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A STUDY OF ANGULAR DISPLACEMENT OF DIFFERENT JOINTS BETWEENMALE AND FEMALE SHOT PUTTERS AND PERFORMANCE

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ABSTRACT

Sport like Shot put requires all of the joints in the kinetic chain to move simultaneously in one single movement. To improve the movements for better performance, the analysis and impact of angular displacement of different parts of the human body is very crucial.

The purpose of this study was to examine the angular displacement of different joints between male and female athletes during stance to delivery action and the performance in shot-put athletes. The subjects for the study were selected from sports hostel in SAI (Salt Lake City). 05 male and 05 female national athletes were selected randomly and aged from 18 to 28 years. Each of them was given six trials and that best trial result was recorded for the analysis of various angular kinematics variables. Such as: ankle joint, knee joint, hip joint, shoulder joint and elbow joint. The above variables were analyzed and calculated with the help of tracker 4.92 software. The actions of athletes were captured using cannon camera with 120fps speed and the parameter like release velocity was calculated. The horizontal distance was calculated by reference tape. Result showed the significance of mean differences of angular displacement of selected joints occurred during stance to delivery action. Only significant difference was found in the displacement of hip joint.

Keywords: Displacement, Joint, Shot put, male, female, performance

1. INTRODUCTION

In shot put, two putting styles are generally used by the athletes: Glide and Rotational. In both the styles the main goal is to throw the shot to the farthest point. To achieve the farthest point, the main objective remains intact i.e. to reach a high rotational body speed and to transfer the energy to the shot. Transfer of mechanical energy through angular displacement of joints to the shot play an important role in analysis of the movement and performance of the athletes.

Angular displacement is used to express the extent of motion in individual joints of human body. Angular displacement is the change of the absolute angle between the initial and the final position of a given segment of human body. In biomechanics, usually angular displacement is described between individual segment of human body. It can be imagined as a single point on each segment, connected by a ray with the intersection of these two segments (i.e. the joint). Change of mutual orientation of these rays equals angular displacement.

Shot put requires all of the joints in the kinetic chain to move simultaneously in one single movement. A push-like movement pattern is the best in shot put for many reasons; one of significance being that simultaneous motion will result in a more accurate movement due to the body travelling in a straight-line. Accuracy is extremely important in shot put to enable the shot to carry further. To execute successful movement in shot put the athlete needs to have a solid stable base of support. The individual rotates their torso and their back knee is bent at the most optimal angle so that angular displacement is correct. There is an upward motion that relies on the power to be generated through extending the knee that is bent. The athlete would apply force to the ground with the leg that is bent. Newton's Laws of Motion state that for every action there is an equal but opposite reaction. As the individual extents the force moves into the arm as the shot put is released the front leg remains straight and the shot is pushed from the tips of the finger at an optimal angle.

The flow of energy by the angular displacement of the joints also occurs when there is translational movement of the joint. The angle between individual body segments is required to describe, evaluate, and improve skills in physical exercise and related sport. In movements requiring high speed generation such as the shot put, the rates of energy transfer are much higher than muscles can generate.Hence, the joint translational power is critical along with proper angular displacement of different parts of the body for better performance.

Reviews

Research studies in the shot put have multifaceted dimensions that include training, investigation of performance determinants and of course the mechanical analysis of techniques.. Few studies are cited below by the researched to expose present trends research in motion analysis of shot put. Chhangte and Mondal (2023) showed that statistically no significant difference in ankle and knee joint angle after push pass soccer drill training. Chanda and Mondal (2020) suggested that the kicked ball angle has a moderate positive relationship with kicking foot ankle angular velocity, moderate negative relationship with kicking leg knee joint's angular velocity and weak positive relationship with kicking leg hip joint's angular velocity in the sample.Chanda and Mondal (2020) reported that a kinematic outcome is the product of all the angles of all the body segments involved in normal kicking action. Nevertheless, is the chip shot , all body segments are involved in their optimal angular kinematics. Chanda and Mondal (2019) suggested that C.G height reduction of male soccer players in performing of ground contact, ball contact and follow through in push pass, instep kick, lofted kick, chip shot and in swerve kick but highest reduction have been located in the ball contact phase of all the kicks. Chanda and Mondal (2018) suggested that angular mean velocity of the kicking leg at ball

contact was found higher in the boys may be because of heavier and stronger hip joint muscles in compared to the girls.

