GOAL BASED REHABILITATION PROGRAM VERSUS CONVENTIONAL PHYSICAL THERAPY PROGRAM AFTER ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION

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Abstract

Background: The main goal of a rehabilitation program after an ACL reconstruction is to regain mobility and muscle function and ultimately to return to sports participation. **Purpose of the study**: to investigate the effect of goal based rehabilitation program on knee pain, range of motion (ROM) and function in patients with post ACLR surgery. **Methodology:** Thirty four adult maleswho underwent ACLR surgeryparticipated in this study, their age ranged from 18 to 40 years and their body mass index (BMI) was ranged from 18 to 25 kg/m^2.They were randomly assigned into two equal groups. Group (A) received goal based rehabilitation protocoland group (B) received conventional physical therapy program. Treatment sessions were conducted 5 times per week for 22 weeks for both groups. All patients assessed pre and post treatment for pain intensity using visual analogue scale (VAS), knee range of motion using universal goniometer (UG) and knee function using Arabic version of knee injury and osteoarthritis outcome score (KOOS). **Results:** Post treatment results revealed that there was a significant improvement in pain, ROM and function in both groups but, there was a significant superior improvement in group A than in group B. **Conclusion:**Both protocols were effective, but goal based was more effective than conventional program.

Key Words: Post ACLR rehabilitation, Conventional physical therapy program, Goal based rehabilitation.

Introduction

Knee injuries are the second most frequently occurring musculoskeletal injuries in the primary care. The prevalence of knee injuries is approximately 48/1000 patients a year, 9% of which are ligamentous injuries with anterior cruciate ligament (ACL) being the most common of these **(1&2).** The ACL is one of the four major ligaments that minimize stress on the knee joint and ensures joint stability through resistance against motion caused by anterior tibial translation and internal tibial rotation **(3)**. ACL injury leads to disuse atrophy of the thigh muscles **(4)**, destabilizes the knee joint, reduces control of nerve roots and decreases joint active range of motion**(5)**.

The goal of a rehabilitation program after an ACL reconstruction (ACLR) is to regain mobility and muscle function and ultimately to return to sports participation **(6)**. So rehabilitation plays a significant role in determining how quickly and safely an athlete can return to sport **(7)**. Recent literature describes time based rehabilitation protocols that are mainly based on the remodeling process of the graft **(1).** Since there is still uncertainty about the time schedule of the human remodeling process, it makes more sense to incorporate functional goal based criteria to the rehabilitation protocol **(8-11).**

There is a gap of evidences to determine the best approach to be used in physical therapy rehabilitation program following ACL reconstruction so this study was conducted to investigate the effect of goal based rehabilitation program on knee ROM and pain

Subjects, Instrumentations and methods

Subjects:

This study was conducted in the outpatient clinic of Faculty of Physical Therapy, Cairo University in the period from April 2017 to January 2018. Thirty four male football players or who perform physically demanding work patients underwent ACLR surgery with age ranging 18-40 years and BMI 22.585±0.82 and agreed to participate in this study. They were referred from orthopedic surgeon immediately after the operation. Written informed consents **(appendix 1)** were received from all participants after detailed explanation about the aims, benefits, and risks of this study. Participants were informed that they are free to withdraw from the study at any time without penalty. Patient recruitment and retention was explained in **Figure 1**.The approval of ethical committee number is REC/012/001619.

All the patient fulfilled the following inclusion criteria; 1) Underwent pre-operative rehabilitation program with minimal knee effusion and full extension, good patellofemoral mobility, and the patient could actively control the quadriceps, 2) Have an ACLR with an autolongous hamstring (HS) graft, 3)Age range from 18 – 40 years old.

Patients were excluded from the study if they had; 1) ACLR with any graft other than hamstring graft, 2) ACL revision surgery, 3) an associated medial or lateral ligamentous injuries, 4) a meniscectomy previous or simultaneously with ACLR, 5) previous meniscal repair or simultaneously with ACLR and 6) cartilage damage.

The patients were were randomly assigned into two equal groups as follow: thirty four folded papers written by (A or B) were put in a box. Each patient was instructed to choose a paper. The patient was assigned to his group according to the letter he had chosen either (A or B), group (A) 17 Patients received goal based rehabilitation protocol and group (B) 17 Patients received conventional physical therapy program.

