A CORRELATION BETWEEN VERTICAL JUMP AND ISOKINETIC MEASUREMENTS IN FEMALE BASKETBALL ATHLETES

Andrew Ebert[1], Steven Leigh[1], and Suzanne Konz[1]

Marshall University, Huntington, WV, United States[1]

The purpose of this study is to determine the relationship between isokinetic measurements and the vertical jump performance in female basketball athletes. The medical records and strength and conditioning measurements of 11 female NCAA-I basketball athletes were examined for vertical jump measurements and isokinetic measurements of the knee. This study found moderate to high correlation of the isokinetic measurements at 60º/s (r^2=0.9806) and 180º/s (r^2=0.9952) and vertical jump performance. The average power in the quadriceps at 60º/s ($p<0.05$, r^2= 0.8334) was the only variable that was significantly correlated with vertical jump height. The results demonstrate the possible influence of isokinetic variables such as power and peak torque on vertical jump performance.

KEYWORDS: basketball, vertical jump, isokinetic

INTRODUCTION: The vertical jump is a fundamental movement in the game of basketball; utilized in shooting, rebounding and the thrilling act of dunking a basketball. Basketball athletes have been found to jump an average of 44 times a game (McInnes, Carlson, Jones, & McKenna 1995). The explosive nature of a vertical jump places high demands on the athlete's muscles and knee. Knee flexor muscles are responsible for knee stabilization and muscular control in a vertical jump (Cometti et al., 2001; Fried & Lloyd, 1992; Andrade et al., 2012). Vertical jump performance and training progression can be measured by vertical jump and isokinetic testing. Athletes undergo performance tests (e.g. vertical jump) throughout their careers as a means to assess their musculoskeletal status. Vertical jump testing is used to determine power, athlete development and training status (Alemdaroğlu, 2012; Konz, 2016)**.** However, leg muscle balance helps the athlete generate power for the activity as well decrease the risk for knee injury (van Dyk et al., 2016).

Isokinetic testing measures the power and peak torque values (Hislop & Perrine, 1967) that help to assess the knee for injury risk and performance critical for vertical jump. Unless using sophisticated equipment, power and torque are unable to be measured by a vertical jump test. An isokinetic test uses an isokinetic dynamometer to monitor the force-velocity relationship at set velocities and measure muscles in concentric and eccentric contractions (Rouis et al. 2015). An isokinetic device challenges muscular force development throughout the range of motion without acceleration of the limb occurring (Moffroid, Whipple, Hofkosh, Lowman, Thistle, 1969). Isokinetic dynamometer testing produces reliable data when testing joints, such as the knee (Zvijac, Toriscelli, Merrick, Papp, & Kiebzak, 2014). Isokinetic testing is used for injury evaluation, injury prevention and return to play purposes (Konz 2016).

Testing that adds information regarding athlete health, preparedness, and capability assists team staff in developing appropriate interventions for the athlete. By comparing the results of isokinetic test results with vertical jump performance test results, a better picture of overall athlete health and capability emerges. Athletes, coaches, and medical staff benefit from another means to evaluate an athlete's ability as well as to gather valuable information regarding athlete knee health. The purpose of this study was to determine the relationship between isokinetic measurements and vertical jump performance in female basketball athletes.

METHODS: This study examined the medical and strength and conditioning records of 11 female NCAA-I basketball athletes. The data were extracted from the results of standard athlete testing conducted by strength and conditioning and sports medicine staffs at the University. Data was taken from preseason and post-season test sessions. The study received approval from the institution's review board.

Protocol: Medical records along with strength and conditioning testing records of 13 female NCAA-I soccer athletes were examined. The medical records included the isokinetic knee flexion and extension testing. This study focused on the isokinetic test measurements of peak torque quadriceps (PTQuad), peak torque hamstrings (PTHam), average power quadriceps (APQuad), average power hamstrings (APHam), along with preseason vertical jump heights (PreVJ) and postseason vertical jump heights (PostVJ). Isokinetic testing was completed on a Cybex Humac Norm (Computer Sports Medicine, Inc., Soughton, MA, USA). Testing on the isokinetic device was conducted at 60°/s and 180°/s. Each athlete was instructed to provide maximal effort and identical protocols were performed during preseason and postseason testing.

Instrumentation: The isokinetic test used 60º/s and 180º/s settings and was completed on a Cybex Humac Norm (Computer Sports Medicine, Inc., Stoughton, MA, USA). Vertical jump height was measured by using a Just Jump System (Power Systems, Knoxville, TN). The dominant leg of each subject was recorded and used for data analysis.

Data Analysis: Correlation and linear regression were used to find relationships between the isokinetic results and vertical jump measurements. The statistical significance level was chosen as $p < 0.5$.

