CHAPTER - II

REVIEW OF RELATED LITERATURE

In this chapter, the researcher is benefited by getting through the relevant literature and this will help him to collect an idea of what has been done with regard to the problem under study. This will help him to achieve a deep and clear perspective of the overall field. The literature in any field forms the foundation upon which all future work will be built. The researcher could not come across many reviews of related literature especially on the Kinematics and bowling in cricket. Recently there is a growing interest among biomechanics and cricket coaches to explore various kinds of kinematic variables, which comes in handy for bowling in cricket.

Max C. Stuelcken conducted a study on Kinematic analysis of offside front foot drives in elite men cricket batting. Two synchronized high speed video cameras were used to capture a total of eleven front foot offside drives played by nine international level batsmen within the ninety degree quadrant between point and stumps at the bowlers end. The video footage of the subjects, seventeen points representative of the joints of the body, six points on the bat and the ball when in view and the calibration frame were manually digitized at 125 Hz from the commencement of the back lift to fifteen frames after bat ball impact. The data then processed and values for the desired parameters were obtained. The means and some standard deviations for these parameters have been quoted for the group as a whole and compared to previous research and recommendations in the coaching literature. The result of this study shows that rather than lifting the bat in the traditional since,
the batmen utilized the bottom hand as a fulcrum and levered into the desired position. The wrist remained close to the centre of the mass and this would have allowed the mass of the bat to remain close to the base.

Pauls. Glazier, Giorgos P. Paradisis conducted a study on Anthropometric and Kinematic influences on release speed in mwn fast-medium bowling. The main aim of this study was to identify significant relationships between selected anthropometric and kinematic variables and ball release speed. Nine collegiate fast-medium bowlers (mean ± s: age 21.0 ± 0.9 years, were selected and were filmed and reconstructed three-dimensionally. Ball release speeds were measured by a previously validated speed check. Relationships between selected anthropometric variables and ball release speed and between kinematic variables and ball release speed were investigated using Pearson’s product-moment correlation coefficients (r). A significant relationship was found between the horizontal velocity during the pre-delivery stride (r = 0.728, P < 0.05) and ball release speed (31.5 ± 1.9 m·s⁻¹). The result shows that the high correlation was due to the bowlers using techniques that allowed them to contribute more of the horizontal velocity created during the run-up to ball release speed. Result also found that the angular velocity (40.6 ± 3.4 rad s⁻¹) of the right humerus had a low correlation (r = 0.358, P > 0.05) with ball release speed. There is high correlations between ball release speed and shoulder±wrist length (661 ± 31 mm; r = 0.626, P < 0.05) and ball release speed and total arm length (860 ± 36 mm; r = 0.583, P < 0.05). Study concludes that the variance in release
speed within this group may be accounted for by the difference in radial length between the axis of rotation at the glenohumeral joint and the release point.

B. C. Elliott and P H Hardcastle conducted a study on the Influence of fast bowling and physical factors on radiological features in high performance young fast bowlers. The 20 members of the Western Australian fast bowling development squad (mean age, 17.9 years), who had previously undergone routine computed tomography (CT) and magnetic resonance imaging (MRI) scans to detect the presence of bony and intervertebral disk abnormalities, acted as subjects for this study. While these radiologic data were being analyzed, these players were filmed both laterally (200 Hz) and from directly above (100 Hz) as their front foot impacted a force platform during the delivery stride of the fast bowling action. On a subsequent trial, kinetic data from the platform were recorded when their back foot impacted the force platform. In addition, these bowlers performed selected physical capacity tests. The occurrence of abnormal radiologic data was then used to group the bowlers (group 1: no abnormal radiologic features from CT or MRI scans; group 2: disk degeneration or bulging on MRI scan; group 3: spondylolysis, spondylolisthesis, or pedicle sclerosis). A Mann-Whitney U-rank test was then used to identify any significant differences (p < 0.05) between the groups for all dependent variables. Pars interarticularis and intervertebral disk abnormalities were commonly identified in this sample of fast bowlers (55 and 65%, respectively) and all players who had experienced back pain had evidence of a radiologic abnormality. No player with a normal diagnosis complained of pain. The appearance of these features was attributed to a
combination of factors rather than a single cause. Bowlers who recorded poorer hamstring or low back flexibility predisposed themselves to a disk abnormality, whereas those who delivered the ball from a high release height relative to their standing height and players who had bowled over several seasons during their growth period were predisposed to a bony abnormality. Furthermore, bowlers who used a technique that combined a front-on back foot placement and a side-on shoulder alignment were more likely to present abnormal radiologic features in the lumbar spine.

