



EXERCISES REHABILITATION FOR PHASE 2 POST RECONSTRUCTION OF ANTERIOR CRUCIATUM LIGAMENT (ACL)

Hapsari Winanti Fitra¹, Komalasari Dwi Rosella², Mardianto Halim³

^{1,2}*Faculty of Health Sciences, University of Muhammadiyah Surakarta, Indonesia*

Jl. A. yani. Tromol Pos I. Pabelan. Kartasura Surakarta 57169

*Corresponding author: Email: hapsari.winanti@gmail.com

Abstract

Introduction : Rupture is the tearing of tissue caused by trauma. The anterior cruciate ligament (ACL) is one of the main ligaments of the knee which functions to prevent the tibia from shifting anteriorly from the femur and to control rotational movement of the knee.

case presentation: A 29-year-old male patient with as a sports teacher came to physiotherapy complaining of pain and stiffness in the knee joint at Wongsonegoro Hospital, Semarang, Central Java. The patient did a surgery of anterior cruciate ligament on October 2020. The management of exercises set for phase 2 rehabilitation.

Management and outcomes : The exercises rehabilitation program included static bicycles, forward lunges on bosu, side lunges on bosu, step ups on bosu, squads with theraband, forward step down, lateral step down with resistance bands for 1 month. Several physical examinations were carried out to examine pain of knee using VAS (Visual Analog Scale), muscle strength examination using Manual Muscle Testing (MMT) on the hamstring and quadriceps muscles, a goniometer used to measure joint range of motion for knee flexion and extension movements, and functional examination measured by Knee Injury and Osteoarthritis Outcome Score (KOOS).

Discussion: exercises rehabilitation for phase 2 post surgery o anterior cruciate ligament (ACL) served to restore balance, increase muscle strength by stabilizing and strengthening during exercise for activation of neuromuscular control.

Conclusion : A month of exercises programs for three times a week were successfully decreasing pain, increasing muscle strength, range of joint motion and functional activity as well.

Keywords : Exercises rehabilitation, phase 2, Anterior cruciate ligament (ACL) Rupture



Introduction

The Anterior Cruciatum Ligament (ACL) rupture is a tear of tissue caused by trauma, while the Anterior Cruciatum Ligament (ACL) is one of the ligaments in the knee that important in preventing a shift of the tibia bone towards the anterior of the femur and controlling rotational motion of the knee (Hughes et al., 2019). There are 2 factors that cause ACL rupture, as direct or indirect contact. The direct contact can occur due to a collision in the area around the knee, while indirect contact, for example, such as when landing suddenly with the knee still in hyperextension position with a rotational hip position and so that the foot is excessively supported (Cooper, 2018). Thus, this can cause the knee joint become unstable and the tibia bone can move freely. The complications happen usually occur after ACL reconstruction are movement limitations especially limit movement of knee extension. Limit movement of knee extension can result muscle weakness, difficulty walking, and knee pain (Evans, 2018).

Generally, the Anterior Cruciatum Ligament (ACL) rupture occurs in active young people or most often occurs in soccer players (Wilk & Arrigo, 2017). The goal of ACL reconstruction itself is to recover quickly so that you can return to playing as before and be able to compete again. A tear in the ACL usually if left untreated can lead to functional decline. ACL reconstruction is carried out in order to restore knee function and allow athletes to return to sports with minimal risk of re-injury.(Lowe et al., 2017).

