The origin of football is vague. Games revolving around the kicking of a ball have been played in many countries throughout history. According to Federation de International Football Association (FIFA) the “very earlier from the game for which there is scientific evidence was an exercise of precisely this skillful technique dating back to the 2nd and 3rd centuries BC in China (the game of Cuju)”. In addition, the Roman game Harpastum may be a distant ancestor of football. Many other variants of the game was played in different part of medieval Europe though rules varied greatly both by period and location.

In India the game is also very popular, played and followed across length and breadth of the country. The Britishers introduced this game during the colonial period and it soon caught the fancy of the native masses and Bengal become its strong foothold Durand Cup, the third oldest football tournament in the world was started in 1898 in Shimla by the foreign secretary, Sir Mortimer Durand. Soon the number of tournaments and the spread of game both increased leading to the formation of All India Football Federation (A.I.F.A.) in 1937.

The performances of soccer players for the developed nations of the world have advanced their research in motor action for the game of soccer. The player tries to exhibit different level of speed and trajectories of the ball, all with high level of precision in execution of their skills. The only way to reach these chosen objectives is by controlling the mechanical variables, the dynamics and motor coordination of various joints and body segments especially of lower limbs. Approaching and analysing soccer phenomena in an objective manner pose no mean challenge to both professionals in soccer business and to sports science researchers.

The instep kick is the most powerful kick in the sports of soccer. Instep kicking is one of the most fundamental and frequently used skills.
Players often use instep kick more effective for maximum force and distance i.e. a long pass or a shot at goal. The inside-instep kick is another most frequently used technique when a shorter and precise pass or shot is required. The soccer instep kick and inside instep kick has received very little attention in the scientific literature till date, although it is the most frequently used during the game. Almost 60 percent of techniques used in a soccer game were instep kicks.

In India, no researches have been undertaken till date in sports biomechanics. In the computer era, the motion analysis software and programming made biomechanical research especially in kinematics, possible to read the sports motion. Hence, I have taken up this study to find out the resultant velocity of the ball in relation to kinematics variables of different level players.

**PURPOSE**

Purpose of the present study was to describe the kinematics of instep and inside instep soccer kick, determine those kinematical variables that closely related to resultant ball velocity, gain a better understanding of mechanics of the instep and inside instep kick in soccer, identify the kinematic aspects of instep and inside instep soccer kick and to understand its different mechanics and the effects of soccer kick at different joint of different level players.

**SIGNIFICANCE**

The result of this study will be a turning factors for the Indian football/ soccer players to finest their movement patterns or performances. The study will be of significant in the following ways:

1) This study will assist in an attempt to understand the effect of soccer kicking mechanics.
2) This study will provide a mechanical area of skill movement and technique of different level soccer players.

3) This study will generalize the mechanical aspect kicks (instep and inside-instep) of soccer players and ball velocity.

4) This study will contribute to analyses the perfect skill movements, segmental positions and angle of the lower limbs to bring about the maximum ball velocity.

5) This study will contribute to understand the intricacies involve in coming up with best kick performances.

6) This study will provide to be acquainted with mechanical advantages of segmental movement in kicks.

7) This study will contribute to identify the variation of lower leg segment’s joint angle and joint displacement in particular to the level of player and explicit kick type.

8) This study will contribute to identify the variation of lower leg segment’s linear velocity and angular velocity in particular to the level of player and explicit kick type.

9) This study will offer principal variation of lower leg segment to the preferred level of player and kick type to optimize the ball velocity performances.

10) This study will offer principal variation in ball velocity performances, demanded at the instant of play situation and with the type of kick.

11) This study will offer with wide variation of application of these mechanical aspects of lower leg segments or the ball velocity performances in virtual circumstance.

12) This study will provide concept of mechanics of soccer kicks to Indian athletes, trainers, physical educators and coaches.

13) This study will provide understanding of mechanical aspect in soccer kicks to athletes, trainers, physical educators and
coaches to exploit for the maximum advantages to boost kicking performance.

14) This study will provide well-defined mechanical aspect of segmental maneuvers to soccer kick performance for ball velocity to athletes, trainers, physical educators and coaches, and will be able to extract the flaws in technique/skill or ball velocity performance.

**METHODOLOGY**

The ninety-nine skilled soccer players were randomly selected for the study from different levels (i.e. high, medium and low). All the selected players had readily agreed and volunteered to act as subject for the study.

The researcher collect data of national and inter-university level players designated as high level players; state competition and inter-college tournament players for medium level players; and representing play in district competition as low level players. In order to maintain homogeneity only right-footed kickers were selected for the study. The selection of subjects of each level was done by random method, the selected subjects were initiated through concerned coaches, and later direct contacts were made. The coaches provided names of the potential players who were free of any type of injury in the lower extremities.

The subject's anthropometric measurements, the body weight of each subject were measured in kilogram using a simple weighing machine. Height was measured by a vertical ruler and segmental length as lower leg length, thigh length, foot length, were measured with the help of measuring tape in centimeters.