B C Elliott and J W Davis DipRG conducted a study on Disc degeneration and the young fast bowler in cricket. Twenty-four male fast bowlers of mean age 13.7 years, who bowled competitively at a school and club level, were selected from five Western Australian schools. At the time of the testing all bowlers, who were bowling completely freely, underwent magnetic resonance imaging to detect the presence of intervertebral disc abnormalities. While these radiological data were being analysed, the players were filmed both laterally (200 Hz) and from directly above (100 Hz) as their front foot impacted a force platform during the delivery stride of the fast bowling action. In addition these bowlers performed selected physical capacity tests. The occurrence of abnormal radiological data were then used to group the bowlers (group 1, no abnormal features; group 2, disc degeneration and/or bulging on scan). A Mann-Whitney U rank test was then used to identify any significant differences ($P < 0.1$) between the groups for all dependent variables. Five of the subjects recorded abnormal magnetic resonance imaging scans of the lumbar spine, while nineteen recorded
normal intervertebral discs, normal alignment of the lumbar spine, and no sign of spondylolisthesis. Bowlers who rotated the trunk to realign the shoulders to a more side-on position between back foot impact and front foot impact in the delivery stride were more likely to record abnormal intervertebral disc features.

Lee RY, Turner-Smith conducted a study on the influence of the length of lower-limb prosthesis on spinal kinematics. The main objective of the study was to examine the immediate effects of a change in prosthetic length on the kinematics of the lumbar spine in lower-limb amputees. The design was an experimental study with repeated measurements of lumbar spine movements under conditions of different prosthetic lengths. A free-standing rehabilitation center in the United Kingdom was used and the participants were Twenty unilateral below-knee amputees. Patients performed anatomic movements of the lumbar spine in standing and a sit-to-stand activity. Changes in prosthetic length were produced by placing a wooden block under the prosthetic and sound legs. The positions of the pelvis and the lumbar spine in standing and the movement patterns of the lumbar spine were recorded by an electromagnetic tracking device. Results show a change in prosthetic length produced lateral tilt of the pelvis and lateral bending of the spine in standing. The mean maximum magnitudes of lateral bending and axial rotation toward the sound and prosthetic sides were different. Subjects exhibited lateral bending and axial rotation when they performed the flexion movement. There were also changes in the direction of coupling between lateral bending and axial rotation in some subjects. The study concludes that
a change in prosthetic length or leg-length inequality altered the kinematics of the lumbar spine.