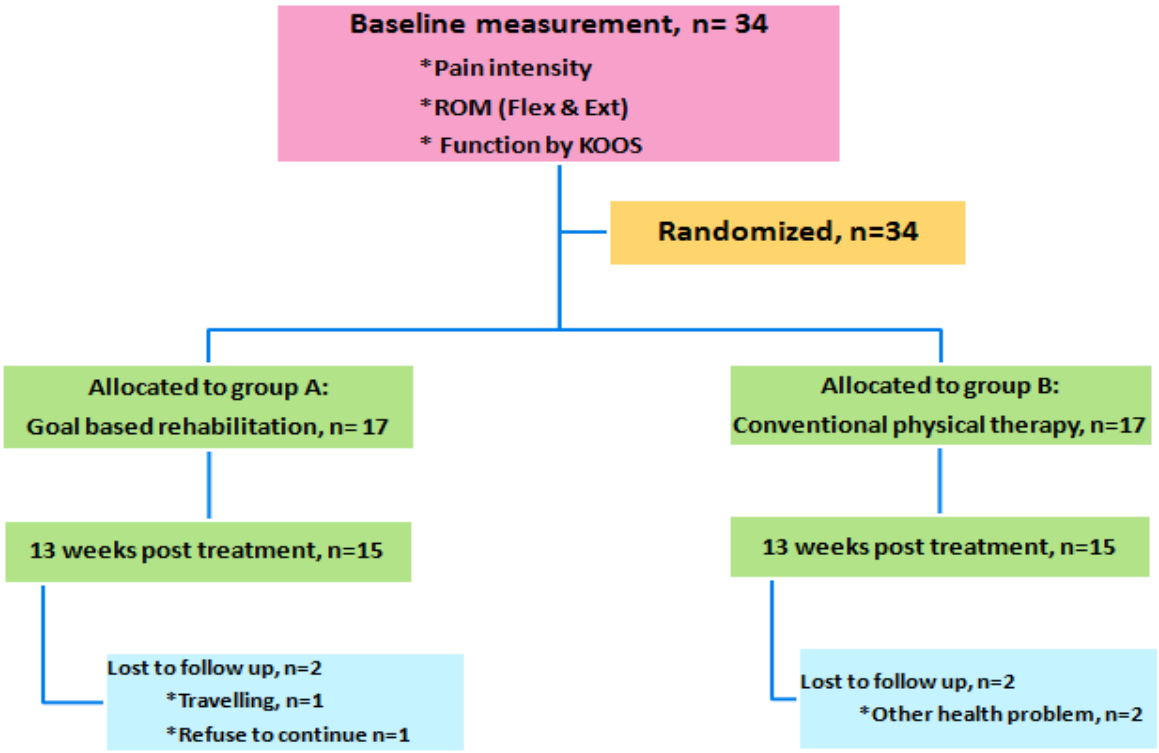

Figure 1 shows the flow diagram of patient recruitment and retention**.**

Methods

All outcome measures were collected at baseline and 22 weeks after the interventions of the 3 groups. The primary outcome measure was pain intensity, measured by **visual analogue scale (VAS)** and the secondary outcome measure were knee ROM measured by **universal goniometer (UG)** and knee function measured by **Arabic version of Knee injury and Osteoarthritis Outcome Score (KOOS) (12) (Appendix 2)**

Group (A) received goal based rehabilitation protocol **(13-17) (Appendix 3)** and group (B) received conventional physical therapy program**(13&18) (Appendix 4)**. All patients in both groups had 5 sessions a week for 22 week. They were well instructed how to perform their exercises and they were allowed to perform them alone after a successful 3 trials under supervision of the same physical therapist

Statistical analysis:

Reported data were analyzed using Statistical Package for Social Sciences (SPSS) computer program (version24 windows) (Charles R Flint, New York, USA). Potential differences in baseline demographic and clinical variables between groups were examined using independent sample t test. Two-way MANOVA was used to examine the effects of treatment on pain, ROM (knee flexion and extension) and function (KOOS) at an a priori alpha level of .05. A Bonferroni post hoc test was used to determine which group was superior when the interaction was significant. Individual paired t tests (two tailed) for each group were done to determine the magnitude of changes within each group.

