ACUTE BIOMECHANICAL EFFECTS OF STATIC STRETCHING VERSUS DYNAMIC STRETCHING VERSUS FOAM ROLLING ROUTINES USING MARKERLESS MOTION CAPTURE SYSTEM

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INTRODUCTION

Motion capture systems (MCS) can be used to assess an individual's upper-and lower-body motions, both explosive and functional in nature. Advancements in technology and screening protocols are capable of detecting acute biomechanical alterations. More specifically, warm-up routines have been shown to influence athletic performance.

PURPOSE

This study compared the effects of various warm-up routines [i.e. dynamic stretching (DS), static stretching (SS), foam rolling (FR), and control (CON)] using the functional motion analysis (FMA).

METHODS

Five women ($\bar{X}$ ±SD; age=21.8±1.6 yrs., hgt.=169.2±5.6 cm, wgt.=68.3±4.0 kg) and seven men (age=21.4±1.3 yrs., hgt.=181.4±6.7 cm, wgt.=84.1±12.2 kg) volunteered for this investigation. Subjects were screened using the FMA, consisting of 19 movements. Including shoulder ranges mobility (i.e., shoulder abduction and adduction, horizonal abduction and adduction, internal and external rotation, flexion and extension), trunk rotation, overhead squat, unilateral squats, forward lunges, single leg balance, vertical jump (VJ), unilateral VJs, static VJ, multiple unilateral VJs, and depth VJ. The 3-D MCS (DARI Motion, Scientific Analytics, Lincoln, NE) was used to analyze the kinetic and kinematic data, from which 192 variables were calculated and reported in FMA scores (i.e. composite, power, functional strength, dysfunction, vulnerability). Each subject completed four randomized experimental

METHODS (continued)

warm-up routines (CON, DS, SS, FR) lasting 30 minutes in duration. Focusing on total-body and primary large muscle groups. The FMA scores were collected for each pre- and post- warm-up routine. Statistical analyses were conducted using the FMA scores x warm-up routines x time (pre-test, post-test) repeated measures MANOVA.

Figure 1a

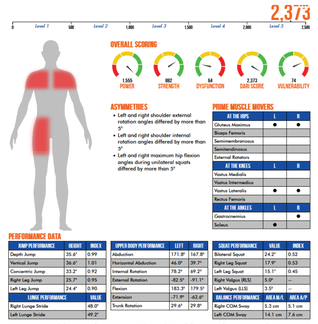

Figure 1b

Figure 1a, 1b. Displays the markerless motion capture system (MCS) used for investigation (Figure 1a) and example of MCS report used for pre- and post-warm-up task (Figure 1b).

RESULTS

The MANOVA indicated no significant interactions (condition x time x score) (p<0.05) (Table 01 and Table 02).

DISCUSSIONS

The current investigation was not able to statistically demonstrate the influences of the warm-up routines. Further examination of the FMA scores during each of the warm-up routines speculates the mechanical influences following each warm-up task. Further investigations are needed to examine the effects of warm-up routines on total-body biomechanics.

Table 01. Functional movement analysis scores pre- and post-warm-up routines (dynamic, static, foam rolling, and control) using a markerless motion capture system

	Composite Score	Power Score	Functional Strength Score
Pre-Static	1418.5±368.4	831.8±281.1	716.8±155.6
Post-Static	1423.3±333.9	834.9±286.4	712.4±148.4
Pre-Dynamic	1376.3±319.3	706.5±150.3	829.6±277.8
Post-Dynamic	1426.3±319.8	695.8±150.9	872.4±305.8
Pre-Foam Rolling	1446.9±380.2	836.8±309.4	728.1±128.0
Post-Foam Rolling	1434.8±404.8	828.8±295.2	739.1±141.0
Pre-Control	1437.1±310.9	836.8±268.3	728.3±144.4
Post-Control	1432.4±321.3	831.6±283.5	737.5±127.8

n=12, (*) idicates significant difference (p <0.05).

Table 02. Functional movement analysis scores pre- and post- warm-up routines (dynamic, static, foam rolling, and control) using a markerless motion capture system

	Dysfunction Score	Vulnerability Score
Pre-Static	130.2±74.4	47.2±16.8
Post-Static	124.1±59.6	46.9±19.7
Pre-Dynamic	153.2±80.7	51.9±18.9
Post-Dynamic	141.9±81.6	52.8±26.2
Pre-Foam Rolling	118.0±84.8	44.9±19.0
Post-Foam Rolling	133.2±61.4	46.5±15.3
Pre-Control	128.0±38.5	48.6±15.4
Post-Control	136.7±66.6	46.5±19.1

n=12, (*) idicates significant difference (p <0.05).

PRACTICAL APPLICATION

Various warm-up routines have been reported to influence exercising performances, however, movement analysis on total-body mechanics following warm-up routines has not been examined. As a coach, trainer, or athlete it is critical to understand influences and mechanical alterations on each warm-up routine.