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Effect of ROM and Weight Bearing Exercise on the Degrees of Knee ROM and Muscle Strength of Post-Extremity of ACL Sprain Grade 1

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***Abstract*— Exercise therapy in the form of ROM (Range Of Motion) and weight bearing exercises can be used as a means of accelerating the healing of injuries, such as ACL sprains injury. This study aims to determine the effect of ROM and weight bearing exercises on the degree of ROM or range of motion in the knee and muscle strength of the lower extremities after first grade ACL sprain injury. This study used Single Subject Research (SSR) method. The research design model used in this research is A-B-A'. The results of the research that has been done on the subject of this study showed the influence of ROM and weight bearing exercises on the degree of ROM knee and lower limb muscle strength. This study has an influence on the increase of target behavior of research subjects, because the level of change during the study was 60% that was an increase of 320 on the degree of knee ROM and 50 kg in lower extremity muscle strength.**

Keywords— sprain, ACL, ROM, weight bearing

I. INTRODUCTION

Anterior Cruciate Ligament (ACL) is a ligament found in the knee joint that functions as a stabilizer in preventing excessive shifts [1]. Everhart [2] says that when the knee performs a movement that exceeds ROM (Range Of Motion) or when landing on one leg with extreme leg rotation to the knee it can increase the risk of ACL injury. An ACL injury is an ACL sprain. The ACL sprain often occurs in high-impact athletes such as basketball, badminton and soccer. It is recorded that there are 200,000 cases of ACL sprain occurring every year in the United States with only less than 100,000 ACL reconstruction procedures performed annually [3]. Even Wiratna [4] also said that there were 78% of cases of Anterior Cruciate Ligament (ACL) injuries that accompanied in sports activities.

ACL sprains can occur in several grades based on their severity, ranging from grade 1 to 3. ACL sprains that are in grade 1 are stretches and micro tears in the ligaments, while in grade 2 macro tears occur in the ligament which results in instability in the knee [1]. A few moments after the ACL sprain occurs, the knee will experience inflammation and will be difficult to move and even feel very painful. Bekerom [5] said that the first treatment for ACL sprain is to use the RICE (Rest, Ice, Compress, Elevation) method. After 2 to 3 days, special treatment is needed to help recover more quickly in the form of physiotherapy using electronic therapy devices. Treatment using electronic therapy equipment is quite costly. This is what underlies a special treatment in the form of ROM and weight bearing exercise therapy to restore ROM and lower extremity muscle conditions after grade 1 ACL sprain injury without using electronic therapy.

It is very important to start as soon as possible mobilization in the form of ROM and weight bearing exercises after inflammation has subsided slightly with the aim of improving extension position, accelerating recovery and relieving pain after ACL injury.. ROM exercises also have a good effect on knee flexibility [6]. This is reinforced by Gusti & Armayanti [7] which states that ROM exercises or range of motion can increase flexibility.

The design of exercise therapy in the form of ROM and weight bearing exercises for grade 1 ACL sprain injuries without using electronic therapy is intended to help athletes know and understand how to cope with ACL sprain without using electronic therapy so that it can save more money. In addition, the exercises performed during exercise therapy will help prevent atrophy in the supporting muscles. This is so that athletes can restore knee conditions and can help speed up the recovery of the physiological condition of the body to exercise so that sports achievements can still be achieved.

The aim of this study was to determine the effect of ROM and weight bearing exercises on the degree of knee ROM in subjects after ACL sprain injury. In addition, it is also to determine the effect of ROM and weight bearing exercises on lower extremity muscle strength.

II. METHOD

The type of research to be conducted is a quasi-experimental study (Quasi Experiment). This study uses SSR (Single Subject Research) or in Indonesian known as single subject research with pre-posttest design to measure knee ROM and lower limb muscle strength. The approach used in this study is a quantitative approach.

This SSR research design will use the A-B-A design. The design where (A) shows Baseline 1, namely the initial

condition of target behavior before intervention, (B) shows Intervension namely target behavior conditions after intervention, with the application of exercise therapy , (A ') shows Baseline 2, the condition after intervention.