RESULTS

Thirty four male patients with age range 18-40 years (mean ± SD age, 23.51 ± 3.97) were eligible and agreed to participate in this study. They were randomized to group A: goal based rehabilitation program (n = 17) and group B: conventional physical therapy program (n = 17). Patient recruitment and retention was explained in **Figure 1**.There was no significant difference between both groups for demographic data and the baseline measurements (P>0.05) **(Table I).** Multivariate tests for outcome measures indicate a statistically significant group by time interaction (F= 140.1, P=0.00) **(Table 2).**

The interaction was statistically significant for pain (F =7.73, P=0.007), knee flexion (F =21.78, P=0.000) and function (F =562.3, P=0.000). The patients who received goal based rehabilitation protocols experienced more pain reduction and increasing knee flexion and functional level than those who received conventional treatment (P<0.05) and there was no significant interaction for knee extension (F 1.88, P=0.176) **(Table 3).** However, Bonferroni post hoc test for changes between groups revealed that: the mean value of knee extension ROM was significantly improved in patients who received goal based program (p< 0.05) when compared with its corresponding value in conventional group **(Table 3).** Paired t tests within both groups revealed significant difference for all measured variables (P=0.000) **(Table 3).**

Table 1 showsdemographic features of the two studied groups.

	Group A (n= 15)	**Group B (n= 15)**	**t value**	**P value**
Age (yrs.)	23.4 ± 3.97	23.27 ± 3.84	0.093	0.93 (NS)
Weight (kg)	71.1 ± 4.56	68.86 ± 4.86	1.3	0.204 (NS)
Height (m)	1.76 ± 0.04	1.77 ± 0.05	0.278	0.783 (NS)
BMI (Kg/m^2)	22.87 ± 0.61	22.3 ± 1.03	1.83	0.08 (NS)

Data are expressed as mean ± SD

NS: not significant

Table 2 shows Multivariate Analysis of Variance (MANOVA) for all dependent variables at different measuring periods between studied groups.

Source of Variation	**F-value**	**P-value**
Groups	146.4	0.000*
Measuring periods	32592.4	0.000*
Interaction (group*time)	140.1	0.000*

***Significant at alpha level <0.05**.

Table 3 showspost-intervention, within-group, between-group differences and group by time interaction for pain intensity and knee ROM (knee flexion & extension)

Variable and Group	**Pre-ttt**	**Post- ttt**	**Within group change**				**Between groups change**		**Group * time interaction**	
			MD	**t**	**p**	**%**	**MD**	**P**	**F**	**P**
Pain							0.7	0.003*	7.73	0.007*
A	8.47 ± 0.91	0.9 ± 0.69	7.7	21.25	0.00*	89.37				
B	8.53 ± 1.06	2.1 ± 0.74	6.4	18.33	0.00*	77.49				
Knee flex							8.5	0.000*	21.78	0.000*
A	59.0 ± 3.38	153.67 ± 2.28	94.7	104.2	0.00*	160.5				
B	56.0 ± 6.03	139.66 ± 5.49	83.7	45.08	0.00*	149				

Knee ext							2.07	0.01*	1.88	0.176
A	12.0 ± 3.17	1.0 ± 2.07	13	15.9	0.00*	91.7				
B	13.0 ± 3.68	2.13 ±2.8	10.9	13.32	0.00**	83.6				
Function							5.02	0.000*	562.3	0.000*
A	5± 0.37	86.43 ± 1.08	81.4	274.9	0.00*					
B	4.97 ± 0.39	67.43 ±1.08	71.5	269.8	0.00*					

Data are expressed as mean ± SD, F value= ANOVA test, t value= paired t test.

*p< 0.05= significant.

DISCUSION

Thirty four patients participated in this study, and were randomly assigned into two equal groups; group A (Goal based rehabilitation protocol) and group B (Conventional physical therapy program).This study was designed to investigate the effect of goal based rehabilitation program on knee pain, ROM and function in patients with post ACLR surgery with hamstring graft.

