Chapter III

PROCEDURE

Selection of the Subjects

Thirty-three soccer players from Punjab Police, Patiala Division Football team and students from football discipline of the Regular Diploma course of Sports Authority of India, Netaji Subhas National Institute of Sports, Patiala, volunteered to participate as subjects for this study. Subjects included four national players, nine university players, two services players, two players of school nationals, eight district players of senior division, three-district player of junior division, two national players of junior level and three district level school players. Hence, all the subjects were regarded as having a reasonably good standard of performance in soccer.

All the subjects were well conditioned and were considered fit enough to undergo strenuous Isokinetic and Isotonic strength training. The mean value and standard deviation of decimal age, height and weight of all the thirty-three players were $24.00 \pm 5.36$ yrs, $168.27 \pm 6.73$
cm and 59.06±5.96 k.g respectively. The physical characteristics of all the research groups are presented in Table No.1

Table No. 1

PHYSICAL CHARACTERISTICS OF THE SUBJECTS

<table>
<thead>
<tr>
<th>Group/Subject</th>
<th>Number</th>
<th>Decimal Age (yrs)</th>
<th>Height (cm)</th>
<th>Weight (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean ± S.D</td>
<td>Mean ± S.D</td>
<td>Mean ± S.D</td>
<td></td>
</tr>
<tr>
<td>Isokinetic</td>
<td>11</td>
<td>23.34 ± 3.66</td>
<td>172.5 ± 5.28</td>
<td>61.36 ± 4.74</td>
</tr>
<tr>
<td>Isotonic</td>
<td>11</td>
<td>27.25 ± 4.61</td>
<td>167.90 ± 6.7</td>
<td>60.5 ± 5.77</td>
</tr>
<tr>
<td>Control</td>
<td>11</td>
<td>27.42 ± 5.85</td>
<td>164.36 ± 5.41</td>
<td>55.27 ± 5.39</td>
</tr>
<tr>
<td>Total</td>
<td>33</td>
<td>24±5.36</td>
<td>168.27±6.7</td>
<td>59.06±5.96</td>
</tr>
</tbody>
</table>

Research Design

For this experimental study, the subjects were randomly divided into two experimental groups and one control group of eleven subjects each. The experimental group A identified as Isokinetic training group (IK), was trained in ORTHOTRON II Isokinetic exercise system designed for Hip, Knee and ankle joint training. The experimental group B known as Isotonic group (IT), trained with weights and barbells as per the planned programme, control group C (CG) was given only technical training along with Isokinetic and Isotonic groups.
The subjects of all the three groups were assessed on their peak torque, torque acceleration energy, average power and soccer skill performance before starting the training (Pre-test) and also after completion of eight weeks training (post-test).

**Variables Assessed and Tests Used**

**Peak torque (PT)** is the highest torque value seen from all repetitions and all points in the range of motion and is indicative of maximum muscular tension capability which is measured through Cybex 340 Isokinetic dynamometer as described in Cybex user’s manual (page No.5-4).

**Torque acceleration energy** is calculated by the Cybex 340 as the amount of energy expanded (work performed) in the first 1/8 second of torque production. TAE is indicative of muscular “explosiveness” as described in Cybex user’s manual (page No. 5-5).

**Average power (BWR)** - The “BWR” signifies the average power calculated from best work repetition. Average power is an expression of work per unit time and is an accurate indicator of a subject’s work intensity. The unit of measure used is watts specifically, the Cybex 340 divides the amount of work performed in the best work
repetition by the actual contraction time as described in Cybex user's manual (page No.5-6).

Soccer skills, kicking for distance and accuracy with instep and inner instep of right leg as well as left leg was also assessed.

Tests to Measure Peak Torque of Different Joints

Peak torque is measured by testing slow contractile velocity and in the context of Isokinetic testing it is defined as any velocity at or below 60°/sec. Therefore, speed for the test is fixed at or lower than 60°/sec. The commonly used speeds are 30°/sec., 45°/sec. and 60°/sec. The recommended numbers of repetitions are 10 reps x 3 sets or 5 reps x 3 sets, Davis et al. (1986). The optimal number of repetitions to increase peak torque with Isokinetic training has to be in accordance with body weight ratios. (COMPRENDIUM OF ISOKINETICS).

Hip Joint

This test was carried out following standard protocols of Isokinetic exercise with the speeds of 45°/sec, 60°/sec, and 180°/sec, but for testing of the peak torque slow contractile speed of 45°/sec was used and a proper warming up was given prior to the testing. The dynamometer was made to face front with zero degree tilt. The long
input adapter was attached to the dynamometer and adjustable arm was
installed on it. Thigh pad was attached on the adjustable arms and the
extended end of the pad was made to point towards the dynamometer.
The position of U.B.X.T was fixed parallel to positioning chairs. The
backrest and seat were set to the lowest position and U.B.X.T was kept
in front of the dynamometer.