The instrument used in this study is Gone-meter to measure the range of motion. Besides that there is a dyna-mometer leg to measure the muscle strength of the lower extremity of the research subject. Data collection in this study was carried out by measuring knee ROM and lower limb muscle strength. The stages of data collection are as follows:

Preparation stage (Baseline-1): Data was taken pretest baseline-1 after the subjects conducted a series of first aid injuries in the form of RICE for 2-3 days. Data was obtained from the degree of per-movement angle of the knee as a range of motion. In addition, data was also taken from measurements of lower extremity muscle strength before receiving treatment (at the baseline stage). Measurements at the baseline-1 stage were carried out 3 times.

Implementation or treatment stage (Intervention): ACL sprain injury patients undergo interventions for 4 weeks. Data collection is also carried out every week during the intervention phase or when subjects receive treatment to see the increase or change that occurred during the intervention.

Final stage (Baseline-2): After undergoing the intervention phase for 4 weeks, data will be taken as a final test 3 times.

III. RESULTS

This study uses the A-B-A design, data collected from 18 sessions. The baseline-1 (A) stage has three sessions, while the intervention (B) stage has twelve sessions and the 2 (A ') baseline phase has three sessions. Each session was conducted one day with one week three sessions. At the intervention phase every 3 sessions will be tested to see the developments that occur every week. The recapitulation of the results of measurement of ROM degrees and lower extremity muscles in the study can be seen in Table 1 while the percentage of recapitulation of research data can be seen in Table 2.

TABLE I. RECAP OF RESULTS OF DATA OF DEGREE OF KNEE ROM AND MUSCLE STRENGTH OF LOWER LIMBS

Phase	**Test-**	**Degree of Measurement**	
		ROM	Strength
Baseline 1	1	148^0	46
	2	148^0	46
	3	148^0	46
Intervention	4	157^0	58
	5	166^0	72
	6	171^0	87
	7	178^0	99
Baseline 2	8	180^0	103
	9	180^0	103
	10	180^0	103

TABLE II. RECAP OF RESEARCH RESULTS DATA

Phase	**Test**	**Maximum score**	**Earned Value**		**Percentage**	
			ROM	**Strength**	**ROM**	**Strength**
Baseline 1	1	5	1	1	20%	20%
	2	5	1	1	20%	20%
	3	5	1	1	20%	20%
Intervention	4	5	2	2	40%	30%
	5	5	3	3	60%	50%
	6	5	4	3	70%	60%
	7	5	4	4	80%	70%
Baseline 2	8	5	4	4	80%	80%
	9	5	4	4	80%	80%
	10	5	4	4	80%	80%

Calculation of trends in stability at baseline 1 (A) uses a percentage of 15%. In Table 3 the following data will be presented in calculating the degree of stability of the knee ROM in the baseline phase1. While the data on the stability of the tendencies of muscle strength of the lower extremities in the baseline phase1 can be seen in Table 4.

TABLE III. BASELINE STABILITY TREND DATA1 (A) DEGREE OF KNEE ROM

Calculation	***Baseline***
	ROM
Stability Range	= Highest score x stability criteria = 20 x 0,15 = 3
Mean Level	= sum of points / X = (20 + 20 + 20) / 3 = 60 / 3 = 20
Upper Limit	= *Mean level* + (1/2 x Stability Range) = 20 + (1/2 x 3) = 20+ 1,5 = 21.5
Lower Limit	= *Mean level* - (1/2 x Stability Range) = 20 - (1/2 x 3) = 20 - 1,5 = 18,5
Stability Percentage	= Data on range x 100% / ∑ of data = 3 / 3 x 100% = 100%

TABLE IV. BASELINE STABILITY TENDENCY DATA 1 (A) LOWER LIMB MUSCLE STRENGTH

Calculation	***Baseline***
	Strength of Lower Limbs
Stability Range	= Highest score x stability criteria = 20 x 0,15 = 3
Mean Level	= sum of points / X = (20 + 20 + 20) / 3 = 60 / 3 = 20
Upper Limit	= *Mean level* + (1/2 x Stability Range) = 20 + (1/2 x 3) = 20+ 1,5 = 21.5

Calculation	***Baseline***
	Strength of Lower Limbs
Lower Limit	= *Mean level* - (1/2 x Stability Range) = 20 - (1/2 x 3) = 20 - 1,5 = 18,5
Stability Percentage	= Data on range x 100% ∑ of data = 3 x 100% 3 = 100%

The tendency of stability in the intervention phase also uses 15% stability criteria. In Table 5, a calculation of the tendency of knee ROM degree stability from the intervention phase will be presented. Whereas for the tendency of stability of lower limb muscle strength will be presented in Table 6.