The subject's kicking motion were recorded using VLC Hard Disk video cameras in a field setting. The cameras were set-up on a rigid
tripod and secured to the floor in the location. In order to obtain maximum accuracy in the reconstruction of the two-dimensional coordinates, the location of the cameras were chosen in such a way that the optical axes of the cameras intersected perpendicularly on both planes namely sagittal plane and frontal plane.

One camera was positioned perpendicular to the sagittal plane and parallel to the mediolateral axis (camera optical axes perpendicular on the sagittal plane) as their kicking leg giving approximately a 90° between their respective optical axes.

Other camera was positioned five meter behind the stationary ball position with the camera’s optical axis perpendicular to the frontal plane for measuring the leg motion of players during instep and inside instep soccer kick.

The cameras were elevated 95 cms. from the ground and tilted in order to get the image of the subject as large as possible while all points of interest remained totally within movement. The camera was operated by the researcher assistant. Once the signal was given, the subject began to execute the whole range of kicking motion.

The video graphic data were collected from time to time according to the competition schedules. The video recording was loaded into the researcher’s personal computer (PC) for trail identification. The identified trail were played with the help of Hero Video of Hero Super Player 3000 software to make separate clips of each player for separate kicking skills. The separate clips were then opened on to the Motion Analysis Tool (MAT) software. This software provides to identify the angles, displacement, time and number of frames.

For identification of the subject in the video graph, each subject was given a code/number as to distinguish them in the data recorded.
For identification purposes of a best kick, the trails were viewed on the computer system with expert on the subject (football) to demarcate the trail for the data acquisition. The best trail kicks were spotted and edited for analysis.

To identify the frame of soccer kick movements for analysis has been divided into three components namely initial, contact and follow through phase. The start of the kick is defined as swing of the kicking leg until the point of hip hyperextension and maximum knee flexion. In addition, the finish of the initial phase is defined as the instant immediately before the foot makes contact with the ball. The contact phase defines as the ball contact with the kicking foot or the point of the maximum knee extension until the contact with ball. The follow through phase is explained as the point just after the ball contact until the kicking leg reach up to its maximum height or maximum hip flexion.

SOFTWARE USED FOR ANALYSIS

To analyses the video recording following softwares were used

a) Motion Analysis Tools, Version 1.1a  
b) CoralDRAW Graphics Suit 12, version 12.0.0458  
c) HeroVideo of Hero Super Player 3000  
d) Windows Picture and Fax Viewer (Window XP SP2)  
e) SPSS 13

To data analyse, Motion Analysis Tools, CoralDRAW, HeroVideo of Hero Super Player, Windows Picture and Fax Viewer and SPSS softwares were used. Coral draw was used to measure angles between different phases of different body segments with the help of freehand tools of the software. Windows Picture and Fax Viewer used for selection of initial, contact and final position frame of the subject. Hero video of hero super player was used for constructing the best-performed
kick's clips (Instep and Inside Instep) and their frames. SPSS Software used for to calculate Analysis of Variance (ANOVA) with Least Significant Difference (LSD) post hoc test to determine the means significant difference between different level players during soccer kicks.

STATISTICAL PROCEDURE

In order to test the kinematic data for the joint angle, displacement of joint axis, linear velocity and angular velocity, a two-way analysis of variance (ANOVA) was applied to obtained significance mean difference. A Least Significant Difference (LSD) post hoc test was applied in cases where “F” ratios were significant; to find-out which of the differences of the level paired means were significant.

The t-test was also computed to assess the significant difference of the ball velocity amongst different level of players in instep and inside instep soccer kick; and further between the same level of players (High-High, Medium-Medium and Low-Low).

Kinematic parameters investigated throughout the different phases of kicking motion were represented with various plots and graphs using the SPSS computer software programs.

RESULT

The results of the present investigation have been categorized under the following heading:

1) Analysis of joint angle of different level soccer player during different phases in instep and inside instep soccer kicks.

2) Displacement of various joints of different level players during different phases in instep and inside instep soccer kicks.
3) Description of angular velocity at various joints for different level players in instep and inside instep soccer kick.

4) Description in linear velocity at various joints for different level players of instep and inside instep soccer kick

5) Description of ball velocity for corresponding level players between instep and inside instep soccer kick.

**Analysis of joint angle of different level soccer player during different phases in instep and inside instep soccer kicks**

The result of the study indicated for joint angles of instep kick at initial phase for different level male soccer players that ankle and knee joint angles showed significant difference. Further the LSD post hoc revealed that at ankle joint angle- high and medium; high and low level players showed significant mean difference. For the knee joint angle- high and low level players showed significant mean difference. Joint angles of inside instep kick showed significant difference for ankle and knee joint angles. Further the LSD post hoc revealed that different level (high, medium and low) players showed significant mean difference among them in ankle joint angle. For the knee joint angle- high and medium; and high and low level players showed significant mean difference.