The subject was asked to lie supine on U.B.X.T with the limbs
to be tested closer to dynamometer. Pelvic and torso belts were secured
tightly and Velcro belt attached to thigh pad just above the knee of the
leg to be tested and then UBXT were locked. The subjects were
instructed to begin the test in full flexion and care was also taken not to
exert extensor force with a jerk. Following the instructions hip flexors
and extensors were tested, and prior to testing, four trials were given in
order to get the subjects acquainted with the mode of performing the
task in 45°/sec and after adequate rest finally the test was conducted
and repeated thrice. After 20 sec rest similar procedure was followed at
60°/sec. Prior to the actual test four trials were given and finally the
test was repeated 20 times. The stabilizing belts were removed and the
subject was given adequate rest, the same procedure was followed to
test the left leg. Repositioning U.B.X.T and accessories are moved to
opposite side, to test contra lateral limbs. The setting of the test on the Cybex 340 was done and as described in Cybex user's manual (page No. 6-9 to 6-12).

![Testing of Hip Flexor & Extensor in Cybex 340](image)

**FIG 1: TESTING OF HIP FLEXOR & EXTENSOR IN CYBEX 340**

**Knee Joint**

This test is carried at three suggested speed settings of 60°/sec., 180°/sec., and 240°/sec after giving proper warming up as designed and planned before testing. However for testing of Peak torque 60°/sec was used viewing the nature of velocity of knee joint in soccer kicking. The dynamometer was rotated to the side to be tested and maintained zero degree tilt. The subject was seated as far back on the seat as
possible with the knee flexed to at least 90° arms crossed over the chest. The knee to be tested was kept close to the dynamometer. The back seat was adjusted to support the subject in a comfortable position or with the trunk at the desired angle for testing. The axis of rotation was aligned to moving the seat forward or backward. Long input adapter was attached to the dynamometer and adjustable arms were slided inside the long input adapter. The shin pad was attached to the adjustable arm handle and position of it was adjusted on the leg. The bottom edge of the shin pad was strapped just above the superior border of medial malleolus. To prevent slippage, the shin pad strapped to subject’s leg with Velcro belt was secured as tightly as tolerable. The subject was stabilized from pelvic and torso by tightly securing the three point safety and lap belt. The subjects were instructed to begin the test in full flexion with the heel touching the kick pad. For each player a new file was opened and bio data of the players was entered. Following the standard instruction and procedure, right quadriceps and hamstring muscles were tested at 60°/sec. Prior to the test four trials were given in order to get the subject acquainted with the mode of performing the task and after adequate rest, final test was conducted with 20 repetitions and repeated thrice. The stabilizing belts were removed and subject was given adequate test and then the same
procedure was followed for left leg as described in Cybex user's manual (page No7-4 to 7-8.). After completion of the test the data collected was transferred to the hard disc of the computer and print outs were taken.

FIG. 2 : TESTING OF KNEE FLEXOR & EXTENSOR IN CYBEX 340

Ankle Joint

This test carried at three speeds 45°/sec., 60°/sec and 180°/sec. However to assess peak torque 45°/sec was used. The dynamometer faced forward and maintained a zero degree tilt and the short input adapter was attached to the dynamometer, and simultaneously the knob
was locked. The plantar/dorsiflexion footplate was installed in the short input adapter. The position of the U.B.X.T like back rest was moved to the lowest position, seat to the highest position, U.B.X.T parallel to the position of chair and seat end of U.B.X.T. closet to the dynamometer. After that the thigh stabilization attachment was installed, with the cushion side of the pad facing inside of the limb to be tested so that the angle of the pad may be altered by loosening the large locking knob on the shaft directly behind the pad. Foot-rest was also installed in U.B.X.T. The setting of the test on the Cybex 340 was done as described in Cybex user’s manual.

The subject was instructed to lie supine on U.B.X.T with the ankle to be tested closest to the dynamometer. After warming up the subject positioned in such a way that knee is flexed at 90° and ankle was neither inverted (adducted) nor everted (abducted) when the foot was flat on footplate. Torso was stabilized by torso stabilization belt and pelvis with pelvic stabilization belt. The two ankle plantar/dorsiflexion footplate belts, were strapped as tight as tolerable by the subjects. It is vital to keep the heel down and flush against the heel stop. To prevent foot slippage on the footplate, the subjects wore flat tennis style shoes. Thigh stabilization pad was proximal to the knee
with the belt tightly secured. The test was started in full dorsiflexion in
45°/sec. Before the test, on each speed, a trial of 4 repetitions was
given to the subject to get acquainted with the mode of performing the
task and after adequate rest; the final test was conducted and repeated
20 times. After the completion of the test, the stabilizing belts were
removed and subjects were given adequate rest and then U.B.X.T and
accessories were repositioned to test the contra lateral limbs as
described in Cybex user's manual (page No.8-16 to 8-20). After the
completion of the test, the data collected was transferred to the hard
disc of the computer and print outs were taken.