Methode

A case report conducted to this study by exploring the effect of some interventions (static bicycles, forward lunges on bosu, side lunges on bosu, step ups on bosu, teraband squads, forward step down, lateral step downs with resistance bands) in a specific case of rupture ACL. The study had been approved by Health Sciences Faculty, Universitas Muhammadiyah Surakarta (1292.8/C.8-III/FIK/VIII/2021)

Case Presentation

A 29-year-old male patient as sports teacher came to physiotherapy at Wongsonegoro Hospital, Semarang, Central Java, complained of pain and stiffness in the knee. The history of cse as the patient played a volley ball and fell with worse position of

leg in March 2020. When the patient did jumping to smash the ball, he fell with a straight leg position with the wrong support of foot. The patient felt pain that was increasing every time, then the patient immediately did the X-ray and advise to do the surgery in October 2020. After surgery, the patient came to physiotherapy in January 2021 and until March 2021 he was still undergoing therapy. The exercises rehabilitation planned with phase 2 program. The goals of this phase are improving muscle control, reducing swelling, restoring balance and increasing ROM (Lowe et al., 2017).

When the patient first came to physiotherapy the patient was unable to bend his knee and the patient still felt pain when climbing and descending stairs. After did therapy for 3 months, the patient is able to bend the knee, decrease pain and increase functional activit.

Several examinations were carried out by physiotherapists before handling ACL rupture, some of which were checking vital signs, examined pain with VAS on the knee, measured muscle strength by MMT on the quadriceps and hamstring muscles, and used a goneometer to evaluate ROM of knee extension and flexion, and measured functional activity by KOOS. In addition, the vital signs as blood pressure was 130/79 mmHg, Pulse: 86 times/minute, Breathing: 19 times/minute, 36°C, Height: 171 cm, and Weight: 63 kg as well.

Management and Outcome

The exercises rehabilitation was carried out for 1 month for phase 2 post reconstruction of ACL injuries, given exercises therapy. Before started doing exercises, vital sign examination was applied to clarify the condition of patient as good or bad generally. The exercises program as follows:

a. Static bike



Adjust the height of the bicycle, the patient is asked to sit upright on the bicycle and the heel rests on the pedal, then direct the patient to swing the bicycle. Do it for 10-20 minutes (Evans, 2018).



b. Forward lunges on bosu



Position the patient behind the bosu, then direct the patient as if stepping forward on the footrest above the bosu, with the knee in a flexed position, alternately. Do the exercise with a duration of 20 repetitions for 2 sets (Wilk et al, 2017).

c. Side lunges on bosu



Position the patient beside the bosu, then direct the patient to step sideways with the foot resting on the bosu, with the knee flexed over the bosu and one leg straightened to the side. Do the exercise with a duration of 20 repetitions for 2 sets (Wilk et al, 2017).

d. Step up on bosu



Position the patient standing on the bosu, then ask the patient to lift the legs bent at the knees parallel to the hips, alternately with a duration of 20 repetitions for 2 sets (Wilk et al, 2017).

e. Squads theraband



Standing position with feet parallel to shoulders, then direct the patient for the squads movement. Do the exercise with a duration of 20 repetitions for 2 sets (Wilk et al, 2017)

f. forward down



Standing position on the stool, then direct the patient to move the legs forward alternately and make sure to maintain balance. Do the exercise with a duration of 20 repetitions for 2 sets (Wilk et al, 2017)

g. Lateral down resistance bands



Position the patient standing on the stool, then ask the patient to move the leg forward and give hold on one leg to maintain balance. Do the exercise with a duration of 20 repetitions for 2 sets (Wilk et al, 2017)

The measurement of knee did by asked the patient to bend the knee joint. The VAS scale was applied. There were 3 indicators of pain measurement, as silent pain, motion pain, and tenderness (Fisker, 2014). The results of the examination are as follows:

Table 1. The evaluation of pain

Painful	Results	Interpretation
Silent pain	3.1	Mild pain
Motion pain	6.4	Moderate pain
Tenderness	4.2	Mild pain

The range of motion of the knee joint measured using a goneometer during knee flexion and extension movements. The results obtained were the patient performed the maximally flexion and extention of knee (Santos et al., 2017).

