

# MONITORING LOWER LIMB ASYMMETRY DURING REHABILITATION OF ACL RECONSTRUCTED PATIENTS USING DINABANG DEVICE

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## Introduction

Usual practice of Anterior Cruciate Ligament (ACL) rehabilitation concentrates on quadriceps development with minor concern on hamstring. The aim of the present study is to measure the strength of quadriceps and hamstring during rehabilitation of ACL reconstructed (ACLr) patients. We used DINABANG®, capable of dynamic torque measurement [1].

## Methods

Four male subjects,  $42,5 \pm 11,2$  years,  $179 \pm 23$  cm,  $79,3 \pm 8,6$  kg who had an ACLr according to the hamstring tendon graft technique, were recruited. All subjects provided written informed consent prior to participation. Patients followed an "ACL ligamentization" protocol [2]. Three times during rehabilitation (week 11, 16, 21) quadriceps and hamstring strength was measured ( $60^\circ$ ) using DINABANG® (Fig. 1).



Figure 1: Quadriceps strength measurement as the patient extends the lower limb, with DINABANG secured just above malleolus to a rear fixed point.

## Results

Week after ACLr	Maximal Voluntary Isometric Strength (N)			
	Quadriceps		Hamstring	
	Operated Leg $\bar{x} \pm SD$	Uninvolved Leg $\bar{x} \pm SD$	Operated Leg $\bar{x} \pm SD$	Uninvolved Leg $\bar{x} \pm SD$
11	210.0 $\pm$ 81.2	395.0 $\pm$ 70.5	152.5 $\pm$ 47.9	235.0 $\pm$ 48,0
16	300.0 $\pm$ 75.3	480.0 $\pm$ 62.7	210.0 $\pm$ 27.1	287.5 $\pm$ 32.0
21	395.0 $\pm$ 98.8	525.0 $\pm$ 31.1	267.5 $\pm$ 59,1	335.0 $\pm$ 67.6

Table 1: Mean maximum strength of four ACL operated male individuals, at 11, 16 and 21 weeks after surgery.

Table 1 shows the mean value and standard deviation (SD) of the four subjects at different times. Table 2

shows the limb strength asymmetry, measured for both quadriceps and hamstring as rehabilitation progresses.

Asymmetric Strength: Operated/uninvolved (%)			
Week after ACLr	Week 11	Week 16	Week 21
Hamstring	46	32	23
Quadriceps	64	48	30

Table 2: Mean quadriceps and hamstring asymmetry.

## Discussion

DINABANG® measures torque and angular velocity of lower limbs with elastic bands [1]. DINABANG® is used here to isometrically measure hamstring during flexion and quadriceps strength during extension. During rehabilitation, strength increases in muscles of both limbs (Table 1), the operated side more so. Since the imbalance of strength is an indicator of possible injury [3], DINABANG® calculates the asymmetry index (Table 2). Rehabilitation from week 11 to week 21 roughly halves the asymmetry, because our rehabilitation program concentrates on both.

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## References

1. D. Santos *et al.*, "Hamstring Torque, Velocity and Power Elastic Band Measurements during Hip Extension and Knee Flexion," *Appl. Sci.*, vol. 11, no. 22, p. 10509, 2021.
2. S. Claes *et al.*, "The 'ligamentization' process in anterior cruciate ligament reconstruction: What happens to the human graft? A systematic review of the literature," *Am. J. Sports Med.*, vol. 39, no. 11, pp. 2476–2483, 2011.
3. S. Yeung *et al.*, "A prospective cohort study of hamstring injuries in competitive sprinters: Preseason muscle imbalance as a possible risk factor," *British Journal of Sports Medicine*, vol. 43, no. 8. pp. 589–594, 2009.