FIG. 3: TESTING OF ANKLE PLANTAR & DORSI FLEXOR IN
CYBEX 340
Test to Measure Torque Acceleration Energy and Average Power of Different Joints

Torque acceleration energy and average power is tested by measuring the fast contractile velocity and in the context of IsoKinetic training, any test faster than 60°/sec is considered as power test. Power is defined as the ability to produce force through ROM in a particular time; so, torque acceleration energy is considered as power variable, which measures the amount of work, performed in the first 1/8 sec of torque production. Therefore, testing at a functional speed, i.e., 180°/sec - 300°/sec, is considered to be more important because angular velocities of various activities including sports are very fast. The optimal number of repetitions recommended is 10 reps x 3 sets at 180°/sec., Davis, et al (1987). The optimal number of repetitions to be used with Isokinetic training to increase the average power is followed as given in the compendium of Isokinetic.

Hip Joint

The test carried out by standard protocols of Isokinetic exercise with the speeds, of 45°/sec., 60°/sec and 180°/sec and a proper warming up was given prior to the testing. However for testing of
torque acceleration energy and average power in particular, the fast contractile speed of 180°/sec was used. The dynamometer was faced forward with 0 degree tilt. The long input adapter was attached to the dynamometer and the adjustable arm was installed on it. This pad was attached on the adjustable arm and the extended end of the pad pointed towards the dynamometer. The position of U.B.X.T was fixed parallel to the positions of chairs. The backrest and seat was set to lowest position and U.B.X.T was kept in front of the dynamometer.

The subject was asked to lie supine on U.B.X.T with the limbs to be tested closer to the dynamometer. Pelvic and torso belts were tightly secured and Velcro belt was attached to the thigh pad just above the knee of the leg to be tested and then U.B.X.T was locked. The subjects were instructed to begin the test in full flexion, care was taken not to exert extensive force with a jerk. As per the instructions, hip flexors and extensors were tested and prior to testing, four trials were given in order to get the subjects acquainted with the mode of performing the task in 45°/sec and after adequate rest the final test was conducted and repeated thrice. After 20 sec rest similar procedure was repeated at 60°/sec and in 180°/sec. Four trials were given and finally the test was repeated 20 times. The stabilizing belts were removed and
the subjects were given adequate rest and then the same procedure was followed to test the left leg. Repositioning U.B.X.T and accessories moved to opposite side, to test contra lateral limbs.

**Knee Joint**

This test is carried at three suggested speed settings of 60°/sec, 180°/sec., and 240°/sec after giving proper warming up as designed and planned before testing. However for testing torque acceleration energy and average power the fast contractile speed of 180°/sec and 240°/sec was used. The dynamometer was rotated to the side to be tested and maintained at zero degree tilt. The subject was seated as far back on the seat as possible with the knee flexed to at least 90°, arms crossed over the chest. The knee to be tested was kept close to the dynamometer. The back seat was adjusted to support the subject in a comfortable position with the trunk at the desired angle for testing. The axis of rotation was aligned by moving the seat forward and backward. Long input adapter was attached to the dynamometer and adjustable arms were slided inside the long input adapter. The shin pad was attached to the adjustable arm handle and its position was adjusted on the leg. The bottom edge of the shin pad was strapped just above the superior border of the medial malleolus. To prevent slippage, the skin
pad was strapped to subject’s leg with Velcro belt as tightly as tolerable. The subject was stabilized from pelvis and torso by tightly securing the three-point safety and lap belts. The subjects were instructed to begin test in full flexion with the heel touching the kick pad. For each player a new file was opened and biodata of the player was entered. Following the standard instruction and procedure, right quadriceps and hamstring muscles were tested at 60°/sec. Prior to the test four trials were given in order to get the subjects acquainted with the mode of performing the task and after adequate rest, final test was conducted and repeated thrice. After 20 sec rest similar recording was made at 180°/sec and for 240°/sec, four trials were given and final test was repeated 20 times. The stabilizing belts were removed and subject was given adequate rest and then the same procedure was followed for left leg. After the completion of the test, the data collected was transferred to the hard disc of the computer and print outs were taken.

**Ankle Joint**

This test is carried out at three speeds 45°/sec, 60°/sec, and 180°/sec. However to assess torque acceleration energy and average power, the fast contractile speed of 180°/sec was chosen. The dynamometer was kept facing forward and maintained zero degree tilt,
and the short input adapter was attached to the dynamometer. Simultaneously, knob was locked. The plantar flexor & Dorsi flexor footplate was installed in short input adapter. The position of the U.B.X.T backrest was moved to the lowest position, seat to the highest position, U.B.X.T parallel to the position of chair and seat and U.B.X.T close to the dynamometer. After that the thigh stabilization attachment was installed with the cushion side of the pad facing inside of the limbs to be tested and angle of pad was altered by loosening the large locking knob on the shaft directly behind the pad. Foot-rest was also installed in U.B.X.T.

The subject was instructed to lie supine on U.B.X.T with the ankle to be tested close to the dynamometer. After warming up, subjects positioned in such a way that the knee was flexed at 90° and the ankle was neither inverted (adducted) nor everted (abducted), when foot was flat on footplate. Torso was stabilized by torso stabilization belt. The two ankle plantar and dorsi flexion footplate belts were strapped as tight as tolerable by the subjects. It is vital to keep the heel down and flush against the heel stop. To prevent foot slippage on the footplate, the subject wore flat tennis style shoes. Thigh stabilization pad was proximal to knee with belt tightly secured. The test was started
in full dorsiflexion in 45°/sec., 60°/sec and 180°/sec. Before the test, on
each speed a trial of 4 repetitions, given to the subject to get acquainted
with the mode of performing the task and after adequate rest, final test
was conducted and repeated thrice. After 20 sec rest similar recordings
were made in other speed and final test was repeated 20 times. After
the completion of the test, the stabilizing belts were removed and
subjects were given adequate rest and then U.B.X.T accessories were
repositioned to test the contra lateral limbs. After the completion of the
test, the data collected was transferred to the hard disc of the computer
and print outs were taken.

