Chapter I

INTRODUCTION

In recent years, there has been a remarkable expansion of sports science. Sports science offers methods by which the very fast actions, which occur in sports, can be recorded and analysed in detail. There are various reasons for doing this. One is to understand the general mechanical effectiveness of the movements, another is the detailed description of the skill, yet another is an analysis of the factors underlying successful performance.

The subject area is now recognized both as an academic discipline and a valid area of professional practice in physical education and sports. Sports science is well respected within its parent discipline, for example, physiology, biochemistry, biomechanics, psychology, sociology and so on. A new maturity became apparent as a sports sciences were increasingly applied to address problems in a particular sports rather than to sports in general. One of the specific applications has been to soccer.
The applications of science to soccer predated the formal acceptance of sports science as an area of study in university programmes. National teams of various countries all over the globes used specialists in psychology, physiology, nutrition and conditioning in the preparation of squad for the major international tournament from the early 1970's. The comprehensive systems of scientific support accessible to European, South American and Australian Soccer Teams. In 1980's it became apparent that, the football industry and professionals in the game could no longer rely on the traditional methods of previous decades. Coaches and trainers were more open to contemporary scientific approach to prepare for competition. Still efforts have been made by various universities to compile scientific knowledge, expertise and make them more widely available to the soccer community. In recent years, majority of professional soccer clubs all over the world have employed sports scientists in the quest for competitive edge.

Many actions in the game of soccer are forceful and explosive, for example, tackling, jumping, kicking, turning and changing pace. The power out put during such activities is related to the strength of muscles involved in the movements. Thus it is beneficial for the soccer
player to have a high level of muscular strength, which can be obtained by strength training.

Strength in the lower limbs is of obvious concern in soccer; the quadriceps, hamstrings, plantar and dorsi flexor muscles must generate great force for jumping, kicking, tackling, turning and changing pace. The ability to sustain it forceful contraction is also important in maintaining balance and control. Isometric strength is possibly important in maintaining a player’s balance on a slippery pitch and it also contributes to ball control. For a goal keeper almost all the muscle groups are important for executing skills. In the case of out field players the lower part of the trunk, the hip flexors, plantar flexors and dorsi flexors of the ankle are used most. Upper body strength is employed in throwing, and strength of the neck flexors could be important in forcefully heading the ball. At least a moderate level of upper body part should prove helpful in preventing, from being knocked of the ball.

One essential function of the muscles is to protect and stabilize the joints of the skeletal system. Hence, the strength training is of importance in preventing injuries as well as reoccurrence of injuries. A prolonged period of inactivity such as during recovery from injury will
considerably weaken the muscles. Before a player returns to soccer training after an injury, a period of strength training is needed. The time required to regain strength depends on the duration of the inactive period but generally several weeks are needed. For a group of players who were observed two years after a knee operation, it was found that the average strength of the quadriceps muscles of the injured leg was only 75% of the other leg (Eskstrand, 1982).

The over all aims of muscle strength training in soccer is to develop a player’s muscular make up. The specific aims of muscle strength training in soccer are:

1. To increase muscle power output during explosive activities in a soccer match such as tackling, jumping and accelerating.

2. To prevent injuries.

3. To regain strength after injury.

Strength training can result in hypertrophy of the muscle, partly through an enlargement of muscle fibres. In addition, training with high resistance can change the fibre type distribution in the direction of more fast twitch fibres (Anderson et al. 1992). There is also a neuromotor effect of strength training and part of the increase in
muscle strength can be attributed to changes in nervous system. Improvement in muscular strength during isolated movements seems closely related to training speeds. However, significant increases in force development at very high speed (10-18 rad/sec) have also been observed with slow speed high resistance training (Aagard. et al. 1993).

