Hamstring and Quadriceps Strength Peak Torque, Strength Ratio, Angle of Peak Torque and Torque Acceleration Energy of National Level Throwers

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ABSTRACT

The purpose of the research was to study the hamstring and quadriceps strength level of throwers. Twenty national level throwers were selected as subjects for the study. Isokinetic 340 machine was used to assess the strength level of the throwers. Strength of quadriceps and hamstring muscle groups was assessed at 60 degree per second speed. Maximum strength level, angle of peak torque and torque energy acceleration was studied for unilateral and bilateral comparison of hamstring and quadriceps muscle group. 't' test was applied for comparison of strength, H/Q strength ratio, angle of peak torque and torque energy acceleration.

A significant difference was found between quadriceps and hamstring strength. A non significant difference was observed between dominating and non-dominating hamstring and quadriceps muscle group.A non-significant difference in angle of peak torque and torque acceleration energy between dominating and non-dominating quadriceps and hamstring was found.

INTRODUCTION

The process of monitoring of sports training process comprises planning of training, execution of training, assessment and evaluation, for training. Assessment of performance or performance determining factors, for better control and regulation of training process, is an important area of theory and methods of training.

Physical fitness tests are considered to be the principal means to assess training effects, to form a basis for planning a personalized exercise programme or making modification in the future programme and to motivate the trainees to work harder.

In the past, muscular abilities were normally tested through isotonic and isometric testing procedures. In the late 1960's, the concept of exercise was developed by James Parrine which proved to be a revolution in exercise training and rehabilitation. Instead of the traditional exercises which involve a constant weight of resistence performed at variable speeds, Perrine developed the concept of isokinetics which incolves a dyanamic pre set fixed speed, with resistance that is totally accomodating throughout the range of motion. Since the inception of is okinetics, this form of testing exercise has become

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increasingly popular in clinical, athletic and research settings(Davies 1987)

Sports activites are putting different level of demands on strength abilites. 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 master piece of anatomic engineering, placed in each supporting column of the body, it is subject to severe stress 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(Luttegens and Wells, 1976). Twelve muscles divided into three groups; hamstring groups (Rectus femoris, vastus lateralis, vastus intermedias, vastus medialis), quadriceps group (semitendinosus, semimembera-nosus, biceps femoris) and unclassified group (Sartorious, gracilis, poplitius, gastrocne-mius, plantaris) (Rosch & Burke, 1978).

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 high level throwers to investigate and compare strength of hamstring and quadriceps of dominating and non-dominating legs. The side showing higher value was considered dominating side.

METHODOLOGY

The subject for the present study were 20 throwers. The group consists of hammer thrower, discus thrower, javline throwers and shot putters. Some of the subjects were participating in more than one throw events.

Cybex 340 Isokinetic Machine was used to measure hamstring and quadriceps strength peak torque, at different velocities, i.e, 60 degree/sec, 180 degree/sec, 240 degree/sec, speed. Peak torque is the highest torque value seen from all repetitions and all points in the range of motion. (Davies,1987).

Angle of peak torque was also observed. Angle of peak torque is the angle at which the peak torque occurs (Davies, 1987).

In addition to this hamstring and quadriceps ratio was also seen. In the present study, the hamstring muscle group is considered to be the weaker muscle group where as quadriceps is the stonger muscle group. So the hamstring peak torque value divided by quadriceps peak torque value and multiplied by 100 gives us hamstring/ quadriceps strength ratio values.

Torque accleration energy values of different muscle groups were also studied. This is a measure of 'explosiveness ' of a muscle contraction. This is the total work in the first 1/8 of a second (Davies1987).

The subjects were given proper warm up before testing. Following the standard instructions and procedures the subject was asked to start at 60 degree/sec speed. Four trials were given in order to get acquainted with the mode of performing the task and

after adequate rest final test was conducted.

In addition to the age, height and weight of the subject were 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 between quadriceps and hamstrings of same legs. Hamstring quadriceps ratio was also calculated.

RESULT & DISCUSSION

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

Group	Age	Height	Weight
Throwers	21.60±3.44	182.50±5.81	90.30±10.32

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

Muscle		Dominating	Non-dominating
Quadriceps	Mean	247.15	223.00
	SD	46.63	43.06
Hamstring	Mean	163.75	157.35
	SD	27.49	28.65

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	247.15	46.63	83.40	12.10	6.89*	2.09
	H	163.75	27.49				

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	233.0	43.06	65.65	11.57	5.68*	2.09
	H	157.35	28.65				

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	247.15	46.63	24.15	14.19	1.70	2.09
	ND	223.0	43.06				

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	Quadriceps	Mean	SD	Difference of mean	SE	't'	Required 't' value
60°/sec	D	163.75	27.49	6.40	8.88	0.72	2.09
	ND	157.35	28.65				

Significant at 0.05 level

Significance of difference in peak torque of quadriceps and hamstring of dominating leg, presented inTable 3, shows that peak torque 't' values of 6.89 in throwers at 60° sec speed is found to be significant. It shows that quadriceps is stronger than hamstring muscle group. 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 5.68 is greater than Table value at 60 deg/sec speed.