TABLE V. INTERVENTION STABILITY TREND DATA (B) FOR DEGREE OF KNEE ROM

Calculation	**Intervention**
	Degree of ROM and Muscle Strength
Stability Range	= Highest score x stability criteria = 80 x 0,15 = 12
Mean Level	= sum of points X = 40 + 60 + 70 + 80 4 = 250 = 62.5 4
Upper Limit	= *Mean level* - (1/2 x Stability Range) = 62.5 + (1/2 x 12) = 62.5 + 6 = 68.5
Lower Limit	= *Mean level* - (1/2 x Stability Range) = 62.5 - (1/2 x 12) = 62.5 - 6 = 56.5
Stability Percentage	= Data on range x 100% ∑ of data = 1 x 100% 4 = 25%

TABLE VI. DATA ON TRENDS IN STABILITY OF MUSCLE STRENGTH OF LOWER LIMB INTERVENTION PHASE (B)

Calculation	***Intervention***
	Degree of ROM and Muscle Strength of Lower Limbs
Stability Range	= Highest score x stability criteria = 80 x 0,15 = 12
Mean Level	= sum of points X = 30 + 50 + 60 + 70 4 = 210 = 52,5 4
Upper Limit	= *Mean level* - (1/2 x Stability Range) = 52,5 + (1/2 x 12) = 52,5 + 6 = 58,5
Lower Limit	= *Mean level* - (1/2 x Stability Range) = 52,5 - (1/2 x 12) = 52,5 - 6 = 46,5
Stability Percentage	= Data on range x 100% ∑ of data = 1 x 100% 4 = 25%

After 18 sessions of the study, three sessions in the baseline phase 1 (A), twelve sessions in the intervention phase (B), the tests were carried out every three sessions or once a week, and the baseline phase two three sessions, the data can be presented on the graph in Figure 1 for knee ROM degrees and Figure 2 for lower limb muscle strength.