The results of this study revealed that, 22 weeks application of both goal based rehabilitation protocol and conventional physical therapy program could decrease pain intensity and increase both knee ROM and function. Goal based rehabilitation protocol was more effective than conventional physical therapy program.The results of our study come in accordance with other studies that showed the significant improvement in knee pain, ROM and function as:

The systemic review of **Wright et al 2008** investigated the effect of physical therapy after ACLR, in four RCTsand concluded that it was reasonable that a minimally supervised rehabilitation could result in successful ACLR rehabilitation in self-reported knee function and quadriceps and HS strength 24 weeks after ACLR **(19).**

The prospective cohort study of **Dragicevic-Cvjetkovic et al 2014** found a better self-reported knee function and greater improvement in knee pain intensity, ROM and thigh muscle circumference in a rehabilitation group (20 weeks) compared to a group with no rehabilitation at all at a 1 year follow-up **(20).**

Two RCTs of **Shaw et al 2005** and **Isberg et al 2006** concluded that isometric quadriceps exercises were safe in the first postoperative weeks and lead to better outcome after ACLR surgery, because there were no differences in laxity up to 2 years of follow-up **(21, 22)**. Where **Fukudaet al 2013** revealed that OKC quadriceps exercises when started from week 4 after ACLR with HS, but in a limited ROM between 45° and 90° could lead to better results **(23)**. Also **Lobbet al** found thatthe combination of OKC and

CKC quadriceps exercises results in better strength and return to play than CKC exercises alone **(24)**.

Furthermore**,** two systematic reviews of **Kruse et al 2012** and **Gokeler et al 2012** concluded that the eccentric quadriceps training can be safely incorporated 3 weeks after ACLR and may be the most effective way of restoring quadriceps strength. They concluded that for optimizing outcome after rehabilitation, neuromuscular training should be added to strength training **(6, 25).**

On the other hand, the prospective cohort study of **Laboute et al2014** reported 65.7% of athletes returning to pre-injury sport level **(26)**. While **Zaffagnini et al 2014** reported a higher return to pre-injury sport level of 71% in a group of professional soccer players 4 years after ACLR **(17)**. Where meta-analysis study of **Ardern et al 2014** found only 38% returned to pre-injury level 2 years after ACLR **(27)**. Andprospective cohort studyof **Thomeé et al 2012** found only 23% of patients returned to pre-injury level **(28)**.

Since current rehabilitation protocols are based on remodeling process of the graft and there is still uncertainty about the time schedule of the human remodeling process, besides there are individual differences in neuromotor learning and flexibility after ACLR. It makes more sense to incorporate functional goal based criteria to the rehabilitation protocol **(1, 9-11, 13&15).**Goal based rehabilitation protocol is relatively new in rehabilitation, but it assures a more patient-tailored rehabilitation **(13&16-17)**.

It is imperative to pay more attention to correct qualitative performance of exercises since it was concluded that the risk of second ACL rupture (graft re-rupture and contra lateral ACL) is higher than the risk of a first-time ACL rupture. That altered neuromuscular function and bad kinematics could be; higher dynamic knee valgus, higher trunk lateral flexion or less knee flexion when landing tasks that frequently performed in competitive sports **(29-31).**

Conclusion:

Application of both goal based rehabilitation program and conventional physical therapy program for 22 weeks could decrease knee pain intensity, and increase knee range of motion as well as function of the knee. But goal based rehabilitation protocol was more effective than conventional physical therapy program.

Limitation of the study:

- No follow up was done to know the long term effects of both rehabilitation protocol and recurrence of injury

Conflicts of interest:

None.

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Appendices:

Appendix 3shows consent form.

I am freely and voluntarily consent to participate in this research study under the direction of the researcher /
A thorough description of the procedures has been explained and I understand that .I may withdraw my consent and discontinue participation in this research at any time without prejudice.
Date: / / 20 Participant:

اقرار

اقر انا / الموقع ادناه انني وافقت علي الاشتراك ف برنامج البحث تحت اشراف الباحثه/ وقد تم شرح خطوات البحث لي بالتفصيل وانه من حقي ان انسحب من الدراسة في اي وقت اشاء
التاريخ: / / 20
المشارك:

Appendix 2shows Arabic version of Knee Injury and Osteoarthritis Outcome Score (KOOS).

إستبيان لتقييم الحالة الصحية للركبة (KOOS)

تاريخ اليوم: ...../...../..... **تاريخ الميلاد:** ...../...../.....

الأسم .....

هذه المعلومات سوف تساعدنا لمعرفة كيف تشعر بركبتك و كذالك كيف ستكون قادر علي إنجاز نشاطاتك الإعتيادية.

أجب كل سؤال بوضع **علامة (√) واحدة** علي الإجابة المناسبة أمام كل سؤال, وإذا كنت غير متأكد من الإجابة الرجاء إختيار أقرب إجابة ممكنة.

