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Original Article

Isokinetic evaluation of knee extensor and flexor muscles (quadriceps& hamstrings) in-athletes

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Abstract
The present study aimed to evaluate the muscular peak torque, total muscular force output for the repetition with the greatest amount of work, and to compare the strength of extensor muscles (quadriceps) and flexor muscles (hamstrings) of the knee joint and Knee extension and flexion of the dominant and non-dominant legs.
Data were collected from 20 professional handball players in Jordan, Biodex Medical Systems Multi Joint System3 was used to assess muscle function. The results indicated that significant differences between quadriceps and hamstrings muscle strengthening in terms of peak torque, total work, average power, and AVG peak TQ, No significant differences were found with respect to acceleration time, and declaration.
Keywords: isokinetic, Biodex, knee extensor and flexor, peak torque, average power and total work.

Introduction

Muscle strength is the most important factors that give a clear advantage for successful participation in elite levels of handball beside speed, coordination, agility and endurance (Gorostiaga et al., 2006). Strength asymmetry of knee joint can lead to improper control of body movement (Grygorowicz et al., 2010).The muscles of the thigh that control the knee are important for all motor movement. (Nelson & Kokkonen, 2007). The quadriceps muscles extend the leg powerfully at the knee (make straight the knee joint). Whereas, the hamstring muscles flex the leg at the knee and extend the leg at the hip. (Dimon et al ., 2008).
For an accurate assessment of muscle strength Isokinetic assessment can be used to measure torque values. It is a mode of muscle strength test involving dynamic concentric or eccentric muscular activity performed at a constant angular velocity controlled by an external dynamometer (Edupuganti & Dorgo, 2008). Exercise on an isokinetic device involves three main phases of movement; acceleration, constant velocity, and deceleration (Brown & Whitehurst, 2000).
The Evaluation of such a mode of muscle strength may provide information of torque value, which may explain the maximal capacity or potential of the strength muscles and it can help avoid injuries of handball players. Peak torque is the maximum torque it can generate for a short period of time (Ellis, 2012). Peak torque, total works, and average power, were calculated by the Biodex software system. Highest muscular force output at any moment during a repetition represents peak torque. The max rep total work represents the total muscular force output for the repetition with the greatest amount of work, whereas average power represents how quickly a knee muscle can produce force. The total time to reach isokinetic speed represents the acceleration time. Study conducted by Zouita et al., (2005) found no difference between the dominant and non-dominant leg on muscle strength, whereas Zarembienė et al. (2013) study found the strength was higher of the non-dominant than dominant leg. The peak torque was greater in the knee flexors and extensors in the dominant leg than the non dominant leg in soccer players Brito et al. (2010).
The main purpose of this study is to evaluate the peak torque, total work, average power, and average peak torque, acceleration time, and declaration of quadriceps and hamstrings muscles in both dominant and non-dominate leg.

Materials and methods

Participants

20 professional handball players, (mean age ± SD: 25 ± 1.75 years, height: 1.87 ± 0.06 m, Weight: 83.55±6.95; BMI: 23.92±2.18 kg/m2. Players with acute inflammatory process due to any kind of lesion and/or immediate post-surgery period were excluded from the research players demographic data are presented in Table 1.

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Table 1. Participant Demographics

Characteristic	mean	SD
Weight kg	83.55	6.95
Height m	1.87	0.06
Age	25.00	1.75
BMI_{kg}	23.92	2.18

Procedures and Research Instrument

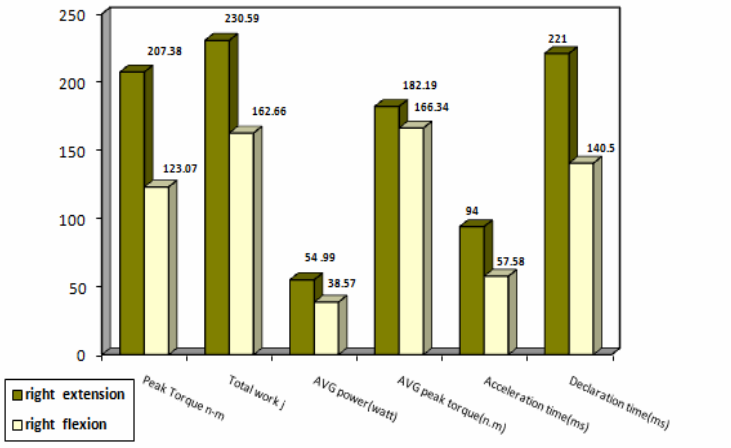
Biodex Medical Systems Multi Joint System3, Inc., Shirley, New York, USA was used to evaluate the muscle performance extensor muscles (quadriceps) and flexor muscles (hamstrings) of the subjects; each participant was added into the system (Figure1). The isokinetic unilateral protocol con/con contractions on the knee included one set of 2 repetitions and 10 seconds of rest, for speed (30°/sec) each player would be set-up to attempt the protocol using dominant and non-dominant legs. The chair and range of motion adjusted for each individual. The settings were recorded to ensure the full extension of the knee; the dynamometer orientation was set at 90° and dynamometer tilt at 0° seat orientation 90°, seatback tilt 70-85°.