Portus MR and Rosemond CD conducted a research on Fast bowling arm actions and the illegal delivery law in men's high performance cricket matches. This study investigated the bowling arm kinematics of 21 elite fast bowlers (mean +/- SD; age = 27.8 +/- 3.9 years) while performing in test, tour and one day international matches. Thirty-one of the 34 deliveries analysed exhibited straightening at the elbow joint (straightening min = 3 degrees, max = 22 degrees, mean +/- SD = 9 +/- 5 degrees), which by strict definition in the 2000 laws of cricket made them illegal. Five deliveries from three bowlers exhibited hyperextension of the bowling elbow (19 +/- 5 degrees). When assessed against an arbitrary threshold of 15 degrees for elbow straightening, ball speeds for deliveries above this threshold (39.5 +/- 2.0 m/s) were significantly faster (effect size = 1.4; p = 0.006) than deliveries below it (37.1 +/- 1.4 m/s). When grouped by delivery length, the bouncers and short deliveries recorded more elbow straightening (12 +/- 6.6 degrees) than the good length deliveries (9 +/- 4.4 degrees) and the full deliveries (8 +/- 5.7 degrees), although these were not statistically significant differences. The results of this study support the implementation of a tolerance threshold for assessing the legality of fast bowling actions. Further research is recommended into in-match kinematic modeling, laboratory based assessments of illegal bowling actions, perceptual aspects of bowling actions and remedial methods to reduce elbow straightening in bowling actions.
Ranson C and King M conducted a study on the effect of coaching intervention on elite fast bowling technique over a two-year period. Fast bowling in cricket is an activity that is well recognized as having high injury prevalence and there has been debate regarding the most effective fast bowling technique. The aim of this study was to determine whether two-year coaching interventions conducted in a group of elite young fast bowlers resulted in fast bowling technique alteration. Selected kinematics of the bowling action of 14 elite young fast bowlers were measured using an 18-camera Vicon Motion Analysis system before and after two-year coaching interventions that addressed specific elements of fast bowling technique. Mann-Whitney tests were used to determine whether any changes in kinematic variables occurred pre- and post-intervention between those who had the coaching interventions and those who didn't. The coaching interventions, when applied, resulted in a more side-on shoulder alignment at back foot contact (BFC) \((p = 0.002)\) and decreased shoulder counter-rotation \((p = 0.001)\) however, there was no difference in the degree of change in back and front knee flexion angles or lower trunk side-flexion. This study has clearly shown that specific aspects of fast bowling technique are changeable over a two-year period in elite level fast bowlers and this may be attributed to coaching intervention.

Robert W Wainsrist conducted a study on a 22-year-old rookie pitcher of a major league baseball team. During his season he developed a rotator cuff tear. After the rehabilitation program he was able to pitch at 70% of his
full speed and a kinematics analysis was performed, utilizing the Aerial performance analysis system. Goal of the study was to determine if the subjects pitching style was dynamically contributory to excessive shoulder stress.

The subject was positioned in front of an indoor pitching range. Two cameras were utilised to film the subject at 60Hz. The camera angles were 45 degrees and 135 degrees from the throwing direction. He is noted to have a premature braking action for forward momentum. This causes him to release the ball in an upright posture that places the burden of shoulder capsule stress in the anterior compartment. The clinician must be prepared to make judgments based on objective data, when addressing the issue of returning the injured athlete to his sports.

Vassilios Panoutsakolus et al., The purpose of the present research was to present the magnitude of the kinematic parameters of the triple jump observed in male and female junior athletes regarding the technique and its effect the load subjected to junior athletes. The male (14.25 m, standard deviation, 0.7) and female (11.93m, standard deviation, 0.5) jumpers competed in the finals of the Greek National Junior Championships served as samples. Three JVC GR-DVL 9600EG (Victor Company of Japan, Ltd) and a Panasonic NV-DS29 (Matsushita Electric Industrial company, Osaka Japan) digital video cameras were used to capture the jumpers attempts and a 2D-DLT kinematic analysis was conducted. Separate independent samples students T Tests were used in order to examine the gender effects on the
kinematic parameters describing the approach, the hop, the step, the jump and the handling. The male jumpers utilized a 36.7% (1.7)-29.7% (1.6)-33.6% (1.2) hop step jump ratio, while the female jumpers used a 38.0% (1.5)-26.1% (2.6)-35.9% (2.6) phase ratio. Statistically significant differences (p<0.05) between male and female jumpers occurred concerning the horizontal and vertical velocity of the body center of mass (BCM), the length of each phase and the BCM height during the support phases. Both male and females lost approximately 35% of the BCM horizontal velocity attained during the last two strides of the approach at the instant of the take off for the jump. In comparison with the seniors, juniors seem to utilize hop dominated techniques, fail to convert successfully horizontal BCM velocity to vertical for the take offs and seems to execute the touchdowns with less pawing action of the support leg.

