

Validity Test of Hamstring Muscle Strength Test for Handball Athletes

Prueba de validez de la prueba de fuerza muscular de isquiotibiales para atletas de balonmano

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Abstract. The purpose of this study was to test the validity of hamstring muscle strength of handball athletes. A total of 30 handball athletes with categories of 15 male athletes (18.0 ± 5.1 years, weight 62.6 ± 20.7 kg, height 173.6 ± 5.0 cm, BMI 22.1 ± 4.0 kg / m²) and female (18.0 ± 5.1 years, weight 54.6 ± 17.4 kg, height 164.7 ± 6.9 cm, BMI 21.4 ± 2.2 kg/m²). No history of lower extremity injuries participated in a hamstring strength test. Hamstring strength tests are performed isometrically with ISO Prone and ISO 60 tests using nordbord tools and load cells tied using hooks called pabletest. From the test results there is a validity level of 0.000 with reliability of 0.8, so that the data can be said to be valid on both tests, namely ISO Prone and ISO 60. Load cells on pabletes are able to measure hamstring muscle strength in handball athletes. The advantages of load cells on pabletes can be made simply but not everyone can make arrangements so as to output data that can be interpreted. Subsequent research can be done using different contractions such as eccentrics and increasing the number of research subjects more by developing better software.

Keywords: validity, hamstring, muscle, strength, isometric

Resumen. El propósito de este estudio fue probar la validez de la fuerza muscular de los isquiotibiales de los atletas de balonmano. Un total de 30 deportistas de balonmano con categorías de 15 deportistas masculinos ($18,0 \pm 5,1$ años, peso $62,6 \pm 20,7$ kg, altura $173,6 \pm 5,0$ cm, IMC $22,1 \pm 4,0$ kg/m²) y femenino ($18,0 \pm 5,1$ años, peso $54,6 \pm 17,4$ kg, talla $164,7 \pm 6,9$ cm, IMC $21,4 \pm 2,2$ kg/m²). Ningún historial de lesiones en las extremidades inferiores participó en una prueba de fuerza de los isquiotibiales. Las pruebas de fuerza de isquiotibiales se realizan isométricamente con pruebas ISO Prone e ISO 60 usando herramientas Nordbord y celdas de carga atadas usando ganchos llamados pabletest. De los resultados de las pruebas hay un nivel de validez de 0,000 con una fiabilidad de 0,8, por lo que se puede decir que los datos son válidos en ambas pruebas, a saber, ISO prono e ISO 60. Las células de carga en ptabletes pueden medir la fuerza de los músculos isquiotibiales en balonmano. Atletas. Las ventajas de las celdas de carga en pabletes se pueden hacer de manera simple, pero no todos pueden hacer arreglos para generar datos que se puedan interpretar. La investigación posterior se puede realizar utilizando diferentes contracciones, como excéntricas, y aumentando más el número de sujetos de investigación mediante el desarrollo de un mejor software.

Palabras clave: validadas, isquiotibiales, músculo, fuerza, isométrica

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Background

Handball is one of the Olympic sports, the popularity of this sport is increasing and there are an estimated 25 million players worldwide. Handball has benefits for cardiovascular, metabolic, muscular, and psychosocial health, but it carries a high risk of injury. Because handball is included in high-intensity sports that have the character of intermittent games and body contact. According to results from the IOC injury and illness surveillance system, this sport requires rapid movement and change of direction, jumps, sprints, and acceleration with high intensity (Nikolaidis & Ingebrigtsen, 2013)(Alesi et al., 2019; Engebretsen et al., 2013; Hornstrup et al., 2019, 2020)(Bencke et al., 2013; Engebretsen et al., 2013).

Frequent body contact between players, handball is one sport that has a risk of injury and athletes are prone to acute and overuse injuries. The estimated incidence of "time-loss" injuries in men's handball athletes is 4.1 to 12.4 injuries per 1000 hours and is 3-10 times higher during the game than during practice (Bere et al., 2015)(Bere et al., 2015),(Møller et al., 2017)(Olsen et al., 2006). Handball injuries generally occur in lower extremity, namely in the ankle, knee, and thigh, and the most common types of injuries are sprains and non-contact muscle injuries in all categories, and (Mónaco et al., 2019; Athletes et al.,

2013)hamstring injuries are also common in Spanish handball athletes (Penichet-Tomás et al., n.d.).

As a result, low muscle strength, incorrect technique, lack of flexibility, and also inadequate injury rehabilitation care have been reported as risk factors for the occurrence of injuries. (Fredriksen et al., 2020).

