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KINEMATIC ANALYSIS OF SNATCH TECHNIQUE IN WEIGHTLIFTING

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Introduction

In the weightlifting competitions the 'snatch' is the first of the two components i.e. Snatch, Clean and Jerk. The objective of the Snatch is to lift the barbell from the ground to overhead in one continuous motion. There are four main styles of snatch i.e. squat snatch, split snatch, power snatch and muscle snatch. The squat snatch and split snatch are the most common styles used in competition while power snatch and muscle snatch are mostly used for training purposes. In the squat snatch, the lifter lifts the bar as high as possible and pulls themselves under it in a squat position to receive the bar overhead with the arms straight to clear more weight. In the split snatch, the lifter lifts the bar as high as possible and pulls themselves under the bar similar to the squat snatch but by splitting the legs by placing one foot in front and the other behind them to receive the bar at lower height. The squat snatch has become more popular among the lifters. In the power snatch, the lifter lifts the barbell as high as possible and receives the bar overhead with only a slight bend in the knee and hips. In the muscle snatch, the lifer lifts the bar all the way overhead with arms locked out and the hip and knee fully extended.

The snatch lift is usually described as having five phases. The lift begins from the Lift Off position (Starting Position), progresses through First Pull, Transition and Second Pull phases to the squat then the finish, or Hold position. The First Pull is from when athlete lifts the loaded barbell from the floor until the bar has cleared knee height. The Second Pull is from when the bar clears the knee and ends with the lower limbs in full extension. During the Second Pull the athlete extends the hips and keeps the bar as close as possible to the body. The Bar Clear is from when the lifter drops under the bar supporting it on extended arms in the full squat position to until the lifter stands. The lift finishes with the bar stable at the Hold position. Stone (1998) described the Second Pull as critical to both the Snatch and Clean lifts as it is considered the highest power phase of both lifts. Reiser *et a/.,(1996)* interpreted bar kinematics as indicative of faults in lifting technique. Successful lifts were described by Isaka *et a/.,* (1996) as those that maximized pull height after second pull and minimized the loss in height of the bar during the squat. The purpose of this study was to determine the bar plus weights and system (body plus bar plus weights) kinematics in the Snatch lift to determine the factors associated with successful lifts.

The study was conducted on the national medalists in weightlifting who are undergoing training at the weightlifting center of excellence at Acharya Nagarjuna University. This study was conducted as part of routine evaluation of the athletes during their training session.

Statement of the Problem

The purpose of the study was to find out the angles of various load bearing joints during the different phases of snatch weightlifting.

Delimitations

The study was delimited to study only the angles in weight bearing joints. The study was conducted on the weightlifters who are the national medalists, undergoing training at Acharya Nagarjuna University.

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Limitations: The data was collected only during their training sessions.

Significance of the Study

The purpose of research in physical education is to help coaches and physical educators to train their sports persons based on new concepts in improving their performance. The data provides the knowledge to the weightlifters to know the optimum angles of weight bearing joints during different phases of snatch lift. It also gives necessary inputs to the coach to compare the data with the data of their weightlifters.

Definition of the Operational Terms

Angle: The space (usually measured in degrees) between two intersecting lines or surfaces at or close to the point where they meet.

Snatch: The snatch is to lift the barbell from the ground to overhead in one continuous motion.

Weightlifting: The sport or activity of lifting barbells or other heavy weights. There are two standard lifts in modern weightlifting: the single-movement lift from floor to extended position (the *snatch*), and the two-movement lift from floor to shoulder position and from shoulders to extended position (the *clean and jerk*).

Methodology

The subjects were selected from Centre of Excellence, Acharya Nagarjuna university Weightlifting. All the three subjects chosen were the national medalists in weightlifting. The data was collected with the informed consent of the weightlifters. The data was collected during their training session on the test day when they were tested with their maximum loads.

The data was collected only for the successful three attempts with their maximum loads.

Table-1 Details about the weightlifter

	Age	Height	Maximum weight lifted
Subject 1	23	168cm	135
Subject 2	22	174cm	130
Subject 3	25	180cm	125

Instruments: JVC camera was used to collect the data. The camera was fixed in line with the weightlifting rod to view the weightlifter from the lateral view. The data was collected continuously during the session and the data of only three successful attempts were taken to analyse.

Software: Quintic 19 was used to analyse the angles. This is software to analyse the data in two dimensional studies only.

Statistical technique: Mean and standard deviations were taken to analyse the data.