Milan Con, Stanislav Peharec and Peter Bacic, the study analysed and identified the major kinematic parameters of the sprint start and block acceleration that influence the result of the sprint running. The biomechanical measurements and kinematic analysis were performed on the best world’s best sprinters during his preparation for the European Athletic Championship in Goetebourg in 2006. In this competition, Matic Osovnoikar won the bronze medal in the 100-meter run and set the Slovenian national record with 10.14 sec. The kinematic parameters of the sprint start were established on the basis of a 2-D kinematic analysis using a high speed camera with a frequency of 200 frames/ seconds. The measurement of block acceleration was made by means of the track technology and an infra-red photo cell system. The
athlete performed five 29 m low start sprint under constant and controlled measurement conditions. The subject of the study was the set position from the point of view of the height of the total bodys center of gravity (TBCG). The block time of the front and the rear blocks, block velocity, the block face angle, the velocity of the TBCG in the first meters and the kinematic parameters of block acceleration in the first ten steps. The study showed the following were the key performances factors in the two phases of sprint running. Medium start block distance, block velocity, low block face angles, first step length, low vertical rise in the TBCG in the first three meters of block acceleration, contact phase/flight phase index in the first ten steps and the optimal ratio between the length and frequency in step.

Scott Simpson et.al,. conducted a study on the Kinematic similarity of the triple jump and associated training drills. The first aim of this study was to quantify the losses in horizontal momentum during the hop step transition and hence to assess the subsequent effect on performance. The second aim of the study was to identify which of the training drills used by the triple jumpers most closely match the movement patterns utilized within a triple jump performance during this critical transition. Method: The experimental setup consisted of a 12 camera Vicon TM MX13 motion analysis system sampling at 100 Hz and calibrated to the manufacturer's instructions and a force platform sampling at 1000 Hz. Three dimensional kinematic and ground reaction force data were simultaneously collected during the hop step transition phase of six triple jump performances and during the ground contact phase of eight
associated training drills for five competitive triple jumpers. Coordinators for 39 reflective markers, used with the Plug-In-Gait marker set, were reconstructed using workstation software (ViconTM version 5.2.4). Lower extremity joint angles were subsequently calculated. The frames associated with touchdown and toe-off of the hop-step transition phase were established using the ground reaction force data.

Results: The loss in horizontal momentum during the hop-step transition in the triple jump trials ranged from 3.2% to 12.2%. Based on the initial measures, it appears that the athletes with greater losses in horizontal momentum achieved greater flight distances in the step phase that followed. The joint angle time histories of the training drills performed indicate that a three side pop-up from a 30 cm raised platform most closely matched the hop-step transition in triple jump performance. Conclusion: In isolation, the loss in horizontal momentum during the hop-step transition is not appropriate as a determinant for successful performance. The conversion of horizontal to vertical momentum needs consideration when assessing the success of the transition. The movement pattern of eight training drills investigated in this study are similar to the target skill, however a kinetic analysis would provide more insights into the roles of individual and coordinated joint contributions and hence inform future training specificity.

Schot and Krutzen conducted a study on biomechanical analysis of four sprint start positions. In this study the sprint starts of 12 skilled collegiate sprinters were filmed for different sprint start conditions. Ground reaction
forces were collected for the first step out of the blocks and velocities through a two meter speed track immediately following the first support phase were recorded. The subjects employed their preferred right left leg placement in block while the anterior posterior spacing the frond block with respect to the starting line and amount of forward lean in the set position were varied. Four positions were constructed that accounted for anthropometric difference. The four positions consist of combinations of two arm orientations (forward lean and perpendicular to the ground) and two front blocks to starting line distance (launched, elongated). Kinematics data were produced to provide center of mass position and velocity measured and analysed for critical events from the first step. Kinematics records were analysed. The results indicated that the elongated starting positions resulted in greater horizontal displacement. Greater propelling impulse increased a two meter speed track arm orientation effects were less well defined forward lean tented to result in greater velocity block clearance and horizontal velocity at first step too-off, were as perpendicular arm positioning resulted in greater two meter track velocity.

Gale Gehnsen conducted a study on aging and distance running kinematics. The purpose of this study was to determine the running kinematics characteristics of long distance runners over a period of twenty years. The subject in this investigation were seventeen long distance runners who at the time of first observation were highly trained runners (running more than 50 miles per week). The second subject observation occurred between 20-23 year after the first observation. At the first time of the second
observation only three of the subjects were no longer running more that 50 miles per week. The first observation data was collected with the aid of a locum camera at film speeds ranging from 60 to 120 Hz. The film data was redigitized at the same time the second time the second observation data was digitized. The second observation data was collected with the aid of a Panasonic 5000 shutter video camera. The peak performance motion measurement system video interface allowed a 60 Hz field rate. Ten subjects ran at a speed of 2.4 m/s (7.5 Mph), Two subjects ran at 3.1 and 3.6 m/s speed and one ran at each of the following speeds 4, 4.5, 4.9 m/s.

