Hamstring and Quadriceps Muscle Groups of Track and Field Jumpers

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The purpose of the work was to study the hamstrings and quadriceps strength level of jumpers. 20 national level jumpers were selected as subject for the study. Isokinetic machine was used to assess the strength level of the jumpers. Strength of quadriceps and hamstring muscle groups was assessed at 60 degree per second speed. Peak torque and Angle of peak torque was studied for comparison between dominating and non-dominating side. 't' test was applied for comparison of strength, H/Q strength ratio and Angle of peak torque.

A significant difference between quadriceps and hamstring strength and hamstring/quadriceps strength ratio of dominating and non-dominating side was found. A non significant difference was observed between dominating and non-dominating side hamstring muscle group strength and a non-significant difference in angle of peak torque between dominating and non-dominating side muscle groups also exists.

INTRODUCTION

Sports activities are putting different level of demands on strength abilities. Throwing, jumping running, cycling etc. needs higher strength of lower extremities. This is due to the fact that maximum training time is being devoted to develop leg strength.

The knee joint is a master piece of anatomic engineering, placed in each supporting column of the body, it is subject to severe stresses and strains in its combined functions of weight bearing and locomotion. 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).

Peak torque, angle of peak torque and hamstring/quadriceps strength ratio needs to be monitored to achieve higher jumping ability.

Since the inception of iso kinetics, this form of testing exercise has become increasingly popular in clinical, athletic and research settings (Davies, 1987).

Till today lot of work has been

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conducted to study quadriceps hamstring ratio in children, Football players, Track and Field athletes, Basketball and Handball Volleyball Players (Schlink - man, 1984; Sentilles, 1980; William, 1984; Thomas, 1979; Chawla 1992 Chawla 1994).

The present study was conducted on a group of Track and Field jumpers to investigate and compare strength of hamstring and quadriceps of dominating and non-dominating legs. The side showing higher value was considered dominating side.

METHODOLGY

The subjects for the present study were 20 Track and Field jumpers. 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 equiiivalent 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 producted (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 quadriceps muscle groups. 't' test was applied to compare the peak torque values of hamstring muscle group of dominating and non-dominating side, peak torque values of Hamstring muscle group of dominating and non-dominating side, and difference between quadriceps and hamstring of same legs. Hamstrings quadriceps ratio was also calculated and compared.

RESULT & DISCUSSION

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

Group	Age	Height	Weight
Jumpers	22.70±3.03	178.30±6.06	69.50±7.25

Table 2: Mean, SD of Peak torque of Quadriceps and Hamstring of Dominating and Non-dominating leg of Throwers at 600/sec speed (Nm)

Muscle		Dominating	Non-Dominating
Quadriceps	Mean	231.95	200.80
	SD	46.70	43.97
Hamstring	Mean	154.85	151.40
	SD	33.80	35.03

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

Speed	Muscle	Mean	SD	Difference of mean	SE	't'	Required 't' value
60%/ sec	Q	231.95	46.70	77.10	12.89	5.98*	2.09
	H	154.85	33.80				

Significant at 0.05 level

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

Speed	Muscle	Mean	SD	Difference of mean	SE	't'	Required 't' value
60%/ sec	Q	200.80	43.97	49.40	12.57	3.93*	2.09
	H	151.40	35.03				

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	Muscle	Mean	SD	Difference of mean	SE	't'	Required 't' value
60%/ sec	D	231.95	46.70	31.15	14.34	2.17*	2.09
	ND	200.80	43.97				

Significant at 0.05 level

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

Speed	Muscle	Mean	SD	Difference of mean	SE	't'	Required 't' value
60%/ sec	D	154.85	33.80	3.45	10.89	0.32*	2.09
	ND	151.40	35.03				

Significant at 0.05 level

Significance of difference in peak torque of quadriceps and hamstring of dominating leg presented in Table 3 shows that peak torque 't' values of 5.98 in jumpers at 600/sec speed is found to be 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 3.93 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 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 2.17 is statistically significant. It is further observed that dominating and non-dominating hamstring peak torque 't' value of 0.32 at 60 deg/sec is not statistically significant (Table 6). It indicates that exercises selected for fitness and skill perfection predominantly leads to improvement in quadriceps strength and for hamstring muscle group specific exercise need to be selected.

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

Speed	Muscle	Mean	SD	Difference of mean	SE	't'	Required 't' value
60%/ sec	D	67.25	8.26	-9.05	3.65	-2.48*	2.09
	ND	76.30	14.10				

Significant at 0.05 level

The values presented in Table 7 indicate that hamstring is 67.25% and 76.30% of quadriceps on dominating and non-dominating side respectively. The strength ratio of hamstrings to quadriceps should be at least 60 percent but ideally 75 percent (http://www.livestrong.com).

The 't' value (2.48) is found to be statistically significant. In an earlier study Singh et.al. (2016) concluded that a non-significant difference exists between dominating and non-dominating side H/Q strength ratio in throwers. There is no differences in the H/Q between the right and left legs for professional Soccer players (ZAKAS, 2006). It shows that the major difference in throwers and jumpers and soccer players and jumpers training is inclusion of jumping and hopping exercises which lead to increase in strength of dominating quadriceps and ultimately to a higher ratio value.

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	65.15	7.16	0.40	2.65	0.15	2.9
	ND	64.75	9.45				

Significant at 0.05 level

Table -6 : 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	34.30	7.76	-0.90	2.77	-0.33	2.09
	ND	35.20	9.63				

Significant at 0.05 level

An observation of angle of peak torque 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. Knee angles of peal torques at 60 degrees. sec-1 in healthy adult males and females for the hamstring occurred at 33 degrees for men and 37 degrees for women (0 degree=full extension) and for the quadriceps was 54 degrees in both groups (Kannus & Bevnnon,1993).

CONCLUSION

Quadriceps are significantly stronger than Hamstring in dominatimg and non-dominating side.

- Dominating side quadriceps are significantly stronger than the non-dominating side Quadriceps muscle group.
- A non-significance difference exists between dominating and non-dominating hamstring muscle group.
- Non-dominating side hamstring and quadriceps strength ratio is significantly higher than 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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