Table 2. The evaluation of ROM for knee flexion and extension

Region	Results	interpretation
Knee dextra	0°-0°-130°	Full ROM knee flexion
Knee sinistra	0°-0°-130°	Full ROM knee flexion

The KOOS enrolled to determine functional ability. There were several points of measurement, such as pain, signs and symptoms, daily activities, sports activities and quality of life. The higher score of the KOOS with high performance of functional activities. The KOOS noted has a validity and rehabilitation value of 0.73-0.85 (Multanen et al., 2018). The results of the KOOS is describing in table 3.

Table 3. The score of KOOS

Category	Results	Interpretation
Painful	83	Well
Signs and symptoms	72.3	Well
Daily activities	86.4	Well
Sports activities	68	Pretty good
Quality of life	77.8	Well
Total	$387.5 : 5 = 77.5$	Well

To measure muscle strength in the knee area, and examination was carried out using manual muscle testing (MMT). After examining the muscle strength with MMT, it was found that the muscles in the flexor part were still less than optimal in fighting resistance (Conable et al, 2011)

Table 4. the evaluation of muscle strength

MMT	Group Muscle	Interpretation
5/5	Flexor Knee (D)	Able to withstand maximum resistance
5/5	Extensor Knee (D)	Able to withstand maximum resistance
4/5	Flexor Knee (S)	Able to withstand minimum resistance
4/5	Extensor Knee (S)	Able to withstand minimum resistance

Discussion

The management of Anterior Cruciate Ligament ACL rupture serves to restore balance, increase muscle strength by stabilizing and strengthening during exercise for activation of neuromuscular control (Siebold et al. 2014). The exercises performed during therapy included static bicycles, forward lunges on bosu, side lunges on bosu, step ups on bosu, teraband squats, forward step downs, lateral step downs with resistance bands. Those exercises reduced the impairments and increased functional ability. The strengthening exercises for hamstring and quadriceps muscles, closed kinetic chain (CKC) exercises can produce co-contraction of the muscles around the joint and compression within the joint resulting in increased joint stability.

Static Bicycles

Cycling can increase muscle strength of lower legs, especially when do the pedaling movement, it can increase muscle strength of calf muscles of hamstring and

quadriceps. So it can strengthen the core muscle, back muscles and gluteus muscle (Evans, 2018).

Forward Lunges On Bosu, Side Lunges On Bosu, Step Ups On Bosu

Exercise using a bosu can improve balance because a less stable bosu surface can increase stability more than a stable surface, therefore a less stable bosu surface is more effective and varied in stimulating exercise and improving neuromuscular adaptation (Id et al., 2019).

Teraband Squats

The squats movement assisted by theraband aims to minimize the occurrence of injuries, activate hamstring and quadriceps muscle groups. When the valgus movement the contraction of the two muscle is reduced so that it can affect the internal tibialis (Foley et al., 2017)

Forward Step Downs, Lateral Step Downs With Resistance Band

In the forward step down movement, the maximum movement of knee flexion is prioritize, while maintaining a more stable body posture. On one leg remains tread to support the body, then when movement down aims to further increase the adduction of the hip. And the lateral movement, the step downs with resistance band aim to provide resistance and control the valgus of the knee during hip abduction (Lewis et al., 2015).

The advantage of this research is giving a perspective to clinicians or physiotherapist about the exercises rehabilitation for phase 2 post surgery of ACL injury. The treatment has been carried out for 1 month, it showed slowly progressing. The weakness of this study, the physiotherapists could not directly supervise the home programs to utilize the goal of treatments. Thus, for further researchers are advised to improve the home programs to recovery effectively.

Conclusion

After being treated for one month by physiotherapists 3 times a week, the results obtained were decreased pain, increased muscle strength, increased range of motion and functional activities.

Acknowledgment

We would like to thank the outstanding participants involved in this study. We thank to Wongsonegoro Hospital, Semarang. Special thanks to our advisor Lect. Dwi Rosella Komalasari, M.Fis.,Sp.Vest for her guidance during this research.

