

Tegner and Lysholm scores in brace-free rehabilitation

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ABSTRACT

Objective: To compare results of aggressive method of rehabilitation after reconstruction of anterior cruciate ligament against results of standard braced method of rehabilitation, and to determine prognostic factors. This is a retrospective comparative study with statistical analysis.

Methods: In this study, 85 patients were operated in the Armed Forces Hospital, Riyadh, Kingdom of Saudi Arabia between December 1998 and December 2001, and underwent rehabilitation with a minimum follow up of 2 years. The patients were split into 2 groups. Group A consist of 32 patients and they underwent the standard rehabilitation program according to established braced programs. Group B is the subsequent 53 consecutive patients who were subjected to aggressive brace-free rehabilitation program. All knees were measured for Tegner and Lysholm scores as the main indicator of assessment in the preinjury hindsight appraisal, and compared with scores obtained 4 months and 2 years post reconstruction.

Results: Linking the preinjury Tegner and Lysholm scores to the 4 months follow up scores for group A, there was a mean loss of 1.9 and 14 constituting 26% and 22.2% ($p=0.015$), range 1.07-3.5 and 9.8-23.5. Linking the preinjury Tegner and Lysholm scores to the 4 months follow up scores for group B, there was a mean loss of

1.1 and 9.0 constituting 15.4% and 13.6% ($p=0.012$), range 0.67-3.5 and 6.8-13.5. When comparing the preinjury Tegner and Lysholm scores to the 2 years follow up scores for group A, there was a mean loss of 1.0 and 8.0 constituting 13.6% and 11.6% ($p=0.024$), range 0.67-3.5 and 6.8-13.5. When comparing the preinjury Tegner and Lysholm scores to 2 years follow up scores for group B, there was a mean loss of 0.4 and 1.0 constituting 5.5% and 1.5% ($p=0.015$), range 0.1-1.5 and 6.8-13.5. Appraisal of the aggregate data of 2 groups has shown that the loss from preinjury Tegner and Lysholm scores was 20.7% versus 16.9% lower at 4 months ($p=0.013$), but only 12.6% versus 3.55% lower at 2 years ($p=0.036$).

Conclusion: Results of aggressive rehabilitation after anterior cruciate ligament reconstruction both subjectively and clinically are superior to that of the standard braced rehabilitation. A better prognostic result with aggressive rehabilitation can be predicted for patients with high preinjury scores compared to patients with a low preinjury score. The result of this study support the use of accelerated brace free rehabilitation in autogenous patellar tendon graft, and has shown that intensive rehabilitation facilitate return to sport activities at 4 months postoperatively.

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In addition to regaining stability, anterior cruciate ligament (ACL) reconstruction lowers the meniscus tear rate and meniscus surgery at 2 years from 27% to 3%.¹ However, there are no studies to date either suggesting or documenting that ACL

reconstruction prevents or delays degenerative changes. For ACL reconstruction, the most commonly used types of grafts are the autogenous patellar tendon and the hamstring tendons. The patellar tendon is preferable to the hamstring tendon

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by the majority of surgeons due to its ease of procurement, sound fixation, and its tolerance to aggressive rehabilitation regimen. Patients have been shown to be able to return to vigorous knee activity 2-6 months postoperatively.²⁻⁴ This state of affair is not true for alternative graft materials.⁵ In a questionnaire, 73% of surgeons who are members of the ACL Study Group choose the patellar tendon, 23% of them choose the hamstrings and 4% other types of grafts, such as allograft.⁶ Another survey of orthopedic surgeons treating American football teams in the major leagues showed that all but one chose autogenous patellar tendon grafts.⁷ The biomechanical properties of central-third bone-patellar tendon-bone and double-looped semitendinosus/gracilis grafts at the age of 40 years shows the mean load to failure for the patellar tendon grafts being 1784 ± 580 N, compared with 2422 ± 538 N for the hamstring tendons. There is no significant difference in stiffness between the 2. The elastic modulus was 225 MPa for the patellar tendon and 145 MPa for the hamstring tendon grafts. The mean cross-sectional area of the hamstring grafts is 57 mm^2 compared with 45 mm^2 for those from the 11 mm^2 wide patellar tendon graft.⁸ The patellar tendon graft is therefore still considered to be the gold standard procedure, mainly due to its biomechanical strength which allows safe early active rehabilitation without an increased risk of graft failure as well as documented good long-term results with regard to stability and functional outcome.⁹⁻¹³ Rougraff et al¹⁴ biopsied 23 patellar tendon grafts at varying stages after reconstruction. They described 4 stages of ligamentation. The initial stage of repopulation occurs during the first 2 months with an increasing number of fibroblasts and active nuclear morphology by 3 weeks. Over the next 10 months, the graft goes through a stage of rapid remodeling in which the fibroblast count increases markedly, the active nuclear morphology and neovascularity remain increased, and more areas of degeneration are present as the percentage of mature collagen decreases. The third or 'maturation' stage occurs over the next 2 years and is characterized by a slow decline in the nuclei and the maturation of the collagen matrix. It is generally thought that the grafts are fully ligamentous at the end of 3 years.¹⁵⁻¹⁷