**Soccer Skill Tests**

*Kicking with the inner instep of the foot for distance*

As per the instructions of the test constructed by Warner
(1950), a sector (lane) of 25 yards wide was marked on the football
field as shown in figure. The subject had to kick a stationary ball with
his right foot, which must stay with in the lane as shown in figure no.4
(page no. 65). The distance covered by the ball in the air was measured
and the spot at which the ball dropped was noted and marked. Each
subject was given three trials.
Scoring: The distance of the kick from the spot to the first bounce was recorded and the best of three kicks measured to the nearest yard was taken as the test score. The test was administered exactly in the same way as kicking with the left foot.

*Kicking with the inner instep of the foot for accuracy*

The test which was designed by Crew (1968) was used. Four circles with radius of 4, 8, 12 and 16 feet were marked on a suitable flat surface with the centre of the target 20 yards from the restraining line as shown in figure no. 5 (on page no.66). The subject was asked to kick the stationary ball through the air with the right foot so that it lands on the target.

---

**Fig.4: KICKING FOR DISTANCE WITH INNER INSTEP OF THE FOOT**
Fig. 5: KICKING FOR ACCURACY WITH THE INNER INSTEP OF THE FOOT

Fig. 6: KICKING FOR ACCURACY WITH THE INSTEP OF THE FOOT
Fig. 7: KICKING FOR DISTANCE WITH INSTEP OF THE FOOT

Each kick was scored according to where the ball initially contacted the target area. No point was awarded if the ball did not land in the target area. Ten kicks constituted a trial and each individual was given two trials. When the ball hit a line, the subject was awarded the higher of two scores. The total number of points for the two trials was the subject’s score. Similar procedure and scoring system was followed for kicking with left leg.
Kicking for accuracy with Instep of the foot

The test, which was published by SAI, was adapted to measure kicking accuracy with the instep of the foot. The goal was divided into three equal parts vertically namely right, middle and left parts with the help of a string as shown in the figure no.6 (page no. 66). A stationary ball was to be kicked with the right foot into predetermined part of the goal from the middle of the penalty area line. Out of a total of ten attempts, four were to be kicked into the right part of the goal, four into the left part of the goal and two in the centre. The following was the sequence of the kicks. The first two kicks into the right part, followed by one kick into the middle part of the goal, followed by two kicks into the left part of the goal. The same sequence was to be repeated once again making the total number of kick ten. The ball must cross the goal line in the air to have the desired speed and force in kicks. The total number of correctly executed kicks was the subject’s score. Similar procedure and scoring system was followed for kicking with left leg as described in the Booklet of Sports Authority of India (Page No. 71).
**Kicking with Instep of the Foot for Distance**

A ball was kept in the middle of the goal area line. The subject was asked to kick with the instep of the foot for maximum distance so that the ball rolled on the ground. Each kick was measured in yards when the ball stops. Three trials were given for each leg and best of three trials of both the legs were taken as the test score. Cabri, 1988: DeProft, 1988 as shown in figure no. 7 (page no. 67).

**Testing the Reliability and Validity of the Skill Test**

**Reliability of tests**

The test-retest method was used to determine the reliability of soccer skill tests. The test was administered twice to a group of subjects in the same way on two different days with a gap of one week in order to assess the reliability of tests. Correlation coefficient of test-retest has been presented in Table no. 2.
Table No. 2

RELIABILITY COEFFICIENT BETWEEN TEST AND RETEST RESULT

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Name of the Test</th>
<th>Value of ‘r’</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Kicking with the instep of the foot for distance (right leg)</td>
<td>.83</td>
<td>S</td>
</tr>
<tr>
<td>2.</td>
<td>Kicking with the instep of the foot for distance (left leg)</td>
<td>.74</td>
<td>S</td>
</tr>
<tr>
<td>3.</td>
<td>Kicking with the instep of the foot for accuracy (right leg)</td>
<td>.65</td>
<td>S</td>
</tr>
<tr>
<td>4.</td>
<td>Kicking with the instep of the foot for accuracy (left leg)</td>
<td>.70</td>
<td>S</td>
</tr>
<tr>
<td>5.</td>
<td>Kicking with the inner instep of the foot for distance (right leg)</td>
<td>.87</td>
<td>S</td>
</tr>
<tr>
<td>6.</td>
<td>Kicking with the inner instep of the foot for distance (left leg)</td>
<td>.89</td>
<td>S</td>
</tr>
<tr>
<td>7.</td>
<td>Kicking with the inner instep of the foot for accuracy (right leg)</td>
<td>.71</td>
<td>S</td>
</tr>
<tr>
<td>8.</td>
<td>Kicking with the instep of the foot for accuracy (left leg)</td>
<td>.93</td>
<td>S</td>
</tr>
</tbody>
</table>

Legends=Significant at 0.05 level.