Jumping and spinning activities have been considered risk factors for injury, as injuries have long-term health consequences that can affect an athlete's career. So the need for training that can improve balance in athletes is recommended as a support for long-term athlete development. Controlling balance during jumping, landing, and hopping, performing eccentric muscle exercise may already occur within the demands of sport or even playground actions. As in the running of the last swing phase, the biceps femoris and hamstring muscles eccentrically resist hip flexion and slow down the extension of the knee, so it will experience different ranges of motion and activation patterns.(Raya-González et al., 2020)(Granacher et al., 2016; Nebigh et al., 2022)(Chaabene et al., 2020)(Higashihara et al., 2015; Nebigh et al., 2022).

Hamstring muscle performance enhancement is considered a good gauge for handball athletes as a coordination support during dribbling, passing and throwing the ball, running and jumping during offensive and defensive actions. Eccentric hamstring strength tests are needed to eliminate

maximal strength and imbalance. Eccentric strength assessment is a feasible and functional test compared to isokinetic. Several studies reveal that eccentric strength assessment is useful as an indicator for predicting injury. (Barrera-Domínguez et al., 2021)(Opar et al., 2013)(Chavarró-Nieto et al., 2022)(Opar et al., 2015)

The research has shown accepted methods to develop valid and reliable studies with pabletes devices on handball athletes. Pabletest are load cells with a capacity of 350 kg that are connected to ESP 32 so that they can output data according to the pull performed. Testing of the pabletest measuring instrument is to assess hamstring strength, so the purpose of this study is to test the validity of hamstring muscle strength of handball athletes.

Method

This study used a correlation test which compared two tools used in testing hamstring muscle strength. A total of 15 male athletes and 15 female athletes with no history of injury or pain participated in isometric measurement of hamstring strength. Before the test, all athletes were asked to warm up first with more focus on the lower extremities and fill out informed consent. Each athlete tested three times with a rest period of 1 minute per repetition, 1 hour rest for test changes and 2 hours of substitution from one tool to the second tool. All athletes were asked to perform an isometric hamstring muscle strength test with iso prone (straight leg) and iso 60 degree tests. The load cell on the pabletes is worth 350 kg by tying it to the ankle with a box on the knee. Furthermore, the incoming data will be processed using Minitab 21 with descriptive tests, difference tests and correlation tests. This research received ethical approval with number 06/KEPK/EC/VII/2023.

Result

Of the 30 handball athletes consisting of 15 male athletes and 15 female athletes. The results of anthropometric measurements consisting of age, height, weight, and Body Mass Index (BMI) conducted on subjects found that the average deviation \pm of the entire sample were (1) male athletes, age (18.0 ± 5.1 years), weight (62.6 ± 20.7 kg), height (173.6 ± 5.0 cm), BMI (22.1 ± 4.0 kg / m²). (2) female athletes, age (18.0 ± 5.1 years), weight (54.6 ± 17.4 kg), height (164.7 ± 6.9 cm), BMI (21.4 ± 2.2 kg/m²). Data on the characteristics of the research subjects can be seen in Table 1.

The differences between the two measuring instruments can be seen in table 2. ISO Prone data shows that the test using pabletest and nordbord has a significant difference with a value of <0.05 and in table 3, namely ISO 60 data also shows that the two hamstring measuring instrument tests, namely pabletest and nordbord, have a significant difference with a significant value of <0.05 .

The results of the level of validity and reliability of ISO Prone data in table 4. shows that in both left and right upper limbs, namely (1) left pabletest (163.2 ± 44.2) and nordbord (206.7 ± 45.3), right (191.0 ± 50.3) and nordbord (209.5 ± 50.6), the reliability results are 0.8 with a p-value of 0.000, so the data can be said to be valid. In addition, in table 5. The level of validity and reliability of ISO 60 data shows that on both left and right feet, namely (1) left pabletest (162.1 ± 57.1) and nordbord (226.6 ± 64.9), (2) right (191.2 ± 53.5) and nordbord (245.2 ± 66.5), the reliability results are 0.8 with a p-value of 0.000, so the data from the ISO 60 results can also be said to be valid.

Table 2. Descriptive result of the statistic T-test ISO Prone

	Variable	Load Cell Pabletest			Nordbord			P-Value
		Mean \pm SD	Min	Max	Mean \pm SD	Min	Max	
Male	L Max Force (N)	182.5 \pm 44.2	111.7	265.8	222.3 \pm 44.8	155.3	298.0	0.001
	R Max Force (N)	223.1 \pm 33.8	181.9	293.4	229.5 \pm 53.5	153.8	295.8	0.043
Female	L Max Force (N)	140.5 \pm 41	77.1	245.4	191 \pm 41.3	131.8	291.3	0.005
	R Max Force (N)	154.2 \pm 52.6	37.8	294.3	189.6 \pm 39.7	131.8	302.0	0.001

Note. L = Left ; R = Right ; N = Newton

Tabel 3.