This study was designed to compare the long term results, as measured by Tegner and Lysholm Scores,¹⁸⁻²⁰ of aggressive brace-free rehabilitation, to determine whether this rehabilitation program will jeopardize the integrity of the graft and to identify which sub-group of patients will mostly benefit from the aggressive rehabilitation.

Methods. Eighty-five patients were operated in Riyadh Armed Forces Hospital, Riyadh, Kingdom of Saudi Arabia between December 1998 and

December 2001, using bone-patellar tendon-bone autogenous graft to reconstruct torn ACLs with 2 interference screws. The graft was taken through a 5-7 cm longitudinal skin incision over the patellar tendon from the distal part of the patella to the proximal part of the tibial tuberosity. The paratenon was incised longitudinally and the central third of the patellar tendon, along with 2.5 cm long bone plugs from both ends, was harvested. No bone graft was used in the cortical defects. Only the paratenon was closed with absorbable sutures. The reconstruction was performed arthroscopically with the one incision technique in all patients. None of the patients was operated upon as a day case.

Timing of surgery is important because stiffness of the knee after ACL reconstruction is a well-recognized complication.^{21,22} In particular, early reconstruction after ACL rupture has been associated with an increased incidence of stiffness and prolonged rehabilitation.^{23,24} A delay in surgical reconstruction also has a potential morbidity, such as inability to return to employment or sporting activities, as well as an increased risk of meniscal damage from further injuries because of instability of the knee.²⁵ We therefore followed the more preferable routine of treating injuries of the ACL with an initial period of rehabilitation followed by reconstruction on, whenever possible, 2 months after the injury.^{25,26}

Rehabilitation methods have also changed from the older procedures of casting, delayed knee motion and ambulatory activities, and open chain exercise to the more recent techniques of continuous passive motion, early motion using a functional knee brace, and closed chain exercise.²⁷⁻³⁸ In this study, we abandoned the functional knee brace and pursued a more aggressive scheme. The scheme of this investigation was to compare the clinical outcomes for subjects who were treated under a standard rehabilitation program following ACL reconstructive surgery against the clinical outcomes for our aggressive rehabilitation protocol.

Those patients were available for follow up for at least 2 postoperative years. This study split the patient into 2 groups. Group A consist of 32 patients and they underwent the standard rehabilitation program according to the old braced methods.³⁹⁻⁴⁵ Group B is the subsequent 53 consecutive patients who were subjected to aggressive rehabilitation without bracing as detailed in **Table 1**. All patients were males and the mean age for group A was 26.3 (range 18-38), and for group B was 25.8 years (range 17-38). Both groups were statistically of the same cohort ($p=0.23$).

We used a paired Student t-test to evaluate data for the 2 groups at both points of evaluation. For result analysis, we used the X-square test or Fischer exact test in the case of categorical variables. Univariate analysis using logistic regression with

backward elimination was used with a model for the variable predicting poor or good clinical outcome.

Results. The mean preinjury Tegner and Lysholm scores for group A were 7.3 and 69. The preinjury scores for group B were 7.1 and 66. The Tegner and Lysholm Scores at 4 months postoperatively for group A were 5.4 and 55. And for group B the scores were 6.0 and 57. The Tegner and Lysholm scores at 2 years follow up for group A were 6.3 and 61, and group B were 6.7 and 65.

When linking the preinjury Tegner and Lysholm scores to the 4 months follow up scores for group A, there was a mean loss of 1.9 and 14 constituting 26% and 22.2% ($p=0.015$), range 1.07-3.5 and 9.8-23.5. When linking the preinjury Tegner and Lysholm scores to the 4 months follow up scores for group B, there was a mean loss of 1.1 and 9.0 constituting 15.4% and 13.6% ($p=0.012$), range 0.67-3.5 and 6.8-13.5. When linking the preinjury Tegner and Lysholm scores to the 2 years follow up scores for group A, there was a mean loss of 1.0 and 8.0 constituting 13.6% and 11.6% ($p=0.024$), range 0.68-3.6 and 6.9-13.6.

