Home Based Rehabilitation Versus Supervised Physiotherapy Based Rehabilitation for First 6 Months Post Anterior Cruciate Ligament (ACL) Reconstruction in Recreational Athletes.

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ABSTRACT

Background:

Home-based rehabilitation is an alternative method of physiotherapy after anterior cruciate ligament (ACL) reconstruction to regain pre injury state level. We conducted a prospective interventional study to investigate the outcome of a newly modified home-based (HB) physiotherapy program for patient post (ACL) reconstruction as comparison with supervised physiotherapy (SP) within 6 months that would be a cost effective and toward patient-directed rehabilitation to improve compliance.

Objective:

The aim for this study was to compare the outcome of post ACL reconstruction rehabilitation between a complete HB rehabilitation and the conventional SP rehabilitation program.

Methodology:

This was a prospective interventional study conducted over 1 year. There were 34 patients with ACL injury randomized either into a HB or SP program. Twenty seven patients successfully completed rehabilitation based on a standard regime of exercises. 15 of them were in the SP group while 12 were in the HB group. Patients were given an explanation, an instructional video CD and equipment to perform the HB rehabilitation. All patients were reviewed at 6 weeks, 3 months and 6 months post ACL reconstruction for evaluation. Knee motion, muscle strength and power, knee stability, and functional outcomes were assessed to investigate the comparison between both groups.

Results:

The mean age for both groups was almost similar; 24.4 in the HB group and 25 in the SP group. 20 of the 27 patients were male. There was an excellent result of range of motion in the HB group as all patients achieved the targeted goal, however, 1 patient did not achieve the targeted range of motion in the early phase for the SP group. Functional outcome scores improved at 6 months as comparison score at 3 months for both groups with mean scores from 86 to 97 and 84 to 95 respectively, but statistically insignificant between both groups (P value 0.652 at 3 month and 0.323 at 6 month). Knee laxity using KT 1000 did not show any significant difference at 6 months (p: 0.371). Both quadriceps and hamstrings muscle strengths that were measured at 2 different speeds (180° and 300° per second) showed no significant difference as well as knee power after 6 months home-based physiotherapy.

Conclusion:

Home-based rehabilitation was as effective as supervised physiotherapy in terms of functional outcome scores, knee range of motion, knee laxity, and muscle strength and knee power for the first 6 months after ACL reconstruction surgery.

Abstrak

Pengenalan

Rehabilitasi berasaskan di rumah adalah satu langkah alternatif untuk melakukan fisioterapi selepas pembedahan rekonstruksi ‘anterior cruciate ligament untuk mencapai tahap seperti sebelum kecederaan. Satu kajian prospektif dan intervensi untuk menyiasat hasil program fisioterapi dilakukan di rumah yang telah diubah suai untuk pesakit selepas pembinaan semula ligamen anterior cruciate (ACL) sebagai perbandingan dengan fisioterapi yang diawasi boleh menjadi suatu yang berkos efektif and ke arah kepatuhan pesakit pada rehabilitasi yang diarahkan

Objektif:

Tujuan kajian ini adalah untuk membandingkan hasil pembinaan semula ACL selepas pembedahan antara program pemulihan berasaskan di rumah yang lengkap dengan program pemulihan fisioterapi yang diawasi.

Metodologi

Ini adalah satu kajian yang prospektif dilakukan dalam masa 1 tahun. 34 orang pesakit, dua puluh tujuh orang pesakit dengan pembedahan pembinaan semula ACL lengkap sepenuhnya menjalani fisioterapi pemulihan berdasarkan kebiasaan rejim latihan. 15 orang dari mereka melakukan fisioterapi yang diawasi oleh ahli fisioterapi, manakala 12 orang lagi pesakit melakukan fisioterapi diri di rumah. Pesakit telah dijelaskan teknik latihan semasa sesi pertama, dan diberi CD video pengajaran sebagai panduan di rumah dan peralatan untuk melakukan senaman di rumah. Semua pesakit diperiksa semula pada 6 minggu, 3 bulan dan 6 bulan selepas

pembedahan pembinaan semula ACL untuk penilaian. Pada rawatan susulan, semua pesakit telah dipastikan bahawa mereka melakukan dengan teknik yang betul dan mengikuti sesi fisioterapi yang diawasi sepenuhnya. Pergerakan lutut, kekuatan otot, kestabilan lutut, dan fungsi hasil lutut pesakit dinilai untuk menyiasat perbandingan antara kedua-dua kumpulan.