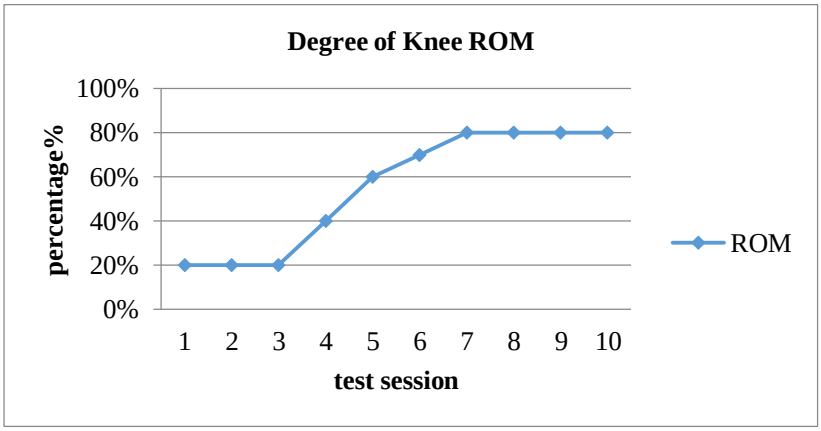

Fig.1 Baseline 1 Data, Intervention and Baseline 2 Degrees Knee ROM

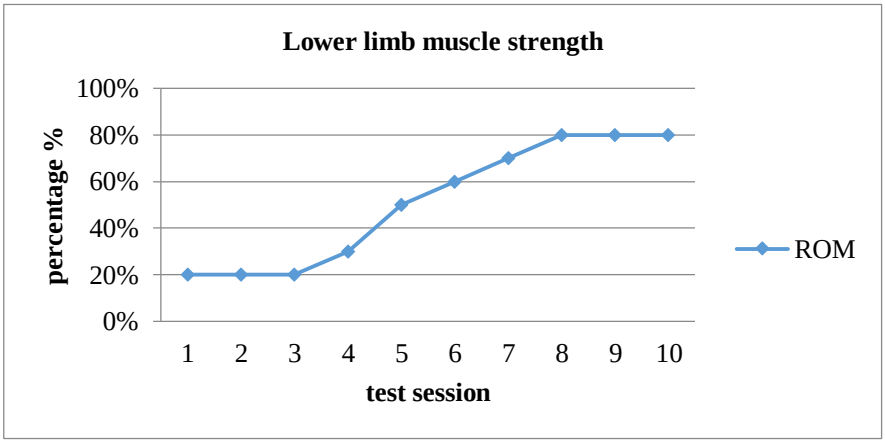

Fig. 2 Baseline 1 Data, Intervention, Baseline 2 Muscle Strength of Lower Limbs

While the level of change from baseline phase 1 to baseline phase 2 is for the degree of knee ROM 80-20 = 60%. While the lower extremity muscle strength is 80-20 = 60%. Overlap data is the similarity between data in the baseline phase (A) and data in the intervention phase (B). The smaller the overlap data the better, it can be said to increase because there is no similarity in the results of the data between the two phases. The percentage of overlap can be calculated by calculating the amount of data in the intervention phase (B) which is in the upper and lower limit of the baseline phase (A) that has been calculated previously. After knowing the point data then multiplied by 100%. The upper limit of ability in the intervention phase (B) degree of knee ROM = 68.5 and lower limb muscle strength = 58.5. The lower limit of ability in the baseline phase (A) degree of knee ROM = 18.5 and lower limb muscle strength = 18.5

$$\frac{\text{intervention points data (B) that enter the upper} - \text{lower limit}}{\text{Number of points in intervention}}$$

$$= \frac{2}{4} \; x \; 100\%$$

$$= 50\%$$

The presentation of degree overlap of knee ROM and lower limb muscle strength is the same ie 50% - 20% = 30%. The smaller the percentage of overlap the better the influence of intervention. Therefore, it can be interpreted that ROM and weight bearing exercises can increase the degree of ROM or range of joint motion and the strength of the muscles of the lower limb of patients after grade 1 ACL sprain injury.

IV. Discussion

This study uses two variables, namely the ability to move the knee joint or the degree of ROM and lower extremity muscle strength which is treated with ROM and weight bearing exercises to know the effect on the variable. After the data was analyzed, it was obtained an increase in direction of change (+) in the intervention phase and no change (=) in the baseline phase 1 or baseline 2, which means that the data taken has increased and the effects of positive interventions indicate an increase. Peru-material levels from the intervention phase (B) and baseline phase (A) are stable to stable with levels of 80% - 20% = 60%, which means that there is a significant increase after being treated with ROM and weight bearing exercises.

The percentage of overlap shows a figure of 30%, which means that the research is very good and indicates the influence of intervention on the variables studied. Based on the explanation it can be seen that the increase in joint motion ability or degree ROM of patients after ACL grade 1 sprain injury with ROM exercises and weight bearing occurs significantly.

The existence of exercise therapy in the form of ROM and weight bearing exercises, patients with grade 1 ACL sprain can improve the quality of their movements after injury. This is in accordance with the theory of Arovah [8] that exercise therapy is a systematic physical activity so that it aims to rehabilitate the body's near-perfect function, besides exercise therapy has the purpose of facilitating the healing process natural. This was supported by a statement from Kushartanti et al. [9] that exercises for rehabilitation of foot and lower leg injuries have been shown to significantly increase leg flexibility and strength.

Data on the results of the study showed an increase in the ability of knee extension movements and increased leg strength. The increase was due to exercise therapy in the form of ROM exercises and weight bearing mens-stimulation of propioreceptors and healing abilities or faster healing. This is in accordance with the theory statement from Wiratna [4], the effect of exercise therapy is that it can provide pain reduction effects, both directly and severing the cycle of pain, besides the light and slow movements in exercise therapy will spread propioceptor which is activation of large diameter afferent fibers. ROM and weight bearing exercises after inflammation have subsided slightly to improve the position of extension and flexion, accelerating recovery and relieving pain.

Based on the statements of experts who have been stated, it can be said that the research in this paper has a positive impact

on the ability to walk and the daily activities of the research subjects. This is because to do walking in the form of walking requires maximum extension of movement from the foot when walking. In addition, increasing the strength of the lower limb muscles is also needed because the foot is a body support that requires great strength to move.

V. CONCLUSION

Based on the results of research on "Effects of ROM Exercise and Weight Bearing on the Degree of Knee ROM and Muscle Strength Under Trauma Post-ACL Grade 1 Sprain Injury" can be summarized as follows: ROM and weight bearing exercises give effect to the research subjects in the form of an increase in knee ROM degrees by 60%, 320. ROM and weight bearing exercise gave effect to the sub-study, in the form of increased limb strength by 60%, 50 kg.

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