When linking the preinjury Tegner and Lysholm scores to the 2 years follow up scores for group B, there was a mean loss of 0.4 and 1.0 constituting 5.5% and 1.5% ($p=0.015$), range 0.1-1.5 and 6.8-13.5. Comparison of the aggregate data of the 2

groups has shown that the loss from preinjury Tegner and Lysholm scores at 4 months was 20.7% and 16.9% lower at 4 months ($p=0.013$), but only 12.6% and 3.55% lower at 2 years ($p=0.036$). There was no statistical difference in the comparative preinjury scores of the 2 groups ($p=0.24$). This suggests that the 2 groups are of the identical cohorts. Seven patient in group B and 4 in group A complained of knee pain at 2 years follow up. There was no incidence of postoperative infection or extensor mechanism failure.

Discussion. Our statistically significant results confirms that accelerated rehabilitation after ACL reconstruction using autogenous patellar tendon graft without brace is a safe and effective means of returning the patient to vigorous activity, and to ensure satisfactory progress for the period of follow up of 2 years. To determine this, it was compared with the standard braced rehabilitation program by linking the comparative data according to Tegner and Lysholm scoring system. A poor comparison results would have suggested that aggressive rehabilitation is not a safe method to perform post ACL reconstruction management. If the primary principles of ACL reconstruction are followed, one can expect consistent results with patellar tendon reconstruction. Proper anatomic position of the femoral and tibial tunnels and secure fixation of the graft is crucial for a rational accelerated rehabilitation protocol. When autogenous patellar tendon graft was used as a replacement for the ACL, the stability is not affected by a return to vigorous activities 2-6 months,⁴⁶⁻⁴⁹ after the reconstruction. Some studies have shown, however, that surgically treated patients do not have a higher activity level compared with non-surgically treated patients, when reviewed after 2-7 years.⁵⁰⁻⁵²

We observed significant progressive improvement in the period between 4 months and 2 years follow up. A deterioration of the 2 years readings from the 4 months scoring results would have meant that the early good results was at the expense of possible decrease of the stability of the knee indicating that the autogenous patellar tendon graft did not tolerate the cyclic energy application emanating from the early stress applied on it, or that the fixation of bone tendon bone graft is unsuitable for accelerated rehabilitation. This confirms existing studies that have shown that a return to vigorous activities is possible with autogenous patellar tendon grafts as early as 2 or 4 months.^{2,5} A major criticism of the patellar tendon graft is the potential for major extensor mechanism complications (patellar fracture or patellar tendon rupture) and the incidence of patellar pain ranging from 3-17% in a number of studies.⁵³⁻⁶¹ The sagittal thickness of the patellar graft is 3.5-4.0 mm, and is rectangular in shape.^{10,62,63} By using a 10 mm wide graft, the

Table 1 - Sequential pattern of accelerated rehabilitation program in Group B patients.

Time period	Graft phase	Activities
12- 24 hours	Inflammatory	Passive continuous movement machine
25-72 hours		Increasing flexion to 120 degrees, and achieve hyperextension actively and passively.
25-48 hours		Aided walking PWB being progressed into unaided FWB.
48 hours-5 days		Vastus medialis enhancement exercises.
5th day	Necrosis	Brisk walk. Aided stairs climbing. Return to non vigorous work.
2 weeks		Unaided stair climbing.
10 weeks		Gentle jogging.
4 months	Remodelling	Return to full preinjury activity

reconstructed ligament would have an average cross section of 37.5 square mm, which is less than the cross section of the native ACL which averages 50 square mm;^{10,39} however, the power of the patellar tendon graft possesses 138% failure tolerance compared to that of the native ACL.

The increased risk of osteoarthritis in patients with meniscal injuries and the increased risk of meniscal injuries in patients with ACL ruptures, who have had multiple giving-way episodes, has made several authors advocate ACL reconstruction to protect the menisci and may, theoretically, reduce the risk of future osteoarthritis, this was achieved by timely reconstruction, and as this study shows, successful rehabilitation.^{52,64-66} The strengths of this study were the sufficient number of patients that were included and that the follow ups were uniform and that the groups were matched. Potential weaknesses were the retrospective nature of the study. During selecting patients for an ACL reconstruction, a number of variables, including the activity level, the preinjury functional performance of the patient, the degree of giving-way during activities, the presence of osteoarthritis and concomitant injuries, are taken into consideration. In many occasions, ACL reconstruction has been performed in high-activity recreational athletes.

In summary, the result of this study support the use of accelerated brace free rehabilitation in autogenous patellar tendon graft, and has shown that intensive rehabilitation facilitate return to sport activities at 4 months postoperatively.

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