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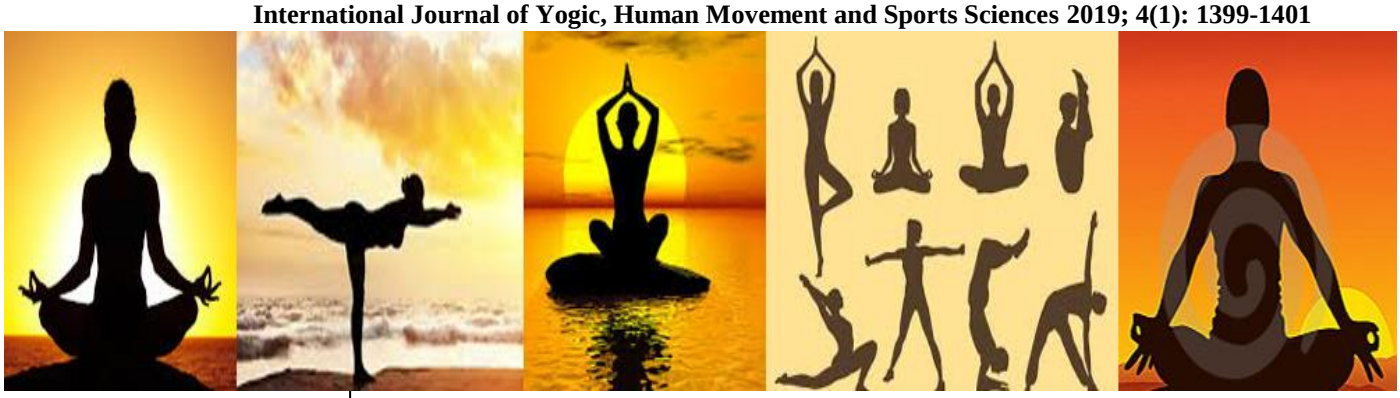

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Kinematical analysis of backsalto in gymnastics

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Abstract
The purpose of the study was to investigate the relationship between the linear kinematic and angular kinematic analysis of backsalto in gymnastics. Total six gymnasts were selected as a sample: Punjabi University, Patiala male gymnasts who had represented at All India Inter University Championship level were selected as a sample on the basis of performance in preceding competition. The age of all the subjects will be ranged above 19 to 25 years. The linear kinematic variables height of center of gravity at the initial phase, height of center of the gravity at the approach phase, height of center of the gravity at the takeoff phase, height of center of gravity at the flight phase, height of center of gravity at the landing phase, time of execution (time taken during complete movements), total horizontal displacement covered on floor and angular kinematic variables angle of left shoulder joint, angle of left hip joint, angle of left knee joint at the time of gymnast perform backsalto on floor. The kinematic analysis of gymnast performance Kinovea Software through and Karl Pearson's product moment coefficient correlation were employed with the help of statistical package of SPSS. The level of significance was set at 0.05. The outcome of the study shows that significant relationship with performance (.878) of gymnast in all variables.

Keywords: kinematic, backsalto, height of center of gravity, shoulder joint, hip joint, knee joint

Introduction
Gymnastics is a sport that requires balance, strength, flexibility, agility, coordination, and endurance. The movement involved in gymnastics contributes to the development of the arms, legs, shoulders, back, chest and abdominal muscle groups. Alertness, precision, daring, self-confidence and self – discipline are mental traits that can also be developed through gymnastics. Gymnastics evolved from exercises used by the ancient Greeks that included skills for mounting and dismounting a horse, and from circus performance skills. Most forms of competitive gymnastics events are governed by the federation of international gymnastics (FIG). Competitive artistic gymnastics is the best known of the gymnastic events. It typically involves the women's events of vault, uneven bars, balance beam, and floor exercise as well as the men's events of floor exercise, pommel horse, still rings, vault, parallel bars and horizontal bar. Other FIG disciplines include rhythmic gymnastics, trampolining and tumbling, acrobatic-gymnastics, aerobic gymnastics and parkour. Disciplines not currently recognized by FIG include wheel gymnastics, aesthetic group gymnastics, recreation gymnasts of ages 3 and up, competitive gymnasts at varying levels of skill, and world-class athletes.
Kinematics may be a branch of Newtonian mechanics that describes the motion of points, bodies objects, and systems of bodies, teams of objects while not considering the mass of every or the forces that caused the motion mechanics, as a field of study, is commonly observed because the "geometry of motion" and is sometimes seen as a branch of arithmetic. The purpose of this study was to differentiate techniques used by beginner and advanced level gymnasts in the take – off of a back salto preceded by a round-off back handspring. Six gymnasts performed multiple trials of the tumbling series, in which horizontal and vertical velocities of the center of the mass were calculated, take – off and flight times investigated and peak heights derived from the analysis. It was found that the advanced gymnasts did possess lower horizontal and vertical velocities, shorter take - off times, longer flight times, and higher saltos than the beginning gymnasts.

The present study was entitled as "Kinematical analysis of backsalto on floor exercise in gymnastics".

Methodology and procedure

Total six male Inter University Gymnasts were select as a sample for the study. The age of the samples was between 19 to 25 years. The subjects were taken from Punjabi University team who had represented at All India Inter University Championship.