Fig. (1). Biodex Medical Systems Multi Joint System3

Results

We found a significant difference ($p < 0.05$) between quadriceps and hamstrings means of the right extensions peak torque (207.38), total work (230.59), average power (54.99) and AVG peak TQ (182.19), the right extensions were significantly greater than right flexions (hamstring) of peak torque (123.07), total work (162.66), average power (38.57) and AVG peak TQ (166.34) as seen in figure 2. There were no significant differences found between right knee extensor and flexor of acceleration time (94); (57.58) and declaration (221); (140.5) respectively.

Fig. (2) Right knee extensor and flexor peak torque, total work, average power, and AVG peak TQ Acceleration time (ms), Declaration time (ms).



The same results were obtained from the left knee extensor and flexor there were significant differences between quadriceps and hamstrings muscles. The results indicated that left knee extension was significantly greater than left flexion.
The peak torque of left knee extension was (202.02), and total work (215.9), average power (55.02) and AVG peak TQ (178.55), whereas the left flexion of peak torque was (115.51), total work (148.74), average power (37.96) and AVG peak TQ (111.25). There were no significant differences found between left knee extensor and flexor of acceleration time (42.63); (54.21) and declaration (204.21); (275.79) respectively as seen in figure 3.

Fig. (3) Left knee extensor and flexor peak torque, total work, average power, and AVG peak TQ, Acceleration time (ms), Declaration time (ms)

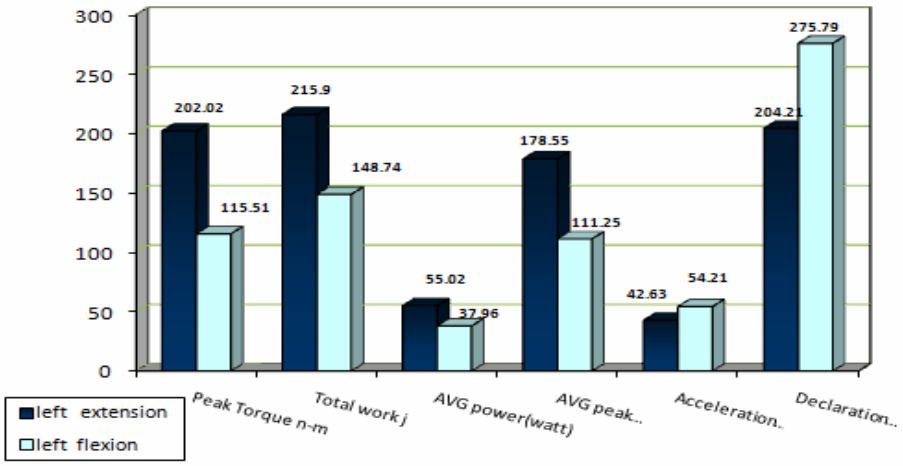
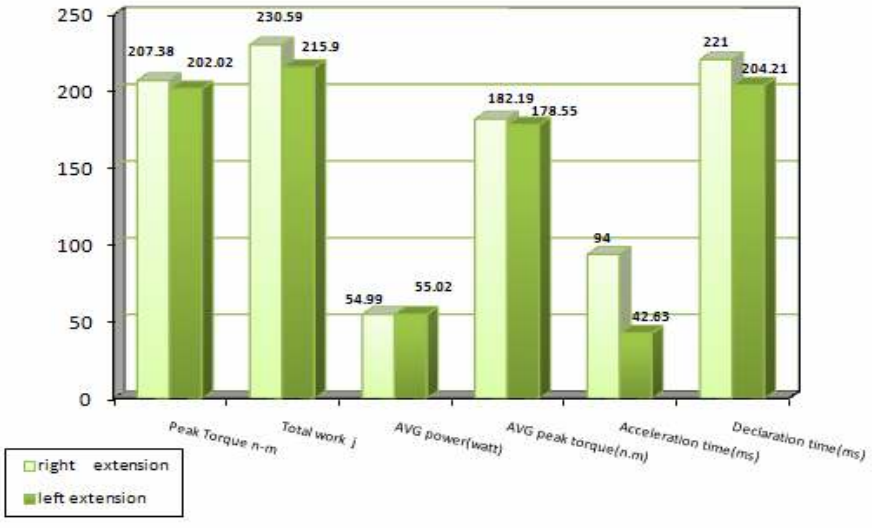
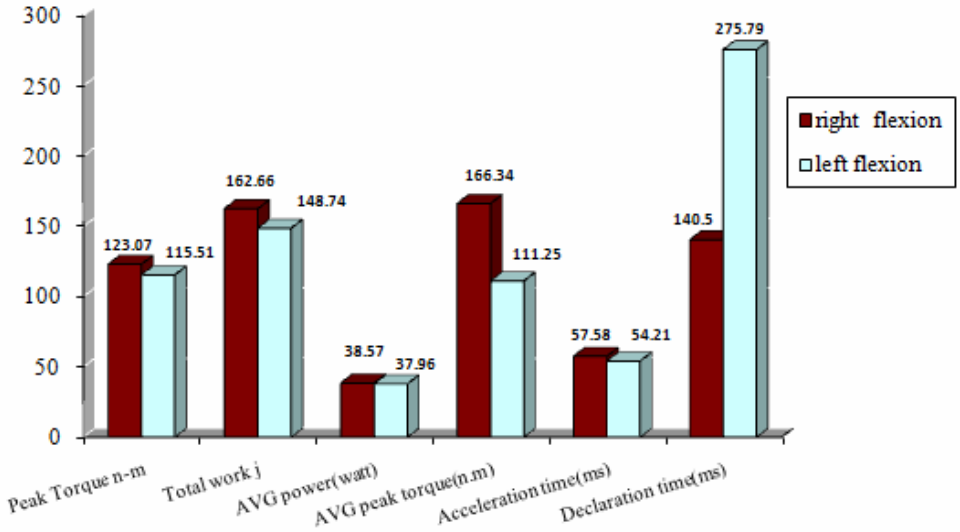


