

ORIGINAL ARTICLE

IJPHY

PRELIMINARY CROSS-SECTIONAL RELIABILITY OF MYO-TECH IN MEASURING QUADRICEPS CONTRACTION AMONG ACL PATIENTS

¹Nabilah Ahmad^{*1}Izham Zain²Azri Hisham Azizon²Nur Asyikin Zol²Verena Edward Cheong Abdullah²Khairul Fizi Md. Kasir²Saadatul Suhaili Abdul Latif

ABSTRACT

Background: The Anterior Cruciate Ligament (ACL) injury is the most traumatic knee joint injury. Surgical reconstruction is the common standard treatment care to ensure an early functional gain. Active quadriceps exercises were introduced at early rehabilitation to prevent muscle lag. However, patients' pain, muscle compensation from other parts of the body, and rapid development of quadriceps weakness were factors that slow down the positive progression of post ACL rehabilitation. Therefore, a new exercise instrument is needed to facilitate muscle contraction during post ACL reconstruction exercise actively. The Myo-Tech is an instrument that helps the patient contract correct muscle during the early phase of rehabilitation. The purpose of this study is to investigate the reliability of the Myo-Tech instrument measuring quadriceps contraction on post ACL reconstruction.

Methods: This is a cross-sectional study design and was carried out on patients with post ACL reconstruction. The patients were required to perform static Quadriceps exercises (SQE) for 10 seconds with Myo-Tech strapped at the upper thigh around the quadriceps area. Graph of muscle contraction was measured for the highest and lowest value in the 10 seconds.

Results: A total of 29 male subjects were involved in this study. The reliability of Myo Tech assist patients in quadriceps contraction is good ($r = 0.67$).

Conclusion: This study showed that Myo Tech is a promising instrument and can be integrated into clinical practice. The Myo-Tech can be used as an assessment to determined proprioceptive deficits following muscle weakness.

Keywords: Quadriceps rehabilitation, anterior cruciate ligament, Myo tech instrument.

Received 26th September 2020, accepted 06th December 2020, published 09th December 2020



www.ijphy.org

10.15621/ijphy/2020/v7i6/839

CORRESPONDING AUTHOR

^{*1}Izham Zain

Physiotherapy Department, School of Health Sciences, KPJ Healthcare University College, 71800 Nilai, Negeri Sembilan, MALAYSIA.
Email: izham@kpjuc.edu.my

¹Physiotherapy Department, School of Health Sciences, KPJ Healthcare University College, 71800 Nilai, Negeri Sembilan, MALAYSIA.

²Physiotherapy Department, KPJ Seremban Specialist Hospital, 70200 Seremban, Negeri Sembilan, MALAYSIA.

INTRODUCTION

Anterior cruciate ligament (ACL) sprain is one of the most common knee injuries [1]. The injury is commonly sustained by active individuals participating in sports that required pivoting, jumping, and decelerating actions [2]. There will be a significant limitation of function following injury. It required a reconstruction done surgically to ensure early return and gaining of functional capabilities [3]. The early quadriceps muscle contraction on post-reconstruction is substantial in preserving muscle strength [4]. However, there are safety issues on early quadriceps muscle strengthening following muscle contraction laxity, which could compromise the ACL's integrity [5]. To prevent such post ACL complications, the Physiotherapist needs to monitor the quadriceps in early ACL protocol phases. Thus, there is still a limitation of instruments or methods used to monitor quadriceps contraction [4, 5]. One of the monitoring quadriceps contraction methods is computerized tomography (CT) measurement of patellar alignment [6]. Even though the CT scan has high validity and reliability, it was not accessible and effective for physiotherapy expertise. However, a new instrument called Myo-Tech (figure 1) was developed by the KPJ Seremban Specialist hospital's innovation team. It can detect the contraction of quadriceps muscle by not compensating to other muscle synergists or stabilizers in the primary muscles. As reflects in this study, it was tested in these post-surgical ACL reconstruction patients. Currently, the available evidence on reliability is inconclusive due to the heterogeneity and limitations of available studies in measuring muscle contractions [3]. Thus, this study is a preliminary study to provide evidence on the reliability of Myo-Tech on quadriceps contraction among ACL post-reconstruction patients.