Observation were obtained during treadmill steady state running as determined by oxygen uptake. Stride length, stride frequency, support and non-support time statistical analysis (anowa) indicated no significant difference (＞ 0.05) between the first observation and the second observation. The results of this indicated the long distance running kinematics do not change with an increase in age.

Winifred A.Witten , et.al., conducted a study on kinematic and kinetic analysis of the overgrip gaint swing on the uneven parallel bars. Fifteen elite level USGF female Gymnasts whose age ranged from 10 to 16 years were filmed performing an overgrip gaint swing on the uneven parallel bars. A video tape of each subjects performance of the over grip gaint swing, isolated from the other skills was shown to four elite and level ten judges, who independently rated the performances of this skill. Based on judges
evaluation, the top five gymnasts were placed into high skilled group. The groups were compared on selected kinematic and kinetic variables in the four quadrants of this skill. There were significance differences (PL.05) between the groups for the peak resultant linear velocity of the angle and hip. There were also significant differences for several segmental velocities and accelerations (foot, shank and arm). These differences indicates that the more highly skilled gymnasts were better able to produce faster moving body segments were a result of successfully performing a tap during quadrant 2. Gymnasts who were able to extent their hips quickly after clearing the low bar were in a position to accelerate their lower segments during quadrant 3 by slightly picking at the hips.

Glenn S. Fleisig, et.al., conducted a study on kinematic and kinetic comparison between baseball pitching and football passing. For the purpose of the study, twenty-six male quarter backs, (13 collegiate, 13 high school) and twenty-six male baseball pitchers were selected for the study as subjects. Each subject was tested with a procedure previously described (Dillman et al., 1993; Fleisig, 1994; Fleisig et al; 1995) subjects were asked to throw 10 balls in an indoor laboratory for data collection. Baseball pitchers threw from a portable pitching mound towards a strike zone ribbon located over a home plate and football quarterbacks threw drop passes from flat ground towards a target net. A three-dimensional high-speed motion analysis system was used to analyse each athlete's motion. The result of the study shows that although maximum shoulder external rotation occurred earlier for quarter backs, maximum angular velocity of pelvis rotation occurred earlier for quarterbacks,
maximum angular velocity of pelvis rotation, upper torso rotation, elbow ex tension and shoulder internal rotation occurred earlier and achieved greater magnitude for pitchers. Quarter backs had shorter strides and stood more erect to ball release. During arm cocking quarterbacks demonstrated greater allow flexing and shorter horizontal abduction. It was concluded that although the throws were qualitatively similar during the arm cocking, arm acceleration and arm deceleration phases. Quantifiable kinematic, kinematic and timing differences were found. Difference in shoulder and elbow kinetic parameters between the two throwing patterns may affect the potential for arm injury. It was also concluded that these results may help explain difference in performance and injury rates between the two sports.

Neptune and Hull conducted a study on the methods for determine hip movement in seated cycling and their effect on kinematics and kinetics. A new video based method (ASIS) presented by Neptune and Hull (1995) for locating the hip joint center (HJC) in seated cycling was shown to be more accurate than tracking a marker placed over the superior aspect of the greater trochanter(TRO). The main goal of the present study was to see if the conclusion presented in Neptune and Hull (1995) may be applied to other cyclists. Seven male cyclists viewed as a random sample from a population of competitive cyclists were selected as subjects. Lower limp kinematic and pedal force data were collected at nine combinations of pedaling rate and work rate using video encoder and pedal dynamometers. Hip joint kinematics were analysed using both TRO and ass recorded simultaneously on the right
leg using video analysis. It was analysed that ASIS produced significantly different hip joint movement pattern than TRO, which resulted in significantly different power and work calculations developed by the intersegmental hip joint force, at all combination extent one. A significant quadratic trend was evident as a function of pedaling rate and a significant linear trend was evident for work rate. It was concluded that naturally preferred pedaling rate (90rpm0 and lower work rates (<225w) the hip joint movement was minimum. It was also concluded that under these conditions the fixed hip assumption is least prone to error.