Since there was significant correlation between test and retest score of the subjects in all skill tests, all the tests were considered reliable.
Construction of rating scale to assess skill performance

Five experts, who were trained and experienced coaches, rated the performance in soccer skills during testing independently, as per the rating scale prepared. To prepare the rating scale, the factors which were to be given main consideration were decided for each skill as suggested by experts and have been shown below:

Factors to be considered for assessing various skills

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. KICKING</strong></td>
<td>A. Back swing</td>
<td>B. Execution</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C. Accuracy</td>
</tr>
<tr>
<td><strong>2. TRAPPING</strong></td>
<td>A. Approaching the ball</td>
<td>B. Retreat of the trapping leg</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C. Control after trapping.</td>
</tr>
<tr>
<td><strong>3. TACKLING</strong></td>
<td>A. Position of the tackling foot.</td>
<td>B. Time of Tackling</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C. Controlling the ball after tackling</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C. Accuracy of passing.</td>
</tr>
<tr>
<td><strong>5. PASSING</strong></td>
<td>A. Time of passing.</td>
<td>B. Speed of passing.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C. Accuracy in passing.</td>
</tr>
<tr>
<td><strong>6. HEADING</strong></td>
<td>A. Surface of Impact.</td>
<td>B. Coordination.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C. Timing.</td>
</tr>
<tr>
<td><strong>7. DRIBBLING</strong></td>
<td>A. Protecting the ball from the Opponent.</td>
<td>B. Speed of dribbling.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C. Feinting while dribbling.</td>
</tr>
</tbody>
</table>
| 8. PSYCHOLOGICAL CHARACTERISTICS | A. Will power.  
| | B. Motivation.  
| | C. Courage.  
| 9. TACTICS | A. Positioning in relation to the game.  
| | B. Creating space.  
| | C. Ability to move quickly.  
| 10. INTERCEPTION | A. Ability to move quickly to the ball.  
| | B. Ability to make quick but correct decision.  
| | C. Ability to study the game.  

*System of Awarding Points for Performance in Each Skill*

A five point scoring system for each skill was adapted. The criteria for awarding points fixed as suggested by Baumgartner and Jackson (1991).

1. Exceptional ability; near perfect for age and sex of the participants---------- 5 points.

2. Above average ability; not perfect but quite skillful for the age and sex of the participants ------- 4 points.

3. Average ability; typical for the age and sex of the participants ---------- 3 points.

4. Below average ability; characterized by more mistakes than is typical performance for age and sex of the participants -------2.
5. Inferior ability; far below typical performance for the age and sex of the participants ———— 1.

In order to establish the reliability of rating scores between different expert, the reliability coefficient between the experts rating was worked out and is presented in Table No.3.

Table No. 3

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Between Experts compared</th>
<th>Value of ‘r’</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>VI and RP</td>
<td>.66</td>
<td>S</td>
</tr>
<tr>
<td>2.</td>
<td>VI and PD</td>
<td>.65</td>
<td>S</td>
</tr>
<tr>
<td>3.</td>
<td>VK and SD</td>
<td>.39</td>
<td>S</td>
</tr>
<tr>
<td>4.</td>
<td>VK and RK</td>
<td>.36</td>
<td>S</td>
</tr>
<tr>
<td>5.</td>
<td>RP and PD</td>
<td>.77</td>
<td>S</td>
</tr>
<tr>
<td>6.</td>
<td>RP and SD</td>
<td>.58</td>
<td>S</td>
</tr>
<tr>
<td>7.</td>
<td>RP and RK</td>
<td>.43</td>
<td>S</td>
</tr>
<tr>
<td>8.</td>
<td>PD and SD</td>
<td>.74</td>
<td>S</td>
</tr>
<tr>
<td>9.</td>
<td>PD and RK</td>
<td>.62</td>
<td>S</td>
</tr>
<tr>
<td>10.</td>
<td>SD and RK</td>
<td>.49</td>
<td>S</td>
</tr>
</tbody>
</table>

Legend: S=Significant at 0.05 level.

Since the rating of skills carried out by different experts for each subject showed significant relationship, the experts were considered to be identical in rating and the average value of rating of all the experts
was taken as expert rating score in all skill performance for further analysis.