Analysis of data

Starting Position: The lifter must assume a starting position in which he/she can create maximal vertical acceleration to the barbell with the least amount of effort. The moment forces acting on the hip, knee and ankle joint must be minimized in order for the lifter to separate the barbell from the floor while maintaining an ideal body position for the subsequent “2nd Pull” or “explosion.” This optimal starting posture can only be realized through proper manipulation of ankle, knee, and hip angles. Therefore, the correct starting position will depend on the lifters height, body proportions, and the grip width. These variables must be manipulated so the shoulders are over or slightly ahead of the bar at the point of lift off, the elbow joint is aligned with or in close proximity with the knee joint, and the bar is over the metatarsal-phalange joint (the 2nd joint of the toe) as is the lifters balance of pressure.

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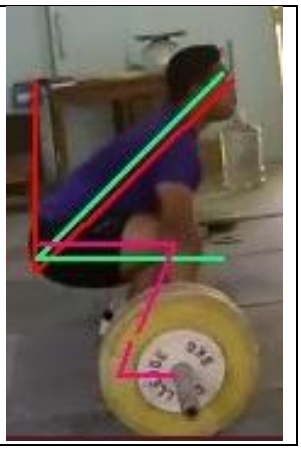
Table 2: Angles at the starting position

Areas	Approximate angle	
1.Hip	43.99° ± 1.2	
2.knee	67.38° ± 3.1	
3.Upperbody from vertical	45.72° ± 3.1	
4.Upperbody from horizontal	45.00° ± 3.0	

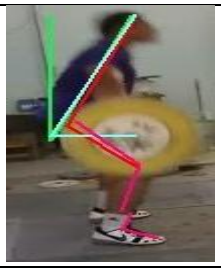
First Pull: As the bar is lifted from the floor (primarily through leg extension), the muscles which extend the torso work isometricly. This allows the hips and shoulders to rise at the same rate, moving the torso upward and slightly forward. During this initial extension of the legs the bar will shift towards the body depending on the height of the lifter and style until it reaches the lower third of the thigh.

Table 3: Angles at the First pull position

AREAS	Approximate angle	
1.Hip	83.94° ± 1.0	
2.knee	132.36°± 2.2	
3.Upperbody from vertical	41.42° ± 2.9	
4.Upperbody from horizontal	45.00° ± 2.0	
5.Ankle	97.13° ± 0.7	

Second Pull: During this phase of the pull, speed of the barbell increases due to the large applied vertical force, this produces acceleration and increased power output by the athlete. Because the moment forces on all of the largest joints of the body are so great as the legs straighten, it is imperative the barbell come back towards the lifter during the first pull. In the second phase the horizontal distance between the bar and the hips minimizes and allows proper utilization of the leg extensors. If a straight barbell path is used, the common center of gravity will be shifted forward towards the toes. This causes a large increase in the moment forces of all the working joints and a decrease in the body's ability to create the acceleration, speed and power necessary for an efficient lift.

Table 4: Angles at the First pull position

Areas	Approximate angle		
1.Hip	115.92°± 2.7		
2.knee	127.22° ± 1.9		
3.Upperbody from vertical	20.15° ± 4.1		
4.Upperbody from horizontal	63.39° ± 3.7		
5.Ankle	99.26° ± 0.5		

The data and pictures clearly indicates that there is a transition from the 1st to the 2nd pull. As the torso begins to extend toward the vertical, the bar continues to rise while the hips move toward the bar and the knees move back under the bar. During the 2nd pull or explosive phase of the pull marked by maximal vertical force, acceleration, and power output due to ankle, knee and hip extension and elevation of the shoulder girdle i.e. the point of full extension (end of the explosion) the lifter's heels leave the ground, the lifters body is extended and inclined backwards.

Conclusions

This study is only a descriptive study where the researcher has analysed the various angles of the weight bearing joints in the snatch in three phases of lift i.e. starting position, first pull and second pull only. The data indicates that the angles of the ankle, knees and hips open up from the starting position to first phase to second phase. This data provides the information related to the angles only. The coaches can utilize these as some reference point to judge the lifts of their wards. There is a need to conduct elaborative kinematic analysis of snatch lifting with more variables like speed, acceleration, angular speed, path of the bar, displacement of bar, duration of each phase of the lift for more understanding of the lift. A three dimensional analysis opens up the total kinematic data related to body and the weightlifting rod during all phases of the snatch for in depth analysis of the lift.

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