Gehsen conducted a study on aging and distance running kinematics. The purpose of this study was to determine the running kinematic characteristics of long distance runners over a period of 20 years. The subject in these investigation were 17 long distance runners who were at the time of first observation were highly trained runners (running more than 50 miles per week). The second subject observation occurred between 20-23 years after the first observation. At the time of second observation only three of the subjects were no longer running more than 50 miles per week. The first observation data was collected with the aid of a locam camera at film speed ranging from 60 to 120 HZ. The film data was redigitalised at the same time. The second observation data was collected with the aid of a Panasonic 5000 shutter video camera. The peak performance motion measurement system video interface allowed a 60 HZ field rate. Ten subjects ran at a speed of 2.4 m/s (7.5 HPH) two subjects ran at the 3.1 and 3.6 m/s speed and one ran at each of the following speeds 4.0, 4.5 and 4.9 m/s. The observation was
obtained during treadmill steady state running as determined by oxygen uptake. Stride length, Stride frequency, support and non support time statistical analysis (ANOVA) indicated no significant differences (P.0.05) between the first observation and the second observation. The result of this indicated the long distance running kinematics do not change with an increase in age.

Shibjuping studied the effect of various speeds on kinematic and kinetic factors during walking on a stair climbing machine. The purpose of this project was to explore the interaction between kinetic and kinematic factors and to investigate whether this relationship is affected by different conditions (43,60,77 and 45 equivalent 8 inch steps / min) in walking on stair climbing machines. A secondary purpose was to determine if there were any differences in terms of kinematic and kinetic factors between experienced and inexperienced subjects.

The kinematic parameters included hip flexion angle and pedal angle and the kinetic parameters studied were maximum force applied on the pedal, maximum force applied on the hand rails, maximum right hip movement and maximum right knee movement.

Twelve healthy male stair climbing machine users were tested in four different test conditions.

It was determined from the study that

1. As the speed increased, there is an increase in the force applied on the pedal both in inexperienced and experienced people.
2. Between inexperienced and experienced people, the minimum pedal angle and the maximum hip extension angle and the two main kinematic parameters which shows significant difference.

3. For the inexperienced group people, the force applied on the pedal and the movement in the knee joint is smaller than the experienced group people. But the inexperienced group people have a larger force applied on the hand rails and the movement in the hip joint.

Wainwright conducted a study on a twenty-two year old rookie pitcher of a major league baseball team. During the season he developed a rotator cuff tear. After rehabilitation programe he was able to pitch 70% of his full speed and a kinematic analysis was performed, utilizing the ariel performance analysis system. Goal of the study was to determine if the subjects pitching style was dynamically contributory to excessive shoulder stress. The subject was positioned in front of an indoor pitching range. Two camera were positioned in front of an indoor pitching range. Two cameras were utilized to film the subject at 60 Hz. The camera angles were 45 degrees and 135 degrees from the throwing direction. He is noted to have a premature braking action of forward momentum. This caused him to release the ball in an upright poster that places the burden of shoulder capsule stress in the anterior compartment. The clinician must be prepared to make judgments based on objective data, when addressing the issue of returning the injured athlete to his sports.
Nancy conducted a study on changes in sprint stride kinematics with age in masters athletes. The purpose of the study was to determine the kinematic nature of the decline in sprint velocity that has been found to occur with aging. Subjects included 162 master sprinters ranging in age from 30 to 94 years. Data were collected at a national championship meet and world veterans meet through use of video tape and the peak performance motion measurement system. From the digitalized video tape data, measures of sprint stride velocity, stride period, stride length, support time, swing time, hip knee and trunk range of motion were calculated. The result of the study reveal that velocity, stride length, flight time, swing time and range of motion in the hip and the knee all decreased significantly (PL.05) with age whereas stride period and support time increased. Further the promotional relationship between the components of the stride was significantly (PL.05) altered. It was concluded that these sprinters aged there was a decreased ability to move quickly through a full range of lower extremity motion.