*Evaluation of the validity of the tests through correlation between test score and expert rating*

Five experts rated the performance of the subjects on ten skills and average of all rating scores of each skill test was taken and correlated with each soccer skill test score. Correlation coefficient obtained between test score and expert rating has been presented in Table No.4.
Table No. 4

CORRELATION COEFFICIENT BETWEEN EXPERT RATING AND ACHIEVEMENT IN SOCCER SKILL TEST

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Name of the Test</th>
<th>Value of ‘r’</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Kicking with instep of the foot for distance (right leg) and AER</td>
<td>.38</td>
<td>S</td>
</tr>
<tr>
<td>2.</td>
<td>Kicking with instep of the foot for distance (left leg) and AER</td>
<td>.39</td>
<td>S</td>
</tr>
<tr>
<td>3.</td>
<td>Kicking with instep of the foot for accuracy (right leg) and AER</td>
<td>.38</td>
<td>S</td>
</tr>
<tr>
<td>4.</td>
<td>Kicking with instep of the foot for accuracy (left leg) and AER</td>
<td>.42</td>
<td>S</td>
</tr>
<tr>
<td>5.</td>
<td>Kicking with inner instep of the foot for distance (right leg) and</td>
<td>.41</td>
<td>S</td>
</tr>
<tr>
<td>6.</td>
<td>Kicking with inner instep of the foot for distance (left leg) and AER</td>
<td>.36</td>
<td>S</td>
</tr>
<tr>
<td>7.</td>
<td>Kicking with inner instep of the foot for accuracy (right leg) and AER</td>
<td>.38</td>
<td>S</td>
</tr>
<tr>
<td>8.</td>
<td>Kicking with instep of the foot for accuracy (left leg) and AER</td>
<td>.45</td>
<td>S</td>
</tr>
</tbody>
</table>

Legend: S=Significant at .05 level.

AER=Average of experts Rating

Since there was significant correlation between the performance score of the subjects in each skill test and expert rating score, all the skill tests were considered to be valid tests for further use in this study.
Testing Programme and Procedure

All soccer technique tests were conducted on all the subjects in one session in the afternoon with the exception of test for peak torque and torque acceleration energy, which were conducted over three days because of the lengthy procedure of testing in Cybex 340 Isokinetic dynamometer. The recording of scores in Isokinetic dynamometer was done with the help of experts from the GTMT department and, for scoring in soccer skill tests, the help of coaches from the department of football of SAI, NSNIS, Patiala and master of sports coaching students was taken:

The order of conducting soccer technique tests was:

1. Kicking with the inner instep of the foot for distance.
2. Kicking with the instep of the foot for distance.
3. Kicking with the inner instep of the foot for accuracy.
4. Kicking with the instep of the foot for accuracy.

The order of conducting the test for peak torque and torque acceleration energy in Cybex 340 Isokinetic dynamometer was:

1. Hip Joint.
2. Ankle joint.

Fifteen to twenty minutes warm-up was made obligatory before the tests. The warming-up for all subjects was similar in duration, intensity and nature of exercises. After the warming up, the subjects were permitted to perform a few trials of the tests to adjust to the nature and conditions of the tests. The subjects were thoroughly motivated to perform their best in the test, for peak torque, torque acceleration energy in cybex 340 Isokinetic dynamometer and also during the soccer skill tests.

Training Programme

Specific training programmes for all experimental groups and control group were drawn and implemented. The isokinetic training programme followed for one week has been shown in Table no. 5 & 6 as a model and the isotonic training programme followed for one week has been shown in Table no. 7 & 8.
### Table No. 5

**ISOKINETIC STRENGTH TRAINING PROGRAMME FOR ONE WEEK**

<table>
<thead>
<tr>
<th>Exercise</th>
<th>Speed/Resistance</th>
<th>No. of Repetition</th>
<th>No. of sets</th>
<th>Recovery/Sets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hip flexion/Extension</td>
<td>45°/sec</td>
<td>6</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>60°/sec</td>
<td>5</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>180°/sec</td>
<td>5</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Knee/ flexion/extension</td>
<td>45°/sec</td>
<td>6</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>180°/sec</td>
<td>5</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>240°/sec</td>
<td>5</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Ankle</td>
<td>45°/sec</td>
<td>6</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Plantar/ dorsi Flexion</td>
<td>60°/sec</td>
<td>5</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>180°/sec</td>
<td>5</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

**Days**

- Tues
- Thurs
- Sat
- Tues
- Thurs
- Sat

### Table No. 6

**MICRO CYCLE ILLUSTRATING VARIOUS KIND OF TRAINING GIVEN IN EVERY WEEK FOR ISOKINETIC GROUP**

<table>
<thead>
<tr>
<th></th>
<th>Monday</th>
<th>Tuesday</th>
<th>Wednesday</th>
<th>Thursday</th>
<th>Friday</th>
<th>Saturday</th>
<th>Sunday</th>
</tr>
</thead>
<tbody>
<tr>
<td>6-8 AM</td>
<td>REST</td>
<td>Strength</td>
<td>REST</td>
<td>Strength</td>
<td>REST</td>
<td>Strength</td>
<td>REST</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Training</td>
<td>Training</td>
<td>Training</td>
<td>Training</td>
<td>Training</td>
<td></td>
</tr>
<tr>
<td>4-6 PM</td>
<td>Tech/TA Game</td>
<td>Tech/TA Game</td>
<td>Tech/TA Game</td>
<td>Tech/TA Game</td>
<td>Tech/TA Game</td>
<td>Tech/TA Game</td>
<td>REST</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Game</td>
<td>Game</td>
<td>Game</td>
<td>Game</td>
<td>Game</td>
<td></td>
</tr>
</tbody>
</table>
Fig. 8: TRAINING OF HIP FLEXOR & EXTENSOR IN ORTHROTON II.
Fig. 9: TRAINING OF KNEE FLEXOR & EXTENSOR IN ORTHROTON II.
Fig. 10: TRAINING OF ANKLE PLANTER & DORSI FLEXOR IN ORTHROTON II.
Table No. 7
ISOTONIC STRENGTH TRAINING PROGRAMME FOR ONE WEEK