Descriptive result of the statistic T-Test ISO 60

	Variable	Load Cell Pabletest			Nordbord			P-Value
		Mean \pm SD	Min	Max	Mean \pm SD	Min	Max	
Male	L Max Force (N)	175.1 \pm 63.3	96.6	277.7	252.7 \pm 64.7	165.8	342.8	0.001
	R Max Force (N)	216.5 \pm 52	145.9	304.8	277.4 \pm 61.7	179	359.3	0.001
Female	L Max Force (N)	149 \pm 48.9	59.8	217.7	200.5 \pm 55.4	91.8	295	0.003
	R Max Force (N)	165.8 \pm 42.8	72.6	245.8	213 \pm 56	123.5	325.5	0.002

Note. L = Left ; R = Right ; N = Newton

Tabel 4.

Descriptive results of the validity and reliability ISO Prone

Variable	Load Cell Pabletest			NordBord			Reliability Test	p-value
	Mean \pm SD	Min	Max	Mean \pm SD	Min	Max		
L Max Force (N)	163.2 \pm 44.2	102.3	265.8	206.7 \pm 45.3	131.8	298.0	0.8463	0.000
R Max Force (N)	191.0 \pm 50.3	100.7	294.3	209.5 \pm 50.6	131.8	302.0	0.876	0.000

Note. L = Left ; R = Right

Tabel 5.

Descriptive results of the validity and reliability ISO 60

Variable	Load Cell Pabletest			NordBord			Reliability Test	p-value
	Mean \pm SD	Min	Max	Mean \pm SD	Min	Max		
L Max Force (N)	162.1 \pm 57.1	59.8	277.7	226.6 \pm 64.9	91.8	342.8	0.8659	0.000
R Max Force (N)	191.2 \pm 53.5	72.6	304.8	245.2 \pm 66.5	123.5	359.3	0.8612	0.000

Note. L = Left ; R = Right

Discussion

The hamstring is an important muscle in handball. One injury that often occurs in handball athletes is a hamstring muscle injury. If there is a hamstring injury, the athlete needs to rest and recover in order to return to sport because hamstring injuries have a high incidence rate of reinjury (Ekstrand et al., 2011; Petersen et al., 2010; Zein et al., 2022). It will directly harm the team as well as individuals, but there is no other choice. A professional athlete with a hamstring injury cannot perform in match play for an average of 14–27 days (Ekstrand et al., 2011; Reurink et al., 2012). To prevent sports injuries, one of them is screening to determine the maximum strength of an athlete and the asymmetry between right and left, so that athletes know the value of muscle strength bilaterally and the authors recommend assessment using bilateral methods to see bilateral strength ability.

If the maximum strength of the athlete can be known, it will make it easier for a coach to provide the right dosage program for each athlete (Valle et al., 2015). In the position athletes can also measure ability according to the capacity of muscle strength of each individual. But, athletes have a greater risk of injury compared to ordinary people (Firman-syah et al., 2023; Komaini et al., 2022)

A literature review showed that a history of hamstring injuries was a significant risk factor for injuries to the hamstring and ligaments (Harding et al., 2020), but that previous injuries were also a strong risk factor when athletes returned to the field (Mcintyre et al., 2020a; Warren et al., 2010).

There are two tools carried out in this study, namely Nordbord which is the gold standard for measuring hamstring muscle strength and load cell pabletest which is a simple tool. In this study, athletes were asked to perform the same test with different tools. The results of iso prone motion testing on the two tools are significant while those at ISO 60 are also significant. In essence, both measurements using nordbord and load cell pabletes have high validity and reliability. This means that these two tools can be used to measure the maximum strength of a person's hamstring both at the time of starting an exercise program, when doing injury rehabilitation to post-surgery.

The findings in previous studies also tested isometric reliability and imbalance in injured football athletes, in the new isometric test revealed that there is an isometric bilateral strength imbalance in injured or previously injured legs, with reliability reliability of 0.89 using the Nordbord testing system (Mcintyre et al., 2022).

Conclusion

Measuring hamstring muscle strength is important in sports games such as handball. In measuring hamstring muscle strength using isometric contractions, both iso prone and iso 60 tests using nordbord and load cell pabletest have high validity and reliability. In the next study, it can be done by increasing the number of research subjects so that the variety of data can be more and change the type of contraction such as eccentric or concentric.

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