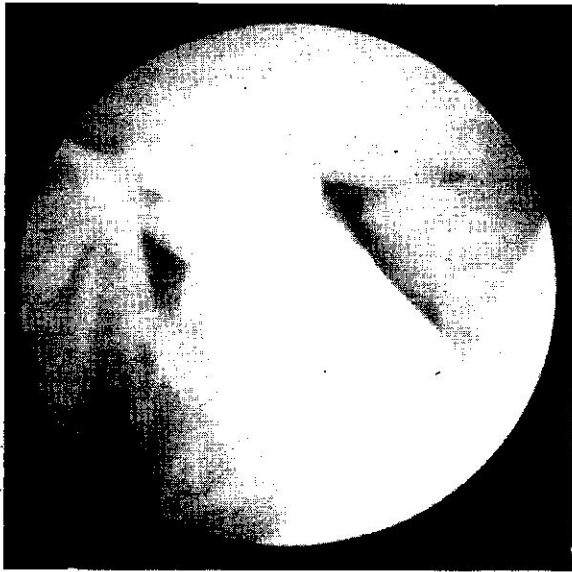


FIG. 3.

Arthroscopic view of the reconstructed anterior cruciate ligament at 3 years post operative.

normal menisci.

There were 3 poor results. Two of them had graft failure. One of them had refused any further intervention and the other whose knee was reexplored, the ligament could be sutured back. She had fair result. The third patient with poor result was due to a malunited lateral condyle fracture of tibia. One of patients with fair results had mild osteoarthritis and had more than 5 mm anterior instability of tibia. This instability was probably because of inadequate tension to the neoligament while fixing it. The other fair result was because of failure to gain the range of movement beyond 120 degrees of flexion, though the knee was otherwise stable.

Discussion

There are three elements in the rehabilitation of patients of ACL reconstruction with autograft - 1) protection of the graft until it matures, 2) gain of range of motion and 3) preservation of quadriceps muscle.

The graft which is selected for this purpose is usually more than one and a half times stronger than ACL. Graft loses strength by about 50% immediately after

reconstruction¹² In such circumstances the graft if exposed to the stress and strain of weight bearing will rupture. The gain of strength follows revascularisation of the neoligament, the vessels being derived from the neighbouring tissues¹ and the remodeling of the collagen fibre bundles in its substance³ The remodeling has been observed in human beings as well^{4,8} and has been estimated to take 12 to 18 months. It is presumed that by about 3 months the graft can withstand the stress and strain of normal walking. Sporting activity is only to be started after one year. The rupture of the graft occurs mostly during the first 3 months and usually results from overzealous physiotherapy, or failure on the part of the patient to adhere to the rehabilitation protocol. The 2 cases in our series who had rupture of the graft occurred during the first 3 months in the past stiffness of the knee joint had nullified the benefits of most of the reconstructions. This has been overcome by a change in the surgical technique and proper timing of the exercises. While reconstructing the ligament, the patella should not be dislocated and the suprapatellar pouch should not be disturbed. In our series, the cases where patella was dislocated,

The gain of range of motion was slow. One of them did not gain full range of motion. Full extension of the knee joint may not be achieved. This may be the result of quadriceps lag or impingement of the graft in the anterior margin of intercondylar notch. The impingement has been overcome by addition of notchplasty to the procedure. The failure to gain full range of movement can occur if the graft placement is not isometric. This may also result in rupture of the graft as the reconstructed ligament cannot stretch more than 2 mm during the range of motion.

The quadriceps muscle wasting is part of all knee injuries. All the patients treated by

us had quadriceps wasting. It has been observed that this muscle starts wasting within a week of the injury. Electrical stimulation of the muscle reduces the muscle atrophy specially in females.² All but 2 of our cases were males. The first 5 cases had undergone electrical stimulation. Later on this was abandoned as most of the patients were able to regain the power only by isometric and isotonic exercises. Electrical Stimulation was useful only in those cases who had a prolonged inhibition of the quadriceps muscle. The effect of immobilisation on the quadriceps muscle wasting has been studied. The muscle wasting was more if the knee was immobilised in 10 to 15 degrees of flexion^{5,6} On the other hand if the knee joint is flexed to about 40 to 45 degrees thus putting the quadriceps muscle under stress the atrophy is minimum^{2,7} Thus for prevention of quadriceps wasting not only isometric exercises are essential, the position of immobilisation also plays a significant role in this. All our cases were immobilised at 30 to 45 degrees of flexion of the knee joint.

A reasonable functional recovery can be expected following anterior cruciate ligament reconstruction provided these patients after surgery are rehabilitated adequately following a time schedule which matches the graft uptake and maturation process. The modification of surgical technique has also enhanced the results to a great extent. Once The crucial phase of failure of the graft is over, the results do not deteriorate with time.

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