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Research Paper

Role of Physiotherapy in Preventing Failure of Primary Anterior Cruciate Ligament Reconstruction
首次前十字韌帶重建手術後物理治療所扮演的角色

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ABSTRACT

Background/Purpose: Anterior cruciate ligament (ACL) reconstruction is routinely performed in sports medicine. We aimed to determine if there is any protective effect of postoperative physiotherapy in preventing graft rupture after primary ACL reconstruction (ACLR).
Methods: A retrospective case–control study was carried out, with demographic data, concomitant meniscal injury, and intraoperative fixation methods matched. The number of sessions of physiotherapy attended by the rupture group and nonrupture group were compared using binary logistic regression.
Results: No significant relationship between the frequency of postoperative physiotherapy and occurrence of graft rupture after primary ACLR was identified.
Conclusion: Further research is needed to verify the effect of physiotherapy in the prevention of graft rupture after primary ACLR.

中 文 摘 要

前十字韌帶重建手術在運動醫學中十分普遍。我們希望找出首次接受前十字韌帶重建手術後物理治療能否保護該韌帶。我們針對首次接受前十字韌帶重建手術的病人做了病例對照研究，研究對象中我們已配對年齡、性別、有沒有同時的半月板受損以及已重建前十字韌帶的固定方法。我們透過二項對數迴歸模式比較了術後前十字韌帶有受損及沒有受損病人的參與物理治療次數。是次研究未有發現重建後的前十字韌帶受損與參與物理治療次數有關。

Introduction

Anterior cruciate ligament reconstruction (ACLR) is a very common operation in sports medicine. About 100,000 ACLRs are performed each year in the United States of America.[1] A failure rate of 4% can be estimated from the available randomised control trials for single bundle reconstruction [2–5]. The total ACL graft rupture rate was 6.2% (173 of 2782; range, 0–13.4%).[6] Bourke et al[7] reported a 2.45% annual rate of ACL graft rupture within 2 years after primary ACLR, but annual rates declined subsequently to 0.42% at up to 15 years after primary ACLR. Similarly, other studies have documented an annual rupture rate of 0.3–1.3%.[7]

The outcome in patients who received primary ACLR followed by physiotherapy was studied. It has been shown that physiotherapy can improve the primarily reconstructed knee in terms of muscle strength of flexor and extensor,[8] anterior knee laxity, and rotational instability.[9] Symptoms and functional status after physiotherapy in patients who received primary ACLR were studied by Feller et al[10] with multiple factors (age, gender, type of ACL graft, level of activity, and occupation before ACL injury) matched. Those who attended physiotherapy infrequently were found to have satisfactory (though not better) outcomes when compared with patients receiving regular physiotherapy. This finding seemed to contradict our belief that physiotherapy has a good clinical impact on the outcome of ACLR. We believe that further studies are needed to investigate the effect of physiotherapy on the outcome of ACLR.

Physiotherapy is hypothesised to have a protective effect in preventing rupture of ACL graft after primary ACLR through

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improved muscle strength,[8] anterior knee laxity, and rotational instability.[9] Our objective was to perform a retrospective study to investigate the association of physiotherapy with the occurrence of ACL graft rupture after primary ACLR.

Methods

A retrospective review of cases of primary ACLR was performed from 2000 to 2008 in Tuen Mun Hospital (TMH) and Pok Oi Hospital (POH), the New Territories West Cluster, Hospital Authority, Hong Kong. Most ACL reconstructions were performed in TMH. ACL reconstruction commenced in POH in December 2008 after the redistribution of manpower from TMH to POH. Preoperative physiotherapy was arranged for patients suffering from ACL rupture (see Table 1). ACLR was arranged when patients' knee injuries achieved adequate muscle strength and range of motion. Patients needed postoperative physiotherapy (see Table 2) to train up muscle strength, neuromuscular control, and agility.

The cases selected for our case–control study were patients with ruptured ACL graft occurring within 5 years after primary ACLR. The controls were patients without ruptured ACL graft after primary ACLR. Patients receiving physiotherapy in the New Territories West Cluster were included. In this study, cases and controls were matched regarding gender, age, concomitant meniscal injury with corresponding management (including intact meniscus, trivial tear not requiring meniscal surgery, or meniscal tear requiring partial menisectomy), and methods of tibial and femoral fixation of the ACL graft.

