Study of Hamstring and Quadriceps Muscle Strength of Track and Field Male Sprinters

Simarjeet Singh*, R.Kalidasan, Jasmail Singh***

ABSTRACT

The purpose of the work was to study the Hamstrings and Quadriceps strength level of male Sprinters. 20 national level Sprinters were selected as subjects for the study. Isokinetic machine was used to assess the strength level of the Sprinters. Strength of quadriceps and hamstring muscle groups was assessed at 60 degree per second speed. Peak torque of hamstring and quadriceps, Angle of peak torque of hamstring and quadriceps and, hamstring/quadriceps strength ratio of dominating and non-dominating side was studied for unilateral and bi-lateral comparisons. 't' test was applied for comparison of peak torque strength, H/Q strength ratio and angle of peak torque.

A significant difference between quadriceps and hamstring strength of dominating and non-dominating side was found. A significant difference between quadriceps of dominating and non-dominating leg and a non-significant hamstring / quadriceps strength ratio between dominating and non-dominating side was found. A non significant difference between hamstring strength of dominating and non-dominating leg, H/Q strength ratio of dominating and non-dominating side and angle of peak torque of dominating and non-dominating side has been found.

INTRODUCTION

Bio-motor abilities enabling an individual perform an exercise are the cause and the movement itself is just the effect. Each exercise has a dominant ability i.e. strength, speed or endurance. Throwing, jumping and sprinting need higher strength level of lower extremities. This is due to the fact that maximum training time is being devoted to develop leg strength. The knee joint is the major joint bearing maximum stress during sports activities. The movements which occur at the knee joint are primarily flexion and extension. A slight amount of rotation can take place when the knee is in flexed position (Luttgens & Wells, 1976). Hamstring and quadriceps muscle groups cause flexion and extension, respectively. Strength and angle of producing peak torque of hamstring and quadriceps needs to be monitored to achieve higher sprinting speed.

It has been established fact that there are dominating and non-dominating

*Scientific Officer, SAINIS, Patiala
**Asst. Professor(SS) Department of Physical Education, Bharathidasan University, Tiruchirappalli-24

body parts in one's body. The coupling between dominating and non-dominating parts determines the performance in activities where both the body parts are involved e.g. running jumping, throwing etc. The dominating part is considered to be the stronger one and the non-dominating part is the weaker one. One comes to know about the level of difference between dominating and non-dominating body parts when the abilities of these parts assessed separately.

Isokinetic testing has become popular in clinical, athletic and research settings. Monitoring of muscle strength at 60 deg./sec speed is a protocol to assess maximum strength. This is also the equivalent to a 1-repetition maximum (1RM) isotonic strength test (Davies,1987).

Till today, lot of work has been conducted to study the quadriceps hamstring ratio in children, Football players, Track and Field athletes, Basketball, Handball and Volleyball players (Schlinkman, 1984; Sentilles, 1980; William, 1984; Thomas, 1979; Chawla, 1992; Chawla, 1994).

The present study was conducted on a group of Track and Field male sprinters to investigate and compare strength of hamstring and quadriceps of dominating and non-dominating legs.

METHODOLOGY

The subjects for the present study were 20 Track and Field sprinters. Isokinetic machine was used to measure hamstring and quadriceps strength peak torque at 60 degree/sec and angle of peak torque.

Peak torque is the highest torque value seen from all repetitions and all points in the range of motion . This was determined within each rep for the entire set. This is also the equivalent to a 1-repetition maximum (RM) isotonic strength test (Davies,1987).

Angle of peak torque is defined as the point in the ROM where peak torque is produced (0 degree = full extension). At any given joint, we are stronger at some joint angles than others. In fact, there is usually one joint angle within the whole range of motion where we are stronger than at all of the others.

Hamstring and quadriceps strength ratio was also calculated. Hamstring peak torque value divided by quadriceps peak torque value and multiplied by 100 gives us hamstring/quadriceps strength ratio value.

In addition to this Age ,Height and weight of the subject was also recorded and fed in the test protocol.

Statistical Procedure

The data collected was statistically analysed. Mean and SD values were

calculated for the peak torque for the dominating and non-dominating hamstring and quadriceps muscle groups. 't' test was applied to compare the peak torque values of quadriceps of dominating and non-dominating side, peak torque values of Hamstring muscle group of dominating and non-dominating side, and difference between quadriceps and hamstrings of same legs. Hamstring quadriceps ratio was also calculated and compared.