Reference

- Conable, K. M., & Rosner, A. L. (2011). A narrative review of manual muscle testing and implications for muscle testing research. *Journal of Chiropractic Medicine*, 10(3), 157–165. <https://doi.org/10.1016/j.jcm.2011.04.001>
- Cooper, R. (2018). ACL Rehabilitation Guide. *Thermoskin*, 28. https://www.fitasaphysio.com/uploads/4/3/3/4/43345381/randall_cooper_acl_rehabilitation_guide.pdf
- Dos Santos, R. A., Derhon, V., Brandalize, M., Brandalize, D., & Rossi, L. P. (2017). Evaluation of knee range of motion: Correlation between measurements using a universal goniometer and a smartphone goniometric application. *Journal of Bodywork and Movement Therapies*, 21(3), 699–703. <https://doi.org/10.1016/j.jbmt.2016.11.008>
- Evans, I. K. (2018). ACL Reconstruction Rehabilitation Protocol. *Sports Medicine North/Orthopedic Specialty Center ACL*, 978, 1–23.
- Fisker, A. (2014). Visuel Analog Skala. *Fysio.Dk*, 3, 1. <https://fysio.dk/fafo/maleredskaaber/visuel-analog-skala>
- Foley, R. C. A., Bulbrook, B. D., Button, D. C., & Holmes, M. W. R. (2017). Effects of a Band Loop on Lower Extremity Muscle Activity and Kinematics During the Barbell Squat. *International Journal of Sports Physical Therapy*, 12(4), 550–559. <http://www.ncbi.nlm.nih.gov/pubmed/28900561> <http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=PMC5534145>
- Hughes, L., Rosenblatt, B., Haddad, F., Gissane, C., McCarthy, D., Clarke, T., Ferris, G., Dawes, J., Paton, B., & Patterson, S. D. (2019). Comparing the Effectiveness of Blood Flow Restriction and Traditional Heavy Load Resistance Training in the Post-Surgery Rehabilitation of Anterior Cruciate Ligament Reconstruction Patients: A UK National Health Service Randomised Controlled Trial. *Sports Medicine*, 49(11), 1787–1805. <https://doi.org/10.1007/s40279-019-01137-2>
- Id, J. A., Busc, B., Id, J. M., & Solana-, M. (2019). *Muscle activity of Bulgarian squat . Effects of additional vibration , suspension and unstable surface*. 1–20.
- Lewis, C. L., Foch, E., Luko, M. M., Loverro, K. L., & Khuu, A. (2015). Differences in lower extremity and trunk kinematics between single leg squat and step down tasks. *PLoS ONE*, 10(5), 1–15. <https://doi.org/10.1371/journal.pone.0126258>
- Lowe, W. R., Warth, R. J., Davis, E. P., & Bailey, L. (2017). Functional bracing after anterior cruciate ligament reconstruction: A systematic review. *Journal of the American Academy of Orthopaedic Surgeons*, 25(3), 239–249. <https://doi.org/10.5435/JAAOS-D-15-00710>
- Multanen, J., Honkanen, M., Häkkinen, A., & Kiviranta, I. (2018). Construct validity and reliability of the Finnish version of the Knee Injury and Osteoarthritis Outcome Score. *BMC Musculoskeletal Disorders*, 19(1), 1–10. <https://doi.org/10.1186/s12891-018-2078-7>
- Siebold et al. 2014. (n.d.). *Rainer Siebold David Dejour Zaffagnini*.
- Wilk, K. E., & Arrigo, C. A. (2017). Rehabilitation Principles of the Anterior Cruciate Ligament Reconstructed Knee: Twelve Steps for Successful Progression and Return to Play. *Clinics in Sports Medicine*, 36(1), 189–232. <https://doi.org/10.1016/j.csm.2016.08.012>
- 2017, the journal of the world of public health volume 6. N. 3. J. (2017). No Titleתועפשה . , 549(Lcl), 40–42.