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Hip- and knee-strength assessments using a hand-held dynamometer with external belt-fixation are inter-tester reliable

Kristian Thorborg · Thomas Rasmussen ·
Per Hölmich

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Abstract

Purpose: In football, ice-hockey, and track and field, injuries have been predicted, and hip- and knee-strength deficits quantified using hand-held dynamometry (HHD). However, systematic bias exists when testers of different sex and strength perform the measurements. Belt-fixation of the dynamometer may resolve this. The aim of the present study was therefore to examine the inter-tester reliability concerning strength assessments of isometric hip abduction, adduction, flexion, extension and knee-flexion strength, using HHD with external belt-fixation.

Methods: Twenty-one healthy athletes (8 women, 30 (8.6) (mean (SD)) years of age, were included. Two physiotherapy students (1 female and 1 male) performed all the measurements after careful instruction and procedure training. Isometric hip abduction, adduction, flexion, extension, and knee-flexion strength were tested. The intra- and inter-tester reliability (ICC 2,1) ranged from 0.76 to 0.95. Furthermore, standard error of measurement in per

cent (SEM %) ranged from 5 to 11 %, and minimal detectable change in per cent (MDC %) from 14 to 29 % for the different hip and knee actions.

Conclusion: The present study shows that isometric hip- and knee-strength measurements have acceptable inter-tester reliability at the group level, when testing strong individuals, using HHD with belt-fixation. This procedure is therefore perfectly suited for the evaluation and monitoring of strong athletes with hip, groin and hamstring injuries, some of the most common and troublesome injuries in sports.

Level of evidence: Diagnostic, Level III.

Keywords: Hand-held dynamometer · Reproducibility · Groin · Hamstring · Athletes

Introduction

Hand-held dynamometry (HHD) is a reliable way of quantifying hip strength, when the same tester performs the measurements (intra-tester reliability) [7, 14, 24]. However, when testers of different sex and strength perform the measurements (inter-tester reliability), the reliability of HHD can be questioned [14, 25, 30, 33]—especially when performed in strong individuals—such as athletes. Hip- and knee-strength assessment has been shown to be relevant in football, ice-hockey, and track and field to predict injury [11, 12, 19, 27]. In addition, it has been shown that when measuring muscle strength above 200 N, an underestimation of a fixed strength is found when using HHD compared to a fixed strength measurement set-up [5, 26]. This becomes especially important in studies investigating athletes, since these individuals often produce force values of more than 200 N [26]. In these situations, the tested individ-

K. Thorborg (✉) · P. Hölmich
Arthroscopic Centre Assens, Copenhagen University Hospital,
Hvidovre, Uthavvej 1, 2600 Copenhagen S, Denmark
e-mail: kristianthorborg@hotmail.com

K. Thorborg
Department of Orthopaedic Surgery and Physical Therapy,
Copenhagen University Hospital, Hvidovre,
Copenhagen, Denmark

T. Rasmussen
Clinical Research Centre and Department of Orthopaedic
Surgery and Physical Therapy, Copenhagen University Hospital,
Hvidovre, Copenhagen, Denmark

효과적인 하지 근력 측정
은 어떤 방법이
있을 까요?

Hip- and knee-strength assessments using a hand-held dynamometer with external belt-fixation are inter-tester reliable.

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“Hand-held dynamometry (HHD)”

HHD 의 사용은 동일한 측정자가 같은 대상자의 각 부위 힘을 측정함에 있어서 상당히 높은 신뢰도를 가지고 있다.

하지만 힘이 다른 측정자 (특히, 성별이 다른 남성/여성 측정자)사이에서 힘이 강한 하지 근력 같은 경우, 정확히 측정함에 제한이 있음을 알 수 있다.



특히, 200N을 넘는 힘을 측정함에 있어, HHD 의 사용은 근력측정 시 고정된 상태에서의 근력 측정에 비해 정확하지 않다는 연구가 많이 진행되어 있다. 또한, 운동선수와 같이 강한 힘을 내는 하지근력은 측정자의 힘보다 더 강하기 때문에 제한이 따른다.

그렇다면, 효과적으로 정확한 하지 근력 검사를 할 수 있는 좋은 방법은 무엇일까?



효과적인 하지 근력 측정 방법에는 무엇이 있는지 알아보자.

이 연구에서는 위의 사진에서 제시한 바와 같이 hip adductor (HADD), hip abductor (HABD), hip extensor (HE) and knee flexor (KFLEX) and hip flexor (HF)의 근력을 belt를 이용해 고정하였고, 측정자 간 (남성 1, 여성 1) 신뢰도를 연구하였다.

Dominant side 의 다리를 Maximal voluntary isometric contraction 으로, HHD with belt fixation 하여 5번 반복하여 측정하였다.

각 동작당 5초간 유지하였고, 마지막 측정에서 최대값이 나올 경우 한번 더 측정하여 더 이상의 근력 증가가 없을 때 까지 시행하였다. 각 부위 측정 후 10분간 휴식 시간을 가졌다.

Table 1 Inter-tester reliability of hip strength assessment using hand-held dynamometry with external belt-fixation

Isometric hip and knee actions	Tester 1 (male) Mean (SD)	Tester 2 (female) Mean (SD)	Difference tester 1-tester 2 Mean (SD)	Paired <i>t</i> test <i>p</i> value	ICC (CI 95 %)	SEM	SEM (%)	MDC	MDC (%)
HABD (N)	164.2 (33.5)	160.4 (33.5)	3.7 (18.4)	n.s.	0.85 (0.67–0.94)	12.8	7.9	35.5	21.9
HADD (N)	180.4 (44.6)	177.8 (43.7)	2.6 (16.0)	n.s.	0.94 (0.85–0.97)	11.1	6.2	30.8	17.2
HE (N)	259.5 (61.7)	259.1 (50.4)	0.3 (18.7)	n.s.	0.95 (0.87–0.98)	13.1	5.0	36.3	14.0
HF (N)	275.7 (62.6)	280.4 (56.4)	−4.8 (41.3)	n.s.	0.76 (0.50–0.90)	28.9	10.4	80.1	28.8
KFLEX (N)	308.9 (74.7)	296.5 (62.6)	12.4 (38.6)	n.s.	0.84 (0.65–0.93)	27.1	9.0	75.1	24.8

N newton, *ICC* intraclass correlation coefficient, *CI* confidence interval, *SD* standard deviation, *SEM* standard error of measurement, *MDC* minimal detectable change, % percentage, *HABD* hip abduction, *HADD* hip adduction, *HE* hip extension, *HF* hip flexion, *KFLEX* knee-flexion, *ns* non-significant

HHD with belt fixation 방법을 통하여 **hip adductor, hip abductor, hip extensor, knee flexor and hip flexor**의 근력 측정시 측정자간 (남성/여성) 신뢰도 측정에서 상당히 높은 수준의 신뢰도를 보임을 알 수 있었다.

따라서 이러한 방법을 통하여 강한 하지 근력 등을 측정할 때, 효과적으로 시행할 수 있을 것이다.

-KEMA 책임 연구원 전인철-

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