RESULT & DISCUSSION

Table-1: Mean and SD values of Age, Height and Weight of Sprinters

Group	Age	Height	Weight
Sprinter	22.20 ± 1.89	174.45 ± 7.59	65.50 ± 6.12

Table-2: Mean, SD of Peak torque of Quadriceps and Hamstring of Dominating and Non-dominating leg of Throwers at 60o/sec speed (Nm)

Muscle		Dominating	Non-dominating
Quadriceps	Mean	208.60	190.60
	SD	19.97	27.59
Hamstring	Mean	139.45	129.05
	SD	19.53	21.17

Table-3: Significance of difference in Peak Torque between Quadriceps and Hamstring of Dominating leg (Nm)

Speed	Muscle	Mean	SD	Difference of mean	SE		Required 't' value
60°/sec	Q	208.60	19.97			11.06*	2.09
	H	139.45	16.53				

Significant at 0.05 level

Table-4: Significance of difference in Peak Torque between Quadriceps and Hamstring of Non-Dominating leg (Nm)

Speed	Muscle	Mean	SD	Difference of mean	SE	't'	Required 't' value
60°/sec	Q	190.60	27.59			7.91*	2.09
	H	129.05	21.17				

Significant at 0.05 level

Table-5: Significance of difference in Peak Torque between Quadriceps of Dominating (D) and Non-Dominating (ND) leg (Nm)

Speed	Quadriceps	Mean	SD	Difference of mean	SE	't'	Required 't' value
60°/sec	D	208.60	19.97			2.36*	2.09
	ND	190.60	27.59				

Significant at 0.05 level

Table-6: Significance of difference in Peak Torque between Hamstring of Dominating (D) and Non-Dominating (ND) leg (Nm)

Speed	Hamstring	Mean	SD	Difference of mean	SE	't'	Required 't' value
60°/sec	D	139.45	19.53			1.62	2.09
	ND	129.05	21.17				

Significant at 0.05 level

The difference in peak torque of quadriceps and hamstring of dominating leg presented in Table 3 shows that peak torque 't' values of 11.06 in sprinters at 60o/sec speed is found to be statistically significant. A similar trend has been observed in case of comparison between hamstring and quadriceps of non-dominating side in the values presented in Table 4. The found value of 7.91 is greater than Table value at 60 deg/sec speed. It shows that quadriceps is stronger than hamstring muscle group. The reason behind this may the greater amount of training being devoted for quadriceps muscle group and in almost all the running, jumping and hopping exercises quadriceps is a prime mover.

The value presented in Table 5 shows that dominating and non-dominating quadriceps peak torque comparison 't' values of 2.36 is statistically significant. It is further observed that dominating and non-dominating hamstring peak torque 't' value of 1.62 at 60 deg/sec is not statistically significant (Table 6). It indicates that exercises selected for fitness and skill perfection pre-dominantly leads to improvement in quadriceps strength and for hamstring muscle group specific exercises need to be selected.

Table-7: Significance of difference in Hamstring Quadriceps Strength Ratio of dominating and non-dominating leg (%)

Speed	H/Q Ratio	Mean	SD	Difference of mean	SE	't'	Required 't' value
60°/sec	D	67.1	11.12			-0.53	2.09
	ND	69.35	15.42				

Significant at 0.05 level

The values presented in Table 7 indicate that hamstring is 67.10 % and 69.35% of quadriceps on dominating and non-dominating side, respectively. The strength ratio of hamstrings to quadriceps should be at least 60 per cent but ideally 75 percent (http://www.livestrong.com).

The 't' value (-0.53) is found to be statistically non-significant. A similar

Table-8: Significance of difference in Angle of peak torque between Quadriceps of dominating and non-dominating leg.

Speed	Quadriceps	Mean	SD	Difference of mean	SE	't'	Required 't' value
60°/sec	D	64.90	5.97			- 0.63	2.9
	ND	66.25	7.50				

Significant at 0.05 level

Table-9: Significance of difference in Angle of peak torque between Hamstring group of dominating and non-dominating leg.

Speed	Hamstring	Mean	SD	Difference of mean	SE	't'	Required 't' value
60°/sec	D	36.05	7.55			0.30	2.09
	ND	35.40	5.86				

Significant at 0.05 level

result was concluded in studies conducted by Singh et al, (2016) on throwers and Zakas (2006) on professional soccer players.

An observation of angle of Peak torque results indicates that there is no difference in angle of peak torque at which the highest peak torque was achieved in dominating and non-dominating side quadriceps. Similar trend has been seen in case of hamstring muscle group. Kannus and Beynnon (1993) reported 33 degrees for men and 37 degrees for women angles of peak torque at 60 degrees.sec-1 for the hamstrings in healthy adult males and females (0 degree = full extension) and for the quadriceps 54 degrees in both groups.

CONCLUSIONS

- Quadriceps is significantly stronger than hamstring in dominating and non-dominating side.
- Dominating side quadriceps is significantly stronger than the Non-dominating side quadriceps muscle group.
- A non-significance difference exists between dominating and non-dominating hamstring muscle group.
- A non-significant difference exists in H/Q strength ratio of dominating and non-dominating side.
- A non-significant difference exists in angle of peak torque of quadriceps of dominating and non-dominating leg.
- A non-significant difference exists in angle of peak torque of hamstring of dominating and non-dominating leg.

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