Keputusan:

Purata umur untuk kedua-dua kumpulan adalah sama 24.4 dalam kumpulan rehabilitasi di rumah dan 25 tahun dalam kumpulan yang diawasi. Terdapat hasil yang sangat baik dari pergerakan dalam kumpulan fisioterapi di rumah kerana semua subjek mencapai matlamat yang disasarkan, tetapi hanya 1 pesakit yang tidak mencapai pelbagai sasaran gerakan pada tahap awal dalam kumpulan fisioterapi yang diawasi. Kekuatan otot ‘quadriceps’ dan ‘hamstring’ yang diukur pada 2 kelajuan berbeza (180 ° dan 300 ° sesaat) tidak menunjukkan peningkatan yang ketara serta kuasa lutut selepas fisioterapi di rumah 6 bulan. Fungsi lutut subjek telah bertambah baik selepas melakukan latihan di rumah dan rejim fisioterapi yang diawasi dari jumlah mata 86 kepada 97 di kalangan subjek fisioterapi di rumah dan 84 kepada 95 di kalangan pesakit fisioterapi yg diselia, tetapi secara statistik pertambahan adalah tidak ketara antara kedua-dua kumpulan (P nilai 0.652 pada 3 bulan dan 0.323 pada 6 bulan). Kelemahan lutut dicatatkan dengan menggunakan KT 1000, ianya tidak menunjukkan perbezaan yang ketara pada 6 bulan dengan nilai p 0.371.

Kesimpulan:

Rehabilitasi di rumah adalah sama dengan fisioterapi yang diselia dalam hasil fungsi lutut dan hasil subjektif, dengan kedua-dua kumpulan melaporkan hasil perbezaan adalah tidak ketara dalam masa 6 bulan selepas pembedahan rekonstruksi ACL.

Chapter 1

INTRODUCTION

INTRODUCTION

Anterior Cruciate Ligament (ACL) is the most frequent injured ligament in the body, and commonly affects the young active population [1]. ACL plays an important role in stabilization of the knee. Disruption of this ligament can contribute to devastating effects ranging from complaints of instability and buckling during high level of sports participation to reports of giving way while walking down the street.

Arthroscopic assisted ACL reconstruction is a common procedure to allow patients to return to their former active lifestyle. ACL reconstruction is the most commonly performed surgery in Orthopedic Sports subspecialty and has become a standard procedure. It is estimated that 175,000 ACL reconstructions were performed in the United States [2].

Rehabilitation or physiotherapy including proprioception exercises is imperative to strengthen the muscles around the knee, improve joint sensorimotor function, and ultimately to improve control and correct lower limb alignment against load [3]. Rehabilitation of the reconstructed ACL is critical for the successful return to risky cutting and jumping activities. A variety of rehabilitation protocols exist, but they are based on similar principles: control of pain and swelling in the early postoperative phase; knee joint motion; early weight bearing; ambulation and muscular strengthening and dynamic balancing [4].

Acknowledging that rehabilitation is pivotal in the management of ACL injuries, all patients who undergo ACL reconstruction surgery in our center are referred to physiotherapist. Unfortunately and admittedly, the physiotherapy that is received in our center is sub-optimal. This can be attributed to several factors. Firstly, there is a significant insufficiency of infrastructure and limited appointment time (frequency of only 1 session per week) because there is no allocated facility for rehabilitation of sports injuries, hence, there has to be sharing of the same facilities for all specialties.

Furthermore, there are no dedicated or trained physiotherapists who focus on sports rehabilitation. Then we have significant patient related factors ranging from compliance issues, occupational burden, long distance of travel to attend the sessions and financial difficulties pertaining to transport. Finally, there is the issue of referring patients to smaller hospitals (upon request for logistic reasons) where their therapists have inadequate exposure and expertise to supervise the rehabilitation.

Considering the above problems and with the emergence of significant home-based rehabilitation for ACL reconstruction in western literature, we decided to assess its applicability in our local setting [5][6][7][8]. The purpose of this study was to evaluate the outcome after ACL reconstruction between a group of patients receiving supervised guided physiotherapy rehabilitation and another group of patients using a home-based rehabilitation program. Our hypothesis was that there would be no difference in outcome between both groups. A positive result from this study would provide a new alternative for rehabilitation of ACL reconstruction patients.