The skill was further sub divided into five phases. There are

- Height of center of gravity at the initial phase
- Height of center of gravity at the approach phase
- Height of center of gravity of the take-off phase
- Height of center of gravity of the flight phase
- Height of center of gravity of the landing phase
- Time of execution (time taken during complete movements)
- Total horizontal displacement covered on floor
- Angle of left shoulder joint
- Angle of left hip joint
- Angle of left knee joint

The criterion measure for this study was the performance of the gymnasts. Total of three attempts were given to each subject. The performance of each gymnast was judged accurately and performance was recorded. The selected linear kinematical variables such as Angle of left shoulder joint, Angle of left hip joint, Angle of left knee joint, and angular kinematical variables Height of centre of gravity at the initial phase, Height of center of gravity at the approach phase, Height of center of gravity at the take off phase, Height of center of gravity at the flight phase, Height of center of gravity at the landing phase, Time of execution (time taken during complete movements), Total horizontal displacement covered on floor was taken.

Six interuniversity male gymnasts were selected as a sample. All the selected subjects were asked to perform the backsalto with their full potential and accurate technique. The gymnasts were well directed, informed and prepared for the study. Three chances were given to every gymnast. They were asked to perform the backsalto in the natural way as they actually perform. Fifty marks were given to perform accurate backsalto and it was ascertain that subjects possess reasonable level of technique. Players were video graphed with systematic filming method as required. Motion capture technique was used in this study. To recorded the video of the gymnasts, while they perform the backsalto, digital video camera (50 fps) will be using by a professional photographer. Digital Video camera was placed 7 meter away at the perpendicular to the plane of motion. The height of the camera was set at 1.49 metres.

Motion capture technique was used in this study. The films was analyzed

by using standard **"**Kinovea Software" approved by Human kinetics. Quick snap shots with the help of software for analysis of selected variables were taken.

Angles were measured through ideography technique. The videos of the gymnast were traced with the help of "Kinovea software" by using auto tracking markers on the selected body joints of gymnast. Using auto tracking markers in "kinovea software" we diagram the video of gymnast at backsalto on floor. In order to receive the complete segmental diagram 'angle finding' option was selected in the software and marks of demanded joints were connected. After completing the marking by joining different highlighted marks on the selected body joints software automatically present the measurements of required angles. Different segments were drawn to find out different angles of the body e.g. Angle of left shoulder joint, Angle of left hip joint, Angle of left knee joint, Height of centre of gravity at the initial phase, Height of center of gravity at the approach phase, Height of center of gravity at the take off phase, Height of center of gravity at the flight phase, Height of center of gravity at the landing phase, Time of execution (time taken during complete movements), Total horizontal displacement covered on floor. The kinematic analysis of gymnast performance Kinovea Software through and Karl Pearson's product moment coefficient correlation were employed with the help of statistical package of SPSS. The level of significance was set at 0.05.

Analysis and Results

Table 1: That all (Shoulder joint, Hip joint and Knees joint) in all phases

S. No.	Variables	Initial phase	Approach phase	Take of phase	Flight phase	Landing phase
1.i)	Shoulder joint (angles in degree)	11◦	67◦	146◦	52◦	88◦
1.ii)	Shoulder joint(after calculation)	.168	-.520	.133	-.699	.042
2.i)	Hip joint(angles in degree)	193◦	92◦	167◦	69◦	106◦
2.ii)	Hip joint (after calculation)	.344	.886	-.483	-.226	-.247
3.i)	Knee joint(angles in degree)	188◦	134◦	127◦	28◦	132◦
3.ii)	Knee joint (after calculation)	.304	.826	-.221	-.209	.054

***** Significant at $'r'_{0.05}(3) = 0.878$

The findings of table 1 clearly revealed that all (Shoulder joint, Hip joint and Knees joint) in all phases (Initial phase, Approach phase, Take off phase, Flight phase and Landing phase) were less than the variables the tabulated value (r=.878) at 0.05 level of significance accept Hip joint in Approach phases shown the greater value (.886) then the tabulated value. In this case the stated hypothesis was partially accepted for Angular kinematic variables with the relationship to the performance.

Table 2: Relationship of linear kinametics with the performance of the gymnast

S. No.	Variables	Correlation
1.	Centre of gravity at the initial phase	-.072
2.	Center of gravity at the approach phase	-.513
3.	Center of gravity at the take off phase	-.148
4.	Center of gravity at the flight phase	.259
5.	Center of gravity at the landing phase	-.463
6	Time of execution	.336
7.	Total horizontal displacement covered on floor	-.078

*****Significant at $'r'_{0.05}(3) = 0.878$

The findings of table also showed insignificant relationship of all the variables with the performance of the gymnasts in Back Salto on Floor Exercise, Because the value of coefficient correlation (r) was less than the tabulated value (r=.878) at 0.05 level of significant.

Conclusions

Based on the analysis and within the limitation of present study following conclusion were drawn:

1. Accept one variable, all the selected angular kinematic variables did not show any significant relationship with the performance of Backsalto on floor exercise at all the phases.
2. All the selected linear kinematic variables also did not show any significant relationship with the performance of Backsalto on floor exercise.

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