The result of the study indicated for joint angles of instep kick at contact phase for different level male soccer players that ankle and knee joint angles showed significant difference. Further the LSD post hoc revealed that at ankle joint angle- high and medium level players showed significant mean difference. For the knee joint angle- high and medium; high and low level players showed significant mean difference. Joint angles of inside instep kick showed significant difference for ankle and knee joint angles. Further the LSD post hoc revealed that at ankle joint angle- high and medium; high and low level players showed
significant mean difference. For the knee joint angle- high and medium; high and low level players showed significant mean difference.

The result of the study indicated for joint angles of instep kick at follow through phase for different level male soccer players that ankle and hip joint angles showed significant difference. Further the LSD post hoc revealed that at ankle joint angle- high and medium; and high and low level players showed significant mean difference. For the hip joint angle- high and medium and high and low level players showed significant mean difference. Joint angles of inside instep kick showed significant difference for ankle and hip joint angles. Further the LSD post hoc revealed that at ankle joint angle- high and medium; and high and low level players showed significant mean difference. For the hip joint angle- high and medium level players showed significant mean difference.

### Displacement of various joints of different level players during different phases in instep and inside instep soccer kicks.

The result of the study indicated for at various joints axis of different level players at initial to contact phase of instep kick that ankle and hip joint axis showed significant difference in displacement. Further the LSD post hoc revealed that high and medium; high and low level players for ankle joint axis; and high and low level players for hip joint axis showed significant mean difference in displacement. The knee joints axis of different level players showed significant difference in displacement for inside instep kick. Further it revealed that high and low level players for knee joint axis showed significant mean difference in displacement.

The result of the study indicated for displacement at various joints axis of different level players at contact to follow through phase of
instep kick that all the joint (ankle, knee and hip) axis displacement showed significant difference in displacement. Further the LSD post hoc revealed that high and medium levels; high and low levels for ankle joint axis; high and medium levels; high and low levels player for knee joint and high and medium level soccer players for hip joint axis displacement showed significant mean difference.

The ankle and knee joint axis displacement of different level players showed significant difference for inside instep kick. Further it revealed that high, medium and low level players showed significant mean difference among them for ankle and knee joints axis displacement.

**Description of angular velocity at various joints for different level players in instep and inside instep soccer kick.**

The result of the study indicated for angular velocity of ankle, knee and hip joint showed no significant difference during soccer among different level (high, medium and low) male soccer players. However the angular velocity of ankle and knee joints showed significant mean difference in inside instep kick. Further, high and medium level; and high and low level players for ankle and knee joint showed significant mean difference.

**Description in linear velocity at various joints for different level players of instep and inside instep soccer kick**

The result of the study indicated for linear velocity at various joints of different level players of instep kick that linear velocity of ankle, knee and hip joints showed significant mean difference. Further, high and medium level and high and low level players at ankle and knee joint and high and medium level player at hip joint showed significant
mean difference. Whereas, during inside instep kick among different level players showed no significant difference.

**Description of ball velocity of different level players and for corresponding level players of instep and inside instep soccer kick.**

The result of the study indicated for ball velocity of different level players showed significant mean difference during instep soccer kick. The high and medium; and high and low level players showed significant mean difference in their ball velocity. During inside instep soccer kick, the ball velocity of among different level players showed significant mean difference.

**Ball velocity between Instep and Inside-Instep kick**

The comparison of means of ball velocity of high, medium, and low level soccer players during instep and inside instep kick have shown significant difference.

**DISCUSSION**

The most important reflections of the study are that the instep and inside instep soccer kicks differ in their kinematical applications; the kinematical variables undertaken for the instep and inside instep soccer kicks of different level of players; the ball velocity amongst different level players and ball velocity between corresponding levels of instep and inside instep soccer kicks have shown significant differences. The finding of this study is analogous to some of the previous study. From the result of the study it can be stated that kinematic variables is responsible for variation in ball velocity during instep as well as in inside instep soccer kicks. Thus, the kinematic (joint angles, displacement, linear velocity and angular velocity of ankle, knee and hip) variations resulted from the analysis of the study must needs to be
considered for correction, training and other factors to enhance the
kicking performance in ball velocity of different level soccer player in
instep and inside instep kick.

RECOMMENDATION

Based on the findings of study and literature reviewed, the following
recommendations can be made in Indian prospective:

1. A similar study may be conducted in laboratory set-up.
2. A similar study can be undertaken with greater number of
   biomechanical variables and considering total body segments.
3. A similar study may be conducted to investigate separately for
   upper and lower body kinematics during various soccer kicks.
4. A similar study may be conducted considering both kinetic and
   kinematic variables.
5. A similar study may be conducted to investigate other
   technique/skill (variations) of soccer kick.
6. A similar study may be conducted in three dimensional analyses
   process and with higher degree of freedom.
7. A similar study may be conducted for Indian woman soccer
   players.
8. A similar study may be conducted with different population, sex
   and age groups at different skill levels.
9. A similar study may be conducted considering Indian
   international level players.
10. A similar study may be conducted to compare considering Indian
    international to world class level players (Europeans, Africans,
    etc.). This would provide invariant parameters for the study.
11. A similar study may be conducted with sophisticated equipments
    and subjects of higher level, taking bigger sample and with
    greater number of variables.