RESULTS: Average power and peak torque values for isokinetic testing improved from pre-season to post-season (Tables 1 and 2). Vertical jump performance decreased from pre-season (0.52±0.08 m) to post-season (0.50±0.05 m). Stepwise linear regression selected the variables most correlated with vertical jump. The post-season average power in the quadriceps at 60º/s ($p < 0.0041$, $r^2=0.8334$) and post-season peak torque in the hamstrings at 60º/s ($p < 0.0224$, $r^2=0.6802$) correlated with vertical jump height. Regression analysis found that preseason vertical jump height was correlated ($r^2=0.7436$) with preseason average power in the quadriceps, and preseason average power in the hamstrings at 60º/s. Postseason vertical jump was correlated ($r^2=0.9952$) with preseason average power of the quadriceps at 60º/s, postseason peak torque of the hamstrings at 60º/s, and preseason average power of the quadriceps at 180º/s. Vertical jump height improvement correlated ($r^2=0.9806$) with preseason peak torque of the quadriceps at 60º/s, postseason average power of the quadriceps at 60º/s, and preseason peak torque of the hamstrings 60º/s.

Table1: Mean (±Std. Dev) of Pre-season and Post-Season Isokinetic Variables at 60°/s

	Avg. Power – Quads (W)	Avg. Power – Hamstrings (W)	Peak Torque – Quads (W)	Peak Torque – Hamstrings (W)
Pre-Season	96.45 (±19.37)	77 (±17.58)	112.36 (±21.81)	75.18 (±16.52)
Post-Season	100.90 (±28.19)	82.81 (±18.98)	119.81 (±32.61)	82.18 (±16.96)

Table 2: Mean (±Std. Dev) of Pre-season and Post-Season Isokinetic Variables at 180°/s

	Avg. Power – Quads (W)	Avg. Power – Hamstrings (W)	Peak Torque – Quads (W)	Peak Torque – Hamstrings (W)
Pre-Season	151.54 (±28.57)	116.90(±17.92)	70.63 (±12.74)	51.09 (±8.32)
Post-Season	185.18 (±25.92)	143.36(±17.90)	81.90 (±10.27)	59.81 (±8.98)

DISCUSSION: The purpose of this study was to determine the relationship among the isokinetic measurements and vertical jump performance. The results of our analysis determined the existence of correlations between isokinetic output and vertical jump height in collegiate female basketball athletes. Quadriceps average power and hamstring peak torque predicted vertical jump height, in this study. Producing greater quadriceps power and allows for greater overall power production and thereby, increased vertical jump height. Hamstring peak torque predicted vertical jump height, in this study. The hamstrings control jumping (Andrade et al., 2012). Producing greater hamstring torque allows for greater power production and thereby, increased vertical jump height. Preseason vertical jump height correlated to preseason average power in the quadriceps, and preseason average power in the hamstrings at 60º/s. Postseason vertical jump correlated with preseason average power of the quadriceps at 60º/s, postseason peak torque of the hamstrings at 60º/s, and preseason average power of the quadriceps at 180º/ s. Vertical jump height improvement correlated with preseason peak torque of the quadriceps at 60º/s, postseason average power of the quadriceps at 60º/s, and preseason peak torque of the hamstrings 60º/s. These results, although not statistically significant, agree with other research. Fisher et al. (2017) determined that isokinetic strength and jump height correlated. Rouis et al. (2015) found positive correlations between isokinetic results and vertical jump. However, Iossifidou, Baltzopoulos, & Giakas, (2005) did not find a correlation with the vertical jump and isokinetic power during slow velocity but did at high velocity.

This study found moderate to high correlation of the isokinetic measurements at 60º/s and 180º/s and vertical jump performance. The average power in the quadriceps and peak torque in the hamstrings at 60º/s were the only variable that was significantly correlated with vertical jump height. The results demonstrate the influence isokinetic variables such as power and peak torque have on vertical jump performance. The small sample size and high variability of data in this study oversaturated the statistical results. More statistical power could be found with a larger sample size for future studies looking at the relationship between isokinetic testing and vertical jump performance.

CONCLUSION: This study determined a relationship among the isokinetic measurements and vertical jump performance. The correlations between isokinetic testing and pre-season and post-season testing of jump height indicate the influence of athlete training throughout the season. Developing athlete capabilities to translate power and torque into solid athletic performance is a process. Pre-season training sets the tone for the competitive season by providing a solid strength and power base. Athletes need to come into the season trained for the rigors of the season. By continuing with appropriate training stimulus, focused on strength and power production of the quadriceps and hamstrings throughout the competitive season, an athlete can improve or maintain power production. Improved or stable power production hopefully translates to improved or consistent performance on the court.

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