أعراض المرض

ينبغي الإجابة علي هذه الأسئلة المتعلقة بالأعراض المصاحبة لركبتك خلال **الأسبوع الماضي.**

1S صعوبة فرد الركبة عند إستيقاضك في الصباح ؟ ما هي شدة

لاشئ	خفيف	معتدل	شديد	شديد جدا
☐	☐	☐	☐	☐

2S ما هي شدة صعوبة فرد الركبة بعد وضع الجلوس، التمدد أو الإسترخاء في وقت لاحق من نفس اليوم؟

لاشئ	خفيف	معتدل	شديد	شديد جدا
☐	☐	☐	☐	☐

3S هل يوجد تورم في ركبتك؟

ماحصلش	نادرا	أحيانا	غالبا	دايما
☐	☐	☐	☐	☐

4S هل تشعر بأي خشخشة أوسماع فرقعة، أو أي نوع آخر من الأصوات عندما تحرك ركبتك؟

ماحصلش	نادرا	أحيانا	غالبا	دايما
☐	☐	☐	☐	☐

5S هل ركبتك تقفش فجأة أو بتعلق عندما تقوم بالحركة ؟

ماحصلش	نادرا	أحيانا	غالبا	دايما
☐	☐	☐	☐	☐

التيبس

الأسئلة التالية تتعلق بدرجة تيبس (تصلب) مفصل الركبة الذي أحسست به خلال الأسبوع الماضي**.** التيبس هو الشعور بالتقييد أو البطئ في سهولة حركة مفصل الركبة.

6S هل يمكنك فرد ركبتك بالكامل (علي الآخر)؟

دايما	غالبا	أحيانا	نادرا	ماحصلش
☐	☐	☐	☐	☐

7S هل يمكنك ثني ركبتك بشكل كامل (علي الآخر)؟

دايما	غالبا	أحيانا	نادرا	ماحصلش
☐	☐	☐	☐	☐

الألم (الوجع)

1P كم مرة تحس بوجع في ركبتك عادة؟

ماحصلش ☐ كل شهر ☐ كل أسبوع ☐ كل يوم ☐ دايما ☐

ماهي شدة الوجع التي قد تكون شعرت بها *الأسبوع الماضى* خلال أدائك للنشاطات الآتية...؟

2P اللف و الإستناد (الإرتكاز) علي الركبة المصابة

لاشئ ☐ خفيف ☐ معتدل ☐ شديد ☐ شديد جدا ☐

3P فرد الركبة بالكامل

لاشئ ☐ خفيف ☐ معتدل ☐ شديد ☐ شديد جدا ☐

4P ثني الركبة بالكامل (وضع الجلوس في الصلاة مثلا...)

لاشئ ☐ خفيف ☐ معتدل ☐ شديد ☐ شديد جدا ☐

5P المشي على الأرض المستوية

لاشئ ☐ خفيف ☐ معتدل ☐ شديد ☐ شديد جدا ☐

6P طلوع أو نزول السلالم

لاشئ ☐ خفيف ☐ معتدل ☐ شديد ☐ شديد جدا ☐

7P في الليل، أثناء وجودك في السرير للنوم

لاشئ ☐ خفيف ☐ معتدل ☐ شديد ☐ شديد جدا ☐

8P وضع الجلوس أو وضع النوم (الإستلقاء)

لاشئ ☐ خفيف ☐ معتدل ☐ شديد ☐ شديد جدا ☐

9P عند وقوفك في الوضع الطبيعي

لاشئ ☐ خفيف ☐ معتدل ☐ شديد ☐ شديد جدا ☐

أنشطة الحياة اليومية

ما الصعوبات التي قابلتها في الركبة *الأسبوع الماضى*...؟

1A في نزول السلالم

لاشئ ☐ خفيف ☐ معتدل ☐ شديد ☐ شديد جدا ☐

2A في صعود (طلوع) السلالم

لاشئ خفيف معتدل شديد شديد جدا

	☐	☐	☐	☐	☐
3A	القيام من وضع الجلوس				
	لاشئ	خفيف	معتدل	شديد	شديد جدا
	☐	☐	☐	☐	☐
4A	الوقوف				
	لاشئ	خفيف	معتدل	شديد	شديد جدا
	☐	☐	☐	☐	☐