Abderrehamane Rahmani, et al., conducted a study on validity and reliability of a kinematic device for measuring the force developed during squatting. This study determined the validity and reliability of the kinematic device developed by Bosco et al. (1995) by comparing peak force, peak power and peak velocity measurements to data obtained simultaneously with a force flat-form placed under the subjects feet. For the purpose of the study fifteen international male down hill skiers performed maximal half squats on a guided barbell with masses of 60-180 kg. Data are presented
as means ± standard deviations (SD). Pearson product movement correlation co-efficient (r) was used to examine the validity of the peak force, velocity and power measured by the kinematic device relative to the force plate. Inter class coefficient was calculated from ANOVA with repeated measures and scheffe post hoc(PL .5) comparisons were carried out to identify any significantly different trail. Statistical analysis shows that the coefficient of correlation (r) between the two peak forces (r = 0.85 – 0.95, P<.001) the two peak velocities (r = 0.74-0.91,P< .001) indicated that the kinematic device measurements were valid. The trail to trail reliability of the half squat exercises measured by the kinematic device gave an inter class coefficient of correlation (CR) of : 70 – 0.90 for peak force, 0.62 – 0.90 for peak velocity and 0.57 – 0.91 for peak power. There were no statistical differences between the two trails. The standard error of the mean (SEM%)was less than 5% for peak force, less than 4% for peak velocity and less than 7% for power. It was concluded that the high CR and low SEM% indicate that the kinematic device is reliable. The movement recorded by the kinematic device accurately descried the action measured by the force platform.

Michael E.Feltner et.al. , conducted a three dimensional kinematics of the throwing arm during the penalty throw in water polo. The purpose was to compute the instantaneous contributions of anatomical rotation of the trunk, upper arms, forearm and hand to ball speed and to quantify the three dimensional angular kinematics of the trunk and throwing arm during water polo players within the age group of 20.5 ± 1.3 years and with a playing
experience of 6.3 ± 1.8 years having a mass of 81.3 ± 9.5 kg and height 185.4 ± 7.0 cm served as subjects. Peak performance video analyses system was used to digitize body landmarks in each image. Mean value per subject were used to compute grand mean and standard deviation value for the sample on the discrete kinematic measures and in correlation analyses to examine relationship between the ball speed contribution and kinematic data. The largest contributors to predicted ball speed 1(VB)1 at release were forearm extension and a counter clockwise twisting rotation of the trunk. Upper arm internal rotation contribution 1 (VB)’1 at release was highly variable and exhibited a significant inverse relationship with the upper arm horizontal abduction contribution to 1 (VB)’1 at release (r = -.70). Subjects with large internal rotation contribution to 1 (VB)’1 tended to have the upper arm in position of less external rotation, but internally rotating at a faster rate, at release . Subjects with large upper arm horizontal abduction contributions to 1 (VB)’1 exhibited trend for faster rates of upper arm horizontal abduction and positions of increased forearm pronation at release. Finding suggests that a continuum to technique styles is used by water polo players to produce ball speed at release.

Max C Stuelcken conducted a study on kinematic analysis of offside front foot drives in elite men cricket batting. The purpose of this study is to identify the important parameters crucial for the successful execution of forward defense and drive of the front foot and yet conjecture and debate still appeared to exist within cricket circles over the relevance and accuracy of some coaching points. Datas were collected from 9 international level
right-handed batsmen using two synchronized high speed cameras to capture a total of eleven front foot drives played within ninety degrees quadrant between point and the stumps at the bowlers end. The video footage of the subjects (17 points representative of joint centers on the body, 6 points on the bat, and and the ball when in view) and a calibration frame were manually digitized at 125 Hz from the commencement of the back lift to fifteen frames after bat ball impact. The data was then processed and values for the desired parameters were obtained. The means and some standard deviation for these parameters have been quoted for the group as a whole and compared to previous research and recommendations in the coaching literature. The result shows the technique for the offside front foot drive that was similar in certain respects to previous batting research but other characteristics of their stroke production not previously addressed may dispel some long held beliefs in coaching literature. It was concluded that the hip alignment at the top of the back lift and the front foot placement at the completion of the stride and the distance between the front foot angle and the impact point requires further investigation.