LITERATURE REVIEW

There have been five randomized control trials comparing home-based physiotherapy and supervised physiotherapy following ACL reconstruction. Initial study on HB physiotherapy found that minimal supervision for rehabilitation could result in equivalent outcome following ACL reconstruction as long as patients were mature enough to control their own rehabilitation progress [8]

Subsequent studies were done to further evaluate the reliability of home-based physiotherapy after ACL reconstruction. In 1998, there were 2 studies evaluating HB physiotherapy and SP rehabilitation. Beard and Dodd [5] evaluated at 3 and 6 months postoperatively on outcome assessed by functional outcome by Lysholm, Tegner and International Knee Documentation Committee scores; visual analog scale; laxity; and muscle strength by isokinetic testing. However, they only separated their 13 patients in HB rehabilitation and 13 patients in SP group after 6 weeks of similar regime of supervised physical therapy. The authors concluded on a short course evaluation after another 6 weeks of rehabilitation in both groups that they found similar findings to Schenck *et al*.[8]. Meanwhile, another study by *Fischer et al*.[9], emphasized on compliance in the HB group by using a training log. They found that the patients in HB group found it more convenient and understood their rehabilitation better..

A large number of patients and level 1 study by Grant *et al*.[6] in 2005 showed a structured HB rehabilitation program was more effective in achieving acceptable knee range of motion in the first 3 months after anterior cruciate ligament reconstruction than a standard program. This finding was also similar with previous studies but they noted a significant difference in flexion and extension range of motion. However, the study was only limited to 3 months post-operative evaluation. Hence, they did a follow up their patients after two to four years to compare of HB and SP groups. The authors concluded that patients who participated in HB rehabilitation program in the first 3 months after ACL reconstruction have similar long term outcomes compared with those who participated in SP program. To date, this is the only long-term study to evaluate the effectiveness of HB rehabilitation.

From our review, studies by Grant et al, Beard et al and Hohmann *et al.* [5][6][7] also evaluated muscle strength between both groups. Keays *et al.* [10] studied the relationship between knee strength and functional stability in ACL injured patients before and after ACL reconstruction. They showed that quadriceps strength significantly correlated with patients' function, as well as hop and agility testing before surgery. Meanwhile both quadriceps and hamstring strength significantly correlated with those tests post-operatively. Petschnig *et al.* [11] and Wilk *et al*.[12] reported a similar result.

The available studies did not explain comprehensively regarding their HB rehabilitation regime that is a fundamental element to ensure the goals of each phase could be achieved. They just stated briefly the goals for each phase and recommended exercises as in Beard and Dodd, Hohmann *et al.* and Schenck *et al.* studies[5][7][8].

All of the studies concluded that there were no statistically differences in functional and objective measurements in different postoperative rehabilitation regimes.

Chapter 2

OBJECTIVES

GENERAL OBJECTIVE

The general objective of this study was to compare the outcome of ACL reconstruction between patients who completed a home-based rehabilitation program and patients who underwent a supervised physiotherapy rehabilitation program, for the first 6 months after surgery

SPECIFIC OBJECTIVES

1. To compare the functional outcome scores at 3 months and 6 months between the 2 groups.
2. To compare the mean knee range of motion at 6 weeks, 3 months and 6 months, between the 2 groups.
3. To compare the mean of quadriceps and hamstrings muscles strength and the knee power at 6 months between the 2 groups.
4. To compare the mean ACL graft laxity at 6 months between the 2 groups.

Chapter 3

MANUSCRIPT

TITLE: Home Based Rehabilitation Versus Supervised Physiotherapy Rehabilitation for First 6 Months Post Anterior Cruciate Ligament (ACL) Reconstruction in Recreational Athletes.

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ABSTRACT

Background:

Home-based rehabilitation is an alternative method of physiotherapy after anterior cruciate ligament (ACL) reconstruction to regain pre injury state level. We conducted a prospective interventional study to investigate the outcome of a newly modified home-based (HB) physiotherapy program for patient post (ACL) reconstruction as comparison with supervised physiotherapy (SP) within 6 months that would be a cost effective and toward patient-directed rehabilitation to improve compliance.

Objective:

The aim for this study was to compare the outcome of post ACL reconstruction rehabilitation between a complete HB rehabilitation and the conventional SP rehabilitation program in term of knee range of motion, functional outcome, strength and power of the operated knees.