ما الصعوبات التي قابلتها في الركبة *الأسبوع الماضي*...؟

5A	إنحناء الجسم أو توطى لإلتقاط الأشياء (الحاجات) من علي الأرض				
	لاشئ	خفيف	معتدل	شديد	شديد جدا
	☐	☐	☐	☐	☐
6A	المشي على أرض مستوية				
	لاشئ	خفيف	معتدل	شديد	شديد جدا
	☐	☐	☐	☐	☐
7A	الصعود و النزول من السيارة (العربية)				
	لاشئ	خفيف	معتدل	شديد	شديد جدا
	☐	☐	☐	☐	☐
8A	الذهاب للتسوق				
	لاشئ	خفيف	معتدل	شديد	شديد جدا
	☐	☐	☐	☐	☐
9A	لبس الشرابات القصيرة أو الطويلة				
	لاشئ	خفيف	معتدل	شديد	شديد جدا
	☐	☐	☐	☐	☐
10A	القيام (النهوض) من السرير				
	لاشئ	خفيف	معتدل	شديد	شديد جدا
	☐	☐	☐	☐	☐
11A	خلع الشرابات القصيرة أو الطويلة				
	لاشئ	خفيف	معتدل	شديد	شديد جدا
	☐	☐	☐	☐	☐
12A	النوم في السرير (التقلب علي أحد الجانبيين أوالحفاظ على وضع ثابث للركبة)				
	لاشئ	خفيف	معتدل	شديد	شديد جدا
	☐	☐	☐	☐	☐
13A	عند قيامك بالإستحمام				
	لاشئ	خفيف	معتدل	شديد	شديد جدا
	☐	☐	☐	☐	☐
14A	وضع الجلوس				
	لاشئ	خفيف	معتدل	شديد	شديد جدا
	☐	☐	☐	☐	☐
15A	عند قيامك بقضاء الحاجة (قياما و قعودا من علي التواليت)				
	لاشئ	خفيف	معتدل	شديد	شديد جدا
	☐	☐	☐	☐	☐

16A الأعمال المنزلية المجهدة (تحريك و نقل الصناديق الثقيلة, شطف البلاط ، ...الخ)

لاشئ	خفيف	معتدل	شديد	شديد جدا
☐	☐	☐	☐	☐

17A الأعمال المنزلية الخفيفة (الطبخ، و مسح الغبار، ...الخ)

لاشئ	خفيف	معتدل	شديد	شديد جدا
☐	☐	☐	☐	☐

النشاط الرياضي و المهارات اللازمة لممارسة الهوايات

ما الصعوبات التي قابلتها في الركبة ***الاسبوع الماضي***؟

1SP ثني الركبتين من وضع الوقوف

لاشئ	خفيف	معتدل	شديد	شديد جدا
☐	☐	☐	☐	☐

2SP الجري

لاشئ	خفيف	معتدل	شديد	شديد جدا
☐	☐	☐	☐	☐

3SP القفز (النط)

لاشئ	خفيف	معتدل	شديد	شديد جدا
☐	☐	☐	☐	☐

4SP اللف و الإستناد (الإرتكاز) علي الركبة المصابة

لاشئ	خفيف	معتدل	شديد	شديد جدا
☐	☐	☐	☐	☐

5SP النزول و الإرتكاز علي الركبتين (كالنزول للسجود في الصلاة مثلا...)

لاشئ	خفيف	معتدل	شديد	شديد جدا
☐	☐	☐	☐	☐

الركبة المصابة و علاقتها بنمط الحياة

1Q إلي أي مدي تشغلك مشاكل ركبتك أو تمثل مساحة من ذهنك أو تفكيرك ؟

ماحصلش	شهريا	أسبوعيا	يوميا	دايما
☐	☐	☐	☐	☐

2Q هل قمت بتعديل أسلوب حياتك لتجنب الأنشطة التي قد تسبب تلفا في ركبتك؟

ماحصلش	قليلا	بإعتدال	بشدة	كليا
☐	☐	☐	☐	☐

3Q ما مدي قلقك من عدم ثقتك بكفأة آداء ركبتك ؟

ماحصلش	قليلا	معتدل	بشدة	بشدة كبيرة
☐	☐	☐	☐	☐

4Q بشكل عام، ما مدى الصعوبات التي تقابلها عند ممارسة حياتك الطبيعية بسبب مشاكل ركبتك ؟

لاشئ	خفيف	معتدل	شديد	شديد جدا
☐	☐	☐	☐	☐

Appendix 3showsgoal based rehabilitation protocol.