In this study, the number of sessions of physiotherapy attended by patients within 1 year after primary ACLR was recorded. Binary logistic regression was employed in the analysis of the relationship between the number of sessions of physiotherapy attended and rupture of the ACL graft after primary reconstruction. Potential confounding factors including age, gender, tibial fixation, femoral fixation, meniscal status, and time between initial ACL injury and primary ACLR were analysed in the logistic regression. Statistical significance was defined as $p < 0.05$. The statistical analysis was performed by SPSS Statistics for Windows, Version 20.0 (IBM Corp., Armonk, NY, USA). This study protocol was approved by the New Territories West Cluster Clinical and Research Ethics Committee, Hospital Authority, Hong Kong. Cases with an identifiable technical cause of the ACLR failure (e.g. unsatisfactory tunnel position resulting in rotational instability) or concomitant ligamentous injury of the same knee were excluded from this study.

Results

There were 275 primary ACLRs using bone–patellar tendon–bone (BPTB) graft performed from 2000–2008. We identified 14 cases of graft rupture, of which 5 cases were excluded from this study. Regarding these 5 cases, the characteristics could not be matched in 1 case, undocumented collateral ligament and posterior cruciate ligament status was found in 1 case, vertical tunnel for ACL grafts was found in the remaining 3 cases (Figures 1A–C). Nine cases and 33 controls were employed in this study. The patient characteristics are illustrated in Table 3.

The number of sessions of physiotherapy attended in 1 year was plotted against the rupture and nonrupture group in a boxplot in Figure 2. The boxplot illustrated higher attendance of physiotherapy in the nonrupture group than the rupture group. The mean numbers of attendance in 1 year were 18.05 ± 12.85 in the rupture group and 18.58 ± 13.72 in the nonrupture group. However, there was no significance difference in the number of attendance between these two groups.

Table 4 illustrates the binary logistic regression coefficients and odd ratios for each of the predictors. Employing a 0.05 criterion of statistical significance, there was no significant difference in the numbers of sessions of physiotherapy attended by patients within 1 year after primary ACLR between the rupture and nonrupture group. No significant relationship was found between the outcome of primary ACLR and age, gender, tibial fixation, femoral fixation, meniscal status, and time between initial ACL injury and primary ACLR.

Table 1
Preoperative physiotherapy protocol*

Acute phase	Days 1–14	● Ice therapy
● Goal		● Flowpulse therapy
■ Decrease pain & swelling		● Weight bearing as tolerated with 2 crutches
■ Maintain ROM		● Quadriceps set exercises
■ Prevent muscle atrophy		● Co-contraction exercise of quadriceps & hamstrings muscle
		● Heel slide within pain tolerated
		● Straight leg raises exercise with 4 planes
		● Standing hamstring curls
	Weeks 2–4	● Begin PREs in knee extension
Intermediate phase (Weeks 4–7)	Weeks 4–6	● PRE knee extension progression to 20 lbs as tolerated
● Goal		● Stationary bike exercise
■ Aim at full ROM		● Lateral step up exercise
■ Increase muscle strength		● Minisquats exercise
■ Proprioceptive training		● Slide board for mobilisation
		● Calf raises
		● Eccentric hamstring work
		● Double leg press
		● Retro walking
		● May begin submaximal isokinetic work at 45–90° flexion at 180°/s
		● Proprioception & balance training
	Weeks 6–8	● Eccentric quadriceps exercise
		● Single leg press
		● Isokinetic exercise at 180°/s & 240°/s
		● Proprioception & close kinetic chain exercises
Advanced phase		● Functional testing at post-injury 12th week
		● Hop test
		● Isokinetic muscle testing
		● Agility drills
		● Isokinetic evaluation for H/Q ratio if needed

ROM = range of motion; PRE = progressive resistance exercises.
* Rationale: development of total leg strength; proprioception training; return to previous level of functional activity.