Various studies have focussed on the effectiveness of strength training for soccer players. Significant increase in strength of the leg muscles leads only to a minor or no improvement in kick performance (DeProft et al. 1998; Aagaard et al. 1993). This illustrates that a player’s ability to produce force during a soccer activity is not solely dependent up on the strength of the muscles involved in the movement, but also influenced by the player’s ability to co-ordinate the muscle actions. Therefore, to utilize improvement in muscle strength effectively during the match play, it is important to combine strength training with technical training to enhance the synchronisation of force development between the agonist and antagonist muscles in movements specific to soccer. Some studies have indicated a relationship between dynamic muscle performance in laboratory and field contexts. Asami and Togari (1968) reported a significant
correlation between the knee extension power and ball speed in instep kicking, both show increase with experience in the game. Cabri et al. (1988) also reported a significant relation between leg strength, measured as peak torque during an isokinetic movement and kick performance indicated by the distance the ball travelled. The relationship was significant for both eccentric and concentric contractions of hip and knee joints in flexion and extension. Soccer players have greater fast speed capabilities than normal players (Oberg et al. 1986) and this may be an important determinant of technique in kicking the ball.

Since, fitness requirements tend to vary with positional roles, muscle strength values may depend on the player’s position. Goalkeepers and defenders were found by Oberg et al. (1984) to have higher knee extension torque at 0.52 rad/s than mid field players and forwards. The result was attributable to differences in body size since correction for the body surface area removed the positional effect.

Different methods of training are being followed by coaches and trainers to develop strength of the soccer player. According to experts, the most commonly used methods in the strength-training programme of soccer players are circuit training and weight training. It is also
reported by experts that most suitable method for the development of explosive strength of football players is the repetition method. Weight training is mainly carried out by employing isotonic method. In modern days isokinetic training method is also being employed using isokinetic machines such as Cybex 340. The isotonic method is used for developing maximum strength and explosive strength endurance. Maximum strength and explosive strength are developed by training for peak torque and torque acceleration energy in isokinetic machines.

Though there were a number of research findings on strength training of soccer players employing isotonic methods and their influence on kicking performance, but the researcher came across very few research reports about isokinetic training for strength and explosive strength of soccer players. Cabri et al. (1988) had reported that isokinetic training would improve the kicking performance of soccer players. It was also opined by the investigator that isokinetic training might improve the power of soccer players more and hence improve the speed and accuracy of kicking in soccer. Since no research study was conducted to know the effect of isokinetic and isotonic strength training on soccer skill performance in India so far, the researcher was motivated to carry out a study to compare the effect of
different strength training programmes on the performance of soccer skills.

**Statement of Problem**

"Effect of eight-weeks Isokinetic and Isotonic strength-training of lower limbs on peak torque, torque acceleration energy, average power and their relationship with selected soccer techniques".

**Delimitation**

1. Strength training by both isokinetic and isotonic methods was delimited to the lower limbs of soccer players.

2. Soccer technique was delimited to kicking with the instep of the foot and the inner instep of the foot.

3. The study was delimited to the variables peak torque, torque acceleration energy, average power, kicking with the instep of the foot for distance and accuracy, and kicking with inner instep of the foot for distance and accuracy.

4. Kicking ability was studied only from two aspects:
   a. Kicking for distance with right and left foot.
   b. Kicking for accuracy with right and left foot.
5. The study was delimited to the following variables:

   a. Peak torque at 45°/sec.
      Hip flexion/extension, Knee flexion/extension (60°/sec), Ankle plantar/dorsiflexion.

   b. Torque acceleration energy at 180°/sec.
      Hip flexion/extension, Knee flexion/extension, Ankle plantar/dorsiflexion.

   c. Average Power at 180°/sec.
      Hip flexion/extension, Knee flexion/extension, Ankle plantar/dorsiflexion.

**Limitations**

1. The tests could not be carried out on all the subjects on the same day because of the long testing procedure.

2. Subjects for the study were not of the same level.

3. Other factors like food, living conditions, and the pre-training state were not the same for all subjects.
Hypotheses

1. Isokinetic training will improve the performance in peak torque, torque acceleration energy, average power of joint actions of hip, knee and ankle joints.

2. Isotonic training will improve the performance in peak torque, torque acceleration energy, average power of joint actions of hip, knee and ankle joint.