<table>
<tr><th colspan="5">Phase 1(Impaired phase)</th></tr>
<tr><td colspan="2">Modalities</td><td colspan="2">When to start</td><td>Repetition and load</td></tr>
<tr><td colspan="2">leg elevation with a pillow under the heel</td><td colspan="2" rowspan="5">Immediately after surgery</td><td>10-15 min x 3-4 times/ day</td></tr>
<tr><td colspan="2">Ankle pumps</td><td rowspan="3">10 rep. X 3 sets X 4-5 times / day</td></tr>
<tr><td rowspan="2">Active knee extensions</td><td>Quad setting</td></tr>
<tr><td>ASLR</td></tr>
<tr><td colspan="2">Patellar mobilization in all directions</td><td></td></tr>
<tr><td rowspan="2">heel slides</td><td>0°-90°</td><td rowspan="2">10 rep. X 3 sets X 4-5 times / day</td></tr>
<tr><td>0°-130°</td><td colspan="2">As early as possible</td></tr>
<tr><td colspan="2">CKC quadriceps
0°-60° (leg press, squat or step-up)</td><td>Week 2</td><td>Without knee reacting with increasing temperature, effusion or pain.</td><td>15 rep. X 3-5 set (20 RM)
Slowly increasing from static stability to dynamic stability by increasing surface instability and decreasing visual input.</td></tr>
<tr><td rowspan="5">OKC quadriceps exercises
(Leg extension)</td><td>90-45°</td><td>Week 4</td><td rowspan="5"></td><td rowspan="5">15 rep. X 3 set
No weight added</td></tr>
<tr><td>90°-30°</td><td>Week 5</td></tr>
<tr><td>90°-20°</td><td>Week 6</td></tr>
<tr><td>90°-10°</td><td>Week 7</td></tr>
<tr><td>90°-0°</td><td>Week 8</td></tr>
<tr><td colspan="2">Hip (abd., add., flex. and ext.)</td><td colspan="2">Week 2</td><td>15 rep. X 3-5 set (20 RM)</td></tr>
<tr><td rowspan="2">wobble-board (only forward-backward movements)</td><td>On two legs</td><td colspan="2" rowspan="2">When tolerated without knee reacting with increasing temperature, effusion and/or pain</td><td rowspan="2"></td></tr>
<tr><td>on one leg</td></tr>
</table>

	Increasing difficult board		3 rep x 30 sec each
	with eyes closed		
Load the operated leg		Immediately after surgery if necessary with crutches.	During walking
Keep using crutches		as long as there is a deviation in the gait pattern	
Cycling		When knee flexion reached 100°	15 min
Encourage a correct quality of performance (e.g. trunk lateral flexion, hip- and knee flexion, dynamic knee valgus and knee-over-toe) during strength training and walking			
Criteria to start phase 2	- No knee pain with phase 1 exercises (VAS) - Minimal effusion, - Knee extension of at least 0° and a 120°-130° flexion - Voluntary control of the quadriceps - Active dynamic gait pattern without crutches - Correct qualitative performance of phase 1 exercises		
Phase 2 (sport-specific training phase)			
Modalities	**When to start**	**Repetition and load**	
Maintain full ROM.	At the start of phase 2.		
Stationary bike		15 min	
outdoor cycling		15 min	
Hip (abd., add., flex. and ext)		12 rep. X 3-5 set (15 RM)	
	When tolerated	8 rep. X 3-5 set (8 RM)	
CKC exercises to full ROM on legged (Leg press and squat)	At the start of phase 2.	12 rep. X 3-5 set (15 RM)	
	When tolerated	8 rep. X 3-5 set (8 RM)	
OKC exercises	At the start of phase 2.	No weight was added	

to full ROM (Leg extension)	Week 12	20 rep. X 3 set (30 RM)
Lunge 4 ways	At the start of phase 2 but only if it is performed symmetrically and the knee does not react with increasing temperature, effusion or pain.	Each way 15 rep. X 3 set (20 RM)
Balance exercises		3 rep x 30 sec each
Jumping		Start with two-legged jumping and work slowly toward one-legged jumping
Jogging		15 min
Plyometric exercises	When tolerated	3 rep x 30 sec each
Sport-specific tasks training		Variations in running, turning and cutting. Duration and speed to be increased and maximized.
Criteria to start phase 3	LSI >80% for a hop test battery Correct qualitative performance of phase 2 exercises	
Phase 3 (return to sport phase)		
Modalities	**When to start**	**Repetition and load**
Strength training	At start of phase 3	Intensify (sport) specific strength training.
Neuromuscular training	At start of phase 3	Emphasis on sport specific movements. Enhance Built sport specific surface
Sport specific training	Correct qualitative performance during Strength training and Neuromuscular training	Restart training at the patient's own sports club.