Acharyya and. Mondal (2017) suggested that the horizontal distance at release is a crucial factor to throwing success. The optimum horizontal release position should be between 0.20 m to 0.50 m in front of the toe board with this distance with largely determine by the anthropometry and technique of the athlete. Kaur and Deol (2016) reported that the kinematical variables of glide technique in shot put i.e. projection angle, horizontal velocity of wrist joint, had significant relationship with performance during moment of release phase. Tae-Sam; & Ji-Seon (2012) reported that the shot putter required to adjust an appropriate ratio between gliding and stance length with a strong muscle power at the trunk, throwing arm and the lower extremity during gliding and delivery phase. Williams (2012) suggested that athletes who produced greater lower body energy will have greater horizontal displacement. Lahtanen, Blomqvist and Vantilnen (2008) reported that during the beginning of the turn when the body weight shifts from the right over the left leg the velocity of the shot increased up to 2-3 m/sec. Young (2007) indicated that measured distance was positively correlated with release speed and shoulder hip separation and negatively correlated with release angle, rear knee angle at rear foot touchdown and rear knee angle at release.

2. METHODOLOGY

The subjects for the study were selected from sports hostel in SAI (Salt Lake City). 05 male and 05 female national athletes were selected randomly and aged from 18 to 28 years. Each of them was given six trials and that best trial result was recorded for the analysis of various angular kinematics variables. Such as: ankle joint, knee joint, hip joint, shoulder joint and elbow joint.

Two cannon video camera were used for the purpose of the study. The camera was placed at a distance of 4 mts at frontal plane from centre of the shot put circle. The height of camera (lenses) fixed at a height 1.32 mts form the ground. For setting up the camera the studies conducted by Z.Chhangte&S.K.Mondal (2023), S. Chanda & S.K. Mondal (2020), S. Chanda & S.K Mondal (2019), S. Chanda &S.K.Mondal (2020), S. Chanda & SK Mondal (2018) and B. Acharyya& DR. S.K. Mondal (2017) were referred and the procedure adopted by them was employed by the researcher in the present study.

3. RESULTS

TABLE 1
COMPARISON BETWEEN MALE & FEMALE ON ANGULAR DISPLACEMENT OF DIFFERENT JOINTS

Variables	Sex	t-ratio
Ankle Right	Male Female	1.350
Knee Right	Male Female	0.729
Hip Right	Male Female	3.636*
Shoulder Right	Male Female	2.227
Elbow Right	Male Female	0.636

***. Significant at 0.05 level**

$t_{.05}$ (8) = 2.306

Table 1 reveals the significance of mean differences of angular displacement of selected joints occurred during stance to delivery action only significant difference was found in the displacement of hip joints.

4. DISCUSSION

It is found that male and female shot putters exhibited no significant difference in the angular displacement of joints starting from ankle to elbow except at right hip, were t-ratio value 3.636 is an evident as it is higher than the tabulated t-value at 0.05 level of confidence.

The significant higher mean value of right hip displacement at release in comparison to the male might has been caused due to structural differences of pelvis and femurs. It is generally agreed that females are more flexible than males in most joints (Entyre& Lee, 1988; Grana & Moretz, 1978; Gray, Tauton& Mc Kenzie, 1985) . But in a study conducted by Lee et. al. (Lee, Entyre, Poindexter, Sokol & Toon, 1989) established that while generating a greater vertical momentum the women's increased hip range of motion was not found to have a significant co-relation whereas the increased range of motion of the hip was found to be significantly with the development of vertical momentum in case of men. Hence, though the women shot putters are likely to have greater range of motion in their hip joints, their wider pelvis, shorter legs, more oblique femurs, larger ratio of leg weight to body weight, greater fat deposition on the thigh place them in a disadvantageous position in maximum utilization of hip range of motion for developing vertical momentum, as well they had significantly lower hip joint displacement at release action when compared to the men. The present findings are in consistence with the invention of wealth's (1991).

The relationship between the energy output with the shot put result and technique indicated that the trunk's energy output was closely correlated with the shot put result. Knowledge of the trunk's movement is of great importance to the shot-put technique.

5. CONCLUSION

- Women had significantly lower hip joint displacement at release action when compared to the men due to shorter legs, more oblique femurs, larger ratio of leg weight to body weight, greater fat deposition on the thigh.
- Male and female throwers exhibit uniform pattern of segmental angular displacement during delivery action.
- The male shot putters have a greater vertical displacement of shot at release due to long lever.

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