Figure 1: Myo Tech Instrument



METHODOLOGY

This preliminary cross-sectional study was conducted at the Physiotherapy Department of KPJ Seremban Specialist Hospital. The ethical approval was granted by the Research Ethical Committee of KPJ Healthcare University and the Research & Quality Innovation Committee of KPJ Seremban Specialist Hospital (KPJUC/MC/SOHS/EC/202 /271). The study subjects were chosen based on

the inclusion criteria, Post-Operative Day-1 for ACL reconstruction surgery, and didn't have any musculoskeletal injury or pathological changes on bone and muscles. The subject's consent was obtained, and they need to disclose demographic information of age and pain score (Numeric Rating Scale) prior to the intervention. The Myo Tech instrument will be placed and strapped at the upper thigh area. The Physiotherapist will assist the subjects in doing Static Quadriceps Exercise (SQE) for 10 seconds. Graph of Quadriceps contraction was plotted and measured for the highest and lowest value in the 10 seconds of quadriceps contraction.

RESULTS

A total of 29 subjects were involved in this study and 100% were males who underwent ACL reconstruction. The range age of subjects undergoing ACL reconstruction was between 21 to 37 years old, with the mean \pm SD is 29 ± 5.23 . The Numeric Rating Scale (NRS) was used to determine the pain score. The mean pain score among subjects was $4.8 (\pm 1.93)$, with the lowest score was 2 / 10 and the highest 8 / 10 (Table 1).

Table 1: Demographic data of subjects

	N (%)	Mean
Age (years old)		29 (± 5.23)
21	2 (7%)	
24	8 (28%)	
29	12 (42%)	
30	5 (17%)	
34	1 (3%)	
37	1 (3%)	
Numeric Pain scale (NRS)		4.8 (± 1.93)
2	3 (10%)	
3	4 (14%)	
4	7 (24%)	
5	9 (32%)	
6	4 (14%)	
7	1 (3%)	
8	1 (3%)	

To determine the reliability, the intraclass correlation coefficient (ICC) with 95% confidence interval (CI) and a standard error of measurement SEM was used. The finding showed that the Cronbach's Alpha for Myo-Tech was $r = 0.67$, which showed a high internal consistency level with a specific sample. The inter-rater reliability indicated a good degree of reliability was found between Quadriceps contraction measurements. The average measure ICC was 0.67 with a 95% confidence interval from 0.14 to 0.91 ($F(9,9) = 3.285, p > 0.05$). (Table 2).

Table 2: This table shows the table of the intraclass correlation coefficient for Quadriceps contraction using Myo-Tech

Scale	ICC	CI (Lower, Upper)	F (df)	p-value
Single Measures	0.51	95% (-0.06, 0.84)	3.28(9,9)	0.04*
Average measures	0.67	95% (0.14, 0.91)	3.28(9,9)	0.04*

*Significant value is when $p < 0.05$; Statistical test = correlation coefficient

Mean \pm SD with SEM for the highest Quadriceps' contraction is 1.98 ± 2.09 with SEM (0.66), whereas Mean \pm SD with SEM for the lowest Quadriceps' contraction is -1.28 ± 0.84 with SEM (0.27) (Table 3).

Table 3: This table shows the table Mean \pm SD and SEM for Quadriceps contraction using Myo-Tech

Scale	Mean (milliseconds) \pm SD	SEM
Highest Contraction	1.98 ± 2.09	0.66
Lowest Contraction	-1.28 ± 0.84	0.27

DISCUSSION

The purpose of this study was to evaluate the reliability of the Myo-Tech instrument on quadriceps contraction among ACL reconstruction patients. The study demonstrated a good reliability score ($r = 0.67$) of Myo-Tech in assessing quadriceps contraction and indicated a high feasibility assessment of dedicated muscle. Hence, this proved that it could be tested in other types of muscle contraction. Comparing to a previous study conducted by Hamilton et al., instruments (Jamar Hand Dynamometer) have high reliability to muscle contraction. Still, it was limited to upper limb muscle only, especially on the hand [3]. The Myo-Tech was considered one of the new inventions in physiotherapy expertise as it was more portable and has proven to show good reliability in measuring muscle contraction. We refer to the result of the mean; the range of quadriceps muscle contraction for POD 1 after ACL reconstruction can be predicted around (-1.28 to 1.98). It can be hypothesized that muscle strength contraction will be improved with time and muscle training protocol repetitions.

Therefore, the limitation of the monitoring method on muscle contraction raised by Buckthorpe et al. (2019) and Shaw et al. (2005) able to overcome by using the Myo Tech instrument [4, 5]. However, in terms of sociodemographic variables, the reading can be slightly different as all the subjects are male. The age range for all the subjects is considered in the adult population [7, 8, 9]. Theoretically, the tested quadriceps muscle is still well-formed in this range of age. The graph of the muscle contraction produced by Myo-Tech had shown a closed relationship with the Numerical Rating Scale (NRS) level. As predicted, a low level of pain can produce strong muscle contraction. These were proved by a graph of muscle contraction that was produced by the Myo-Tech instrument.