RM: Repetition Maximum.1RM is the most weight you can lift for one repetition. 15RM is the most weight you can lift for 15 repetitions.

Appendix 4showsconventional physical therapy program.

Modalities		**When to start**	**Repetition and loads**
Icing		Immediately after surgery	10 min every 2 hours
Ankle pumps			10 rep. X 3 sets X 4-5 times / day
Quad setting			
SLR			
Loading the injured leg			During walking
Faradic			For 30 min
Patellar mobilization			
Heel slides and wall slides			10 rep. X 3 sets X 4-5 times / day
leg elevation with a pillow under the heel			10-15 min x 3-4 times/ day
Hip (Flex, Ext., Abd. and Add.)		Week 2-22	15 rep. X 3 set AROM then slowly adding resistance (manually or by theraband)
Squat	half	Week 2-8	
	full	Week 8-22	
Leg extension	90°- 40°	Week 4-8	15 rep. X 3 set AROM No weight added
	90°- 0°	Week 8-13	
	full	Week 13-22	15 rep. X 3 set Low resistance (manually or by theraband)
Normalize gait pattern with 2 crutches aiming to without crutches		Week 1	
Cycling and swimming		Week 4-22	15 min
Balancing exercises		Week 8-22	Slowly increasing from static stability to dynamic stability with increasing surface instability and decreasing visual input.

برنامج التأهيل على أساس الهدف مقابل البرنامج التقليدي للعلاج الطبيعي بعد إعادة بناء الرباط الصليبي الأمامي

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الخلفية:

تمثل نسبة أصابات الركبة حوالي 48 من 1000 مريض في السنة بنسبة 9% منها اصابات للأربطة. وأصابة الرباط اصيبلي الأمامي هي الأكثر حدوثا. والهدف الرئيسي من التأهيل بعد إعادة بناء الرباط الصيلبي الأمامي هو استرجاع المدى الحركي والأداء الوظيفي للركبة وكذلك الرجوع للمستوى الرياضي قبل الإصابة.

الغرض: تحديد فاعلية البرنامج التأهيلي على أساس الهدف على الألم والمدى الحركي و الناتج الوظيفي للركبة.

منهج البحث: قد شارك في البحث أربعةوثلاثون ممن أجروا جراحة إعادة بناء الرباط الصليبي الأمامي من لاعبي كرة القدم أو ممن يشتمل عملهم على مجهود بدني عالي تتراوح اعمارهم من 18-40 سنه حيث قسموا عشوائيا الي مجمو عتين متساويتين (17 شخص في كل مجموعة). تم قياس كل من: مدي الالم – المدى الحركي – النتاج الوظيفي للركبة باستخدام كل من: مقياس التناظر البصري– مقياس الزوايا العالمي– استبيان لمقدار التحسن بعد اصابات وخشونة الركبة قبل وبعد العلاج. وقد تلقي كل منهم خمس جلسات علاج اسبوعيا لمده اثنين وعشرين اسبوع حيث تلقت مجموعه أ: البرنامج التأهيلي على أساس الهدف و تلقت مجموعة ب: البرنامج التقليدي للعلاج الطبيعي

النتائج: اظهرت النتائج تغير ذو دلالة احصائية حيث قل معدل الالم - بينما زاد كل من المدى الحركي و الناتج الوظيفي للركبة في المجموعتين وقد حظيت المجموعه الأولى بالمقدار الأعلى من التحسن.

الخلاصة : البرنامجين ذو فاعيلة بينما البرنامج التأهيلي على أساس الهدف أكثر فاعلية.

الكلمات الدالة :التأهيل بعد إعادة بناء الرباط الصليبي الأمامي، البرنامج التأهيلي على أساس الهدف، البرنامج التقليدي للعلاج الطبيعي