The value presented in Table 5 shows that throwers dominating and non-dominating quadriceps peak torque values of 1.70, at selected speed, is not significant. It is further observed that dominating and non-dominating hamstring peak torque 't' value of 0.72 at 60 deg/sec was not statistically significant (Table 6).

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

Speed	Quadriceps	Mean	SD	Difference of mean	SE	't'	Required 't' value
60°/sec	D	67.85	10.11	–3.90	3.30	1.18	2.09
	ND	71.75	10.75				

Significant at 0.05 level

The values presented in Table 7 indicate that hamstring is 67.85% and 71.75% of quadriceps of dominating and non-dominating side respectively. The 't' value (1.18) is found to be statistically non-significant.

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	62.70	7.38	2.0	2.72	0.74	2.9
	ND	60.70	9.66				

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	Quadriceps	Mean	SD	Difference of mean	SE	't'	Required 't' value
60°/sec	D	34.55	5.74	3.25	2.68	1.21	2.09
	ND	37.80	10.51				

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 on dominating and non-dominating quadriceps. Similar trend has been seen in case of hamstring muscle group.

Table-10 : Significance of difference in Torque acceleration Energy (TAE) between Quadriceps and Hamstring group of dominating leg (Joule).

Speed	Muscle Group	Mean	SD	Difference of mean	SE	't'	Required 't' value
60°/sec	Quadriceps	3.55	1.88	-0.90	0.50	-1.80	2.09
	Hamstring	4.45	1.22				

Significant at 0.05 level

Table-11 : Significance of difference in Torque acceleration Energy (TAE) between Quadriceps and Hamstring group of Non-dominating leg (Joule).

Speed	Muscle Group	Mean	SD	Difference of mean	SE	't'	Required 't' value
60°/sec	Quadriceps	3.50	2.01	-0.65	0.50	-1.30	2.09
	Hamstring	4.15	0.91				

Significant at 0.05 level

Table-12 : Significance of difference in Torque acceleration Energy (TAE) between Quadriceps of Dominating and Non-dominating leg (Joule).

Speed	Muscle Group	Mean	SD	Difference of mean	SE	't'	Required 't' value
60°/sec	Diminating	3.55	1.88	-0.05	0.62	0.08	2.09
	Non-dominating	3.50	2.01				

Significant at 0.05 level

Table-13 : Significance of difference in Torque acceleration Energy (TAE) between Hamstring of Dominating and Non-dominating leg (Joule)

Speed	Muscle Group	Mean	SD	Difference of mean	SE	't'	Required 't' value
60°/sec	Dominating	4.45	1.12	0.30	0.32	0.94	2.09
	Non-dominating	4.15	0.91				

Significant at 0.05 level

Torque energy accerleration values presented in tables 10 to 13 show a non-significant difference between quadriceps and hamstring group of dominating leg (–1.80), quadriceps and hamstring group of non-dominating leg (-1.30), quadriceps of dominating and non-dominating leg (0.08) and hamstring of dominating and non-dominating leg (0.94). TAE in case of hamstring group in comparison to quadriceps is higher. Whereas, dominating quadriceps and hamstring group show higher TAE in comparison to non-dominating quadriceps and hamstring groups.

The reason behind significant difference between quadriceps and hamstring may be that during the strength training more weightage is given to improvement of quadriceps strength by using quadriceps dominating exercises or where the quadriceps is working as prime mover.

Secondly, very less time is being devoted for hamstring training and there are very few heavy weight exercises being used by throwers.

A non significant difference between quadriceps of dominating and non-dominating leg and hamstring of dominating and non-dominating side shows that both sides are equally involved in strength training exercise. The same may be true in case of Angle of peak torque.

CONCLUSION

* A significant difference between quadriceps and hamstring indicates that quadriceps is stronger that hamstring in dominating and non-dominating side.
* A non-significance difference exists between dominating and non-dominating quadriceps muscle group.
* A non-significance difference exists between dominating and non dominating hamstring muscle group.
* There is no significant difference in hamstring and quadriceps strength ratio between dominating and non-dominating side.
* A significant difference in angle of peak torque quadriceps and hamstring between dominating and non-dominating leg.
* There is no significant difference in torque acceleration energy between hamstring dominating and non-dominating side.
* There is no significant difference in torque acceleration energy between quadriceps of dominating and non-dominating side.
* Balance between quadriceps and hamstring needs to be maintained.
* Angle of peak torque during training exercises should be adjusted as per the requirement of the throwers.

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