Furthermore, muscle contraction also correlates with the occurrence of musculoskeletal disorder, as shown by the result as those who are having any other type of musculoskeletal disorder tend to have weaker quadriceps muscle contraction after ACL reconstruction [4, 5, 6, 11]. Future studies should confirm or discard this association; if these findings are confirmed, it can prove that muscle contraction has association with these pain and the occurrence of musculoskeletal disorder. There are a few limitations in this study, but it didn't affect the study result's inference. The sample size for our analysis was relatively small. It is possible that our results would have differed

with larger sample size. This study is the first to investigate the reliability of Myo-Tech in measuring quadriceps contraction among ACL patients. The Myo Tech is a benefit for clinicians in measuring quadriceps contraction among ACL patients, especially after ACL reconstruction. It is not only implicating for quadriceps muscle, but it can also be used for other muscle types [10, 11]. The Myo-Tech instrument can identify specific muscle contractions after the post-surgical phase in the physiotherapy area in the broader scope.

CONCLUSION

In conclusion, the present data has proved that Myo-Tech has high reliability and feasibility in measuring muscle contraction with highly significant value. It can be assumed that Myo-Tech can be one of the useful and convenient instruments in measuring muscle contraction. Therefore, the Myo-Tech will be useful in clinical for the assessment, monitoring, and rehabilitation of a musculoskeletal patient.

REFERENCES

- [1] Lynch, A. D., Logerstedt, D. S., Axe, M. J., & Snyder-Mackler, L. Quadriceps activation failure after anterior cruciate ligament rupture is not mediated by knee joint effusion. *Journal of Orthopaedic and Sports Physical Therapy*. 2012; 42 (6): 502 - 510.
- [2] Kiapour, A. M., & Murray, M. M. Basic science of anterior cruciate ligament injury and repair. *Bone and Joint Research*. 2014; 3 (2): 20 - 31.
- [3] Hamilton, G. F., McDonald, C., & Chenier, T. C. Measurement of grip strength: Validity and reliability of the sphygmomanometer and Jamar grip dynamometer. *Journal of Orthopaedic and Sports Physical Therapy*. 1992; 16 (5): 215 - 219.
- [4] Shaw, T., Williams, M. T., & Chipchase, L. S. Do early quadriceps exercises affect the outcome of ACL reconstruction? A randomised controlled trial. *Australian Journal of Physiotherapy*. 2005; 51 (1): 9 - 17.
- [5] Buckthorpe, M., La Rosa, G., & Villa, F. Della. Restoring Knee Extensor Strength After Anterior Cruciate Ligament Reconstruction: a Clinical Commentary. *International Journal of Sports Physical Therapy*. 2019; 14 (1): 159 - 172.
- [6] Jan, M. H., Lin, D. A. H., Lin, C. H. O. J., Lin, Y. F., & Cheng, C. K. The effects of quadriceps contraction on different patellofemoral alignment subtypes: An axial computed tomography study. *Journal of Orthopaedic and Sports Physical Therapy*. 2009; 39 (4): 264 - 269.
- [7] Basu, R., Basu, A., & Nair, K. S. Muscle changes in aging. *Journal of Nutrition, Health and Aging*. 2002; 6 (5): 336 - 341.
- [8] Novotny, S. A., Warren, G. L., & Hamrick, M. W. Aging and the muscle-bone relationship. *Physiology*. 2015; 30 (1): 8 - 16.
- [9] Janssens, L., McConnell, A. K., Pijnenburg, M., Claeys, K., Goossens, N., Lysens, R., Brumagne, S. Inspiratory

muscle training affects proprioceptive use and low back pain. *Medicine and Science in Sports and Exercise*. 2014; 19: 12 - 19.

- [10] Permall, C., Van Wyk, A., Van Zyl, A., Vorster, T., & Louw, Q. Effectiveness of early quadriceps exercises after ACL reconstruction. *South African Journal of Sports Medicine*. 2008; 20 (1): 4 - 14.
- [11] Jindal, P., Narayan, A., Ganesan, S., & MacDermid, J. C. Muscle strength differences in healthy young adults with and without generalized joint hypermobility: a cross-sectional study. *BMC Sports Science, Medicine and Rehabilitation*. 2016; 8 (1): 19.