<table>
<thead>
<tr>
<th>Exercise</th>
<th>Intensity 1 repetition maximum</th>
<th>No. of repetition</th>
<th>No. of sets</th>
<th>Recovery/ Set</th>
</tr>
</thead>
<tbody>
<tr>
<td>Half squat</td>
<td>90% 95% 95%</td>
<td>4 2 2</td>
<td>3 3 3</td>
<td>2-5 minutes</td>
</tr>
<tr>
<td></td>
<td>85% 90% 85%</td>
<td>6 4 6</td>
<td>3 3 3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>65% 75% 70%</td>
<td>12 10 12</td>
<td>3 3 3</td>
<td></td>
</tr>
<tr>
<td>Knee extension</td>
<td>90% 95% 95%</td>
<td>4 2 2</td>
<td>3 3 3</td>
<td>2-5 minutes</td>
</tr>
<tr>
<td></td>
<td>85% 90% 85%</td>
<td>6 4 6</td>
<td>3 3 3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>65% 75% 70%</td>
<td>12 10 12</td>
<td>3 3 3</td>
<td></td>
</tr>
<tr>
<td>Knee flexion</td>
<td>90% 95% 95%</td>
<td>4 2 2</td>
<td>3 3 3</td>
<td>2-5 minutes</td>
</tr>
<tr>
<td></td>
<td>85% 90% 85%</td>
<td>6 4 6</td>
<td>3 3 3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>65% 75% 70%</td>
<td>12 10 12</td>
<td>3 3 3</td>
<td></td>
</tr>
<tr>
<td>Heel raise</td>
<td>90% 95% 95%</td>
<td>4 2 2</td>
<td>3 3 3</td>
<td>2-5 minutes</td>
</tr>
<tr>
<td></td>
<td>85% 90% 85%</td>
<td>6 4 6</td>
<td>3 3 3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>65% 75% 70%</td>
<td>12 10 12</td>
<td>3 3 3</td>
<td></td>
</tr>
<tr>
<td>Reverse calf</td>
<td>90% 95% 95%</td>
<td>4 2 2</td>
<td>3 3 3</td>
<td>2-5 minutes</td>
</tr>
<tr>
<td>raise</td>
<td>85% 90% 85%</td>
<td>6 4 6</td>
<td>3 3 3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>65% 75% 70%</td>
<td>12 10 12</td>
<td>3 3 3</td>
<td></td>
</tr>
<tr>
<td>Hip extension</td>
<td>90% 95% 95%</td>
<td>4 2 2</td>
<td>3 3 3</td>
<td>2-5 minutes</td>
</tr>
<tr>
<td></td>
<td>85% 90% 85%</td>
<td>6 4 6</td>
<td>3 3 3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>65% 75% 70%</td>
<td>12 10 12</td>
<td>3 3 3</td>
<td></td>
</tr>
<tr>
<td>Hip flexion</td>
<td>90% 95% 95%</td>
<td>4 2 2</td>
<td>3 3 3</td>
<td>2-5 minutes</td>
</tr>
<tr>
<td></td>
<td>85% 90% 85%</td>
<td>6 4 6</td>
<td>3 3 3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>65% 75% 70%</td>
<td>12 10 12</td>
<td>3 3 3</td>
<td></td>
</tr>
</tbody>
</table>

Mon Wed Fri
Mon Wed Fri
Mon Wed Fri
## Table No. 8

**MICRO CYCLE ILLUSTRATING VARIOUS KIND OF TRAINING GIVEN IN EVERY WEEK FOR ISOTONIC GROUP**

<table>
<thead>
<tr>
<th></th>
<th>Monday</th>
<th>Tuesday</th>
<th>Wednesday</th>
<th>Thursday</th>
<th>Friday</th>
<th>Saturday</th>
<th>Sunday</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>6-8 AM</strong></td>
<td>Strength Training</td>
<td>REST</td>
<td>Strength Training</td>
<td>REST</td>
<td>Strength Training</td>
<td>REST</td>
<td>REST</td>
</tr>
<tr>
<td><strong>4-6 PM</strong></td>
<td>Tech/TA Game</td>
<td>Tech/TA Game</td>
<td>Tech/TA Game</td>
<td>Tech/TA Game</td>
<td>Tech/TA Game</td>
<td>Tech/TA Game</td>
<td>REST</td>
</tr>
</tbody>
</table>