*Fig. (*4) Right and Left knee extensor differences of peak torque, total work, average power, and AVG peak TQ Acceleration time (ms), Declaration time (ms).



The results showed that the means value of the peak torque, total work, average power, and AVG peak TQ were higher for the right dominant leg compared to the left dominant leg in both the extension and the flexion but these means differences weren't significant except the deceleration variable in the which was (0.036) < 0.05 suggesting that there was significant difference in favor of the right dominant leg as can seen in figure 4 and 5.

*Fig (*5) Right and Left knee flexor differences of peak torque, total work, average power, and AVG peak TQ Acceleration time (ms), Declaration time



(ms)

Discussions

The findings of this study showed the peak torque values, total work, average power, and average peak torque were greater of the quadriceps than hamstring muscles. The acceleration and declaration values did not record any significant differences between right knee extensor and flexor. The same results were obtained using left knee extensor and flexor. According to our results the percentages the peak torque values were higher of the quadriceps (R- 57,5%; L- 52,8%) than hamstring (R- 32,7%; L- 33,9%) muscles of dominant and non-dominant leg respectively

Handball player appeared to have similar patterns of concentric isokinetic strength at the right and left knee. There is no significant differences found between dominant and non-dominate leg of the peak torque, total work, average power, and average peak torque, which could indicate similar strength between quadriceps and hamstring muscles of both leg.

There has been relatively little research done in handball players. Our findings are supported by Zouita et al., (2005) Research who did not find a significant difference between the dominant and non-dominant leg on muscles. Furthermore, the observed differences between lower right and left limbs weren't statistically significant for the quadriceps or hamstrings muscles. (Read & Bellamy ,1990) ; Zabka et al., 2011) .

However research by Sadauskaitė et al. (2013) reported higher significant differences in favor of the strength of the non-dominant than dominant leg.

Brito et al. (2010) indicated that the peak torque of the dominant leg higher than the non dominant leg.

Conclusion

The lack of studies examining strength of extensor muscles (quadriceps) and flexor muscles (hamstrings) of handball players. Thus, this study will help to provide insight into how equal, or unequal, left and right handball player's lower limb ability may be. Further research should investigate the similarities and differences extensor muscles and flexor muscles of dominant and non- dominant leg with different speeds (30□/s, 60□/s, and 90□/s).

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