Methodology:

This was a prospective interventional study conducted over 1 year. There were 34 patients with ACL injury randomized either into a HB or SP program. Twenty seven patients successfully completed rehabilitation based on a standard regime of exercises. 15 of them were in the SP group while 12 were in the HB group. Patients were given an explanation, an instructional video CD and equipment to perform the HB rehabilitation. All patients were reviewed at 6 weeks, 3 months and 6 months post ACL reconstruction for evaluation. Knee motion, muscle strength and power, knee

stability, and functional outcomes were assessed to investigate the comparison between both groups.

Results:

The mean age for both groups was almost similar; 24.4 in the HB group and 25 in the SP group. 20 of the 27 patients were male. There was an excellent result of range of motion in the HB group as all patients achieved the targeted goal, however, 1 patient did not achieve the targeted range of motion in the early phase for the SP group. Functional outcome scores improved at 6 months as comparison score at 3 months for both groups with mean scores from 86 to 97 and 84 to 95 respectively, but statistically insignificant between both groups (P value 0.652 at 3 month and 0.323 at 6 month). Knee laxity using KT 1000 did not show any significant difference at 6 months (p: 0.371). Both quadriceps and hamstrings muscle strengths that were measured at 2 different speeds (180° and 300° per second) showed no significant difference as well as knee power after 6 months home-based physiotherapy.

Conclusion:

Home-based rehabilitation was as effective as supervised physiotherapy in terms of functional outcome scores, knee range of motion, knee laxity, and muscle strength and knee power for the first 6 months after ACL reconstruction surgery.

Keywords: *Anterior cruciate ligament; Reconstruction; Rehabilitation; Home Based; Supervised Physiotherapy*

Introduction

Anterior cruciate ligament (ACL) reconstruction is a common surgical procedure among patients with ACL injury. Arthroscopic assisted surgery has become the goal standard surgical treatment for ACL reconstruction [1].

Rehabilitation of the reconstructed knee is an essential element for the successful of the surgery. The goal of the rehabilitation following ACL reconstruction is mainly to restore muscle strength, joint stability, range of motion and neuromuscular control. Following any knee surgery, appropriate rehabilitation may definitely affect post-operative course and final outcome [2].

Acknowledging that rehabilitation is pivotal in the management of ACL injuries, all patients who undergo ACL reconstruction surgery in our center are referred to physiotherapist. Unfortunately and admittedly, the physiotherapy that is received in our center is sub-optimal. This can be attributed to several factors. Firstly, there is a significant insufficiency of infrastructure and limited appointment time (frequency of only 1 session per week) because there is no allocated facility for rehabilitation of sports injuries, hence, there has to be sharing of the same facilities for all specialties.

Furthermore, there are no dedicated or trained physiotherapists who focus on sports rehabilitation. Then we have significant patient related factors ranging from compliance issues, occupational burden, long distance of travel to attend the sessions and financial difficulties pertaining to transport. Finally, there is the issue of referring patients to smaller hospitals (upon request for logistic reasons) where their therapists have inadequate exposure and expertise to supervise the rehabilitation.

The purpose of this study was therefore to investigate the outcome after ACL reconstruction between a group of patients who received an unsupervised home based (HB) rehabilitation program and a group of patients that followed rehabilitation under the supervision of a physiotherapist. Our hypothesis was that there would be similar outcome in both groups.

METHODOLOGY

This was a prospective interventional and randomized study. The study population comprised patients who sustained ACL injury, recruited from Orthopaedic Sports Clinic Hospital Universiti Sains Malaysia, Kubang Kerian, Kelantan. Prior to participation, all patients gave verbal and written informed consent in accordance to the Human Research Ethics Committee Universiti Sains Malaysia Panel. The study was performed at Hospital Universiti Sains Malaysia, Kubang Kerian, Kelantan and the duration was from April 2016 until April 2017. This study received the ethical approval from Human Research Ethics Committee (HREC), Universiti Sains Malaysia (Appendix1).

SAMPLE SIZE

Sample size calculation for this objective was calculated using formula for estimation for differences between two means. With the population standard deviation for ACL graft laxity as one of main outcome measure amount of 2.4 as in Grant *et al*. [3] study, type I error of 0.05, type II error of 0.2, the smallest significant mean difference of 3 and the ratio between control to case of1, the minimum sample size required was 11 patients per group. Based on the calculation above, the largest sample size obtained from calculation of sample size is 11 patients. After adding 30% anticipated dropout rate, the number of patient required is 15 patients per group.

Any isolated ACL injury among recreational athlete with or without meniscus injury between the ages of 18 to 40 who were able to give independent consent were