3. Isokinetic and Isotonic training will improve kicking performance in soccer in terms of accuracy and distance.

4. There will not be significant difference in the effect of isotonic and isokinetic training programme in the improvement of peak torque, torque acceleration energy and average power of the joint actions of hip, knee and ankle joints and in the performance in the selected soccer techniques.

5. There will be positive correlation between the effects of isotonic and isokinetic training on selected soccer techniques.
Definition and explanation of terms

Peak Torque

“Peak torque is the highest torque value seen from all repetitions and all points in the range of motion. The unit of measure used is ft-lbs. “Peak torque is the indicative of maximum muscular tension capability”. Cybex user’s manual (page No.5-4).

Torque Acceleration Energy (TAE)

“Torque acceleration energy is the amount of energy expended (work performed) in the first 1/8 second of torque production. TAE is indicative of muscular “explosiveness”. The unit of measure is foot lbs.” Cybex user’s manual (page No.5-5).

Average Power (BWR)

“BWR” signifies that the average power is calculated from the best work rep. Average power is an expression of work per unit time and is an accurate indicator of the subject’s actual work rate intensity. The unit of measure used is watts.” Cybex user’s manual (page No.5-6).
**Isokinetic Resistance**

In simpler terms, Isokinetic resistance is the opposite of isotonic resistance. Isotonic exercise is a work against a fixed amount of resistance at a variable, unknown and uncontrolled speed. With an isokinetic machine, the athlete works at a fixed velocity selected by the clinician, against resistance that automatically accommodates to whatever forces the athlete is capable of producing at any point in the range of motion.

**Advantages:**

1. Permits isolation of weak muscle groups.
2. Accommodating resistance provides maximal resistance throughout the exercise range of motion
3. Accommodating resistance provides inherent safety mechanism.
4. Permits quantification of torque, work and power.

**Disadvantages:**

1. Reliable assessment is limited to isolated muscle groups through cardinal planes of motion.
2. Exercise occurs primarily from weight non-bearing open-kinetic-chain positions.
3. Cost of equipment may be prohibitive for some settings.

*Isotonic resistance*

An exercise is considered isotonic when the segment moves a specified weight through a range of motion. Although the weight of the barbell or body segment is constant, the actual load imposed on the muscle varies throughout the range of motion. An isotonic movement can be produced with an eccentric or concentric muscle action.

*Advantages:*

1. Includes a natural component of concentric and eccentric resistance.
2. Positive reinforcement from progressive increase in resistance.
3. Is easily performed from weight-bearing closed-kinetic-chain positions.

Disadvantages

1. Amount of resistance is limited to weakest point in the range of motion.
2. Inability to quantify torque, work and power.
3. Stronger muscles may compensate for weaker muscle groups during closed kinetic chain exercise.
Cybex 340

The Cybex 340 is the released isokinetic system that is a multiple set up from the older model, the Cybex-II. The system includes improved computer enhancement, electronics, mechanical features and stabilization. The Cybex 340 software now gives the clinician clinical information in colour graphic form with speed, versatility and multiple capabilities.

Orthotron II Isokinetic System

The ORTHOTRON II is an isolated joint, reciprocal, and Isokinetic system for Knee, ankle, shoulder and hip exercises. Literally millions of patients’ treatment in physical therapy and athletic training facilities have established the original orthotron as the most widely used exercise rehabilitation system and have proved its safety and effectiveness. It provides more exercise patterns with superior positioning and stabilization in every pattern. It is most versatile and easy to use rehabilitation system available. It easily and quickly adjusts to accommodate the largest and smallest athlete. It is ideal for children and geriatric patients, yet easily handles the biggest, strongest sports medicine cases in the final stage of rehabilitation.
Significance of the Study

1. The results of the study may reveal whether the strength training increase the accuracy in kicking or not and which type of training is more conducive for its development.

2. The findings of the study may help to find out which type of training is better improves peak torque, torque acceleration energy and power, known to be one of the important factors in soccer playing ability.

3. The findings of the study may help to find out which type of training is better to improve kicking with the instep of the foot and inner instep of the foot.

4. This study may add to the guidelines and information about means & methods suitable for developing strength and kicking performance of soccer players.