## Table No. 9

**MICRO CYCLE ILLUSTRATING VARIOUS KIND OF TRAINING GIVEN IN EVERY WEEK FOR CONTROL GROUP**

<table>
<thead>
<tr>
<th></th>
<th>Monday</th>
<th>Tuesday</th>
<th>Wednesday</th>
<th>Thursday</th>
<th>Friday</th>
<th>Saturday</th>
<th>Sunday</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>6-8 AM</strong></td>
<td>REST</td>
<td>REST</td>
<td>REST</td>
<td>REST</td>
<td>REST</td>
<td>REST</td>
<td>REST</td>
</tr>
<tr>
<td><strong>4-6 PM</strong></td>
<td>Tech/TA Game</td>
<td>Tech/TA Game</td>
<td>Tech/TA Game</td>
<td>Tech/TA Game</td>
<td>Tech/TA Game</td>
<td>Tech/TA Game</td>
<td>REST</td>
</tr>
</tbody>
</table>
Fig. 11 : HALF SQUAT
Fig. 12: KNEE EXTENSION.
Fig. 13: KNEE FLEXION
Fig. 14: HEEL RAISE
Fig. 15: HIP FLEXOR
Training Procedure

The training was held in the GTMT laboratory of Sports Sciences Faculty and Football field of SAI” NSNIS, Patiala, Punjab. Isokinetic training was given in Orthroton II Isokinetic system installed in the laboratory of GTMT department and isotonic’ training was given in the conditioning hall with the help of experts from GTMT department, NSNIS, Patiala.

Soccer technique training, apart from playing the game, was compulsory for all subjects involved in this experimental study and was conducted during the evening sessions with the help of coaches from the Football department and Master of Sports Coaching Students.

Isokinetic Training

For the Isokinetic training group, speed and resistance were selected on the basis of the literature of Isokinetic training as well as standard protocol of Cybex 340, Isokinetic dynamometer.

Fifteen to twenty minutes of warming up was made compulsory before the training. The warming up for all the subjects was similar with regard to nature of warming up, duration, intensity and volume. After warming up, the isokinetic training was carried out as per the
training programme by fixing the speed and repetition in ORTHOTRON II Isokinetic system for hip, knee and ankle joint muscles.

**Isotonic Training**

The starting weight for isotonic training was assessed by 1 RM method with the help of experts of strength training and the percentage of load was given as per the training programme.

Fifteen to twenty minutes of warming up was given before the training, which was similar in nature, intensity and volume. After warming up with reference to starting weight which was assessed by 1 RM, the load for selected exercises was given as per training programme planned.

**Soccer Technique Training**

After proper warming up the soccer technique training, especially kicking with the instep of the foot and inner instep of the foot was’ given to all subjects including the subjects of the control group, emphasizing more on fault correction, for 8 weeks.
Statistical Procedure

The data collected through pre and post-training tests were analyzed to test the hypothesis.

The statistical analysis was carried out through “BEANSTALK ULTIMA” PENTIUM IV 866MHZ and SPSS 13 + PC installed in University of Kerala, Department of Statistics and SAI,LNCPE, Trivandrum. The correlation coefficient, Analysis of Covariance & Variance to compare the effect of different training was worked out. For accepting the results in this study, the significance level of 95% accuracy i.e. P<0.05 was fixed.

Analysis of Covariance (ANCOVA)

It is to be noticed that the individuals in the control and experimental groups may vary widely in the initial pre-test scores. If we use analysis of variance (ANOVA) for testing the significance of the difference between the post test means of the control and experimental groups, then we are ignoring the influence of the initial pre-test scores to the final post test scores. Part of the variation in the post-test scores in the control and experimental groups are due to the influence of these initial pre-test scores also. That means we cannot say
that the changes in the post test means of the control and experimental
groups are due to our training method but part of the variation in the
pre-test means are due to the initial scores also. These pre-test scores
are called ‘covariates’. Therefore we have to eliminate or to keep under
control the effect due to these covariates (pre-test scores) from the final
scores (post-test scores). Hence the data should be analyzed by the
technique of Analysis of Covariance (ANCOVA) rather than Analysis
of Variance (ANOVA). In ANOVA there will not be any covariate
(that is pre-test values). ANCOVA tests the significance of ‘adjusted
post-test mean’ differences between the control and experimental
groups for each of the eight selected variables. Adjusted post-test
means are the post test means after eliminating the effect due to the
pre-test (initial) scores. The adjusted technique serves to remove from
the final scores that portion which is due to the elation between
covariate (pre-test scores) and the final scores, and, in doing so, adjusts
for the initial inter subject differences.

*One-Way Analysis of Variance [ANOVA]*

The One-Way ANOVA procedure produces a one-way analysis of
variance for a quantitative dependent variable by a single factor
(independent) variable. Analysis of variance is used to test the
hypothesis that several means are equal. This technique is an extension of the two-sample t test.

In addition to determining that differences exist among the means, we may want to know which means differ. For this purpose we use Scheffe's post hoc tests for pair wise multiple comparisons, run after the experiment has been conducted.

*Karl Pearson's Product Moment Correlation Coefficient*

A correlation coefficient is a number between -1 and 1 which measures the degree to which two variables are linearly related. If there is a perfect linear relationship with positive slope between the two variables, we have a correlation coefficient of 1; if there is positive correlation, whenever one variable has a high (low) value, so does the other. If there is a perfect linear relationship with negative slope between the two variables, we have a correlation coefficient of -1; if there is negative correlation, whenever one variable has a high (low) value, the other has a low (high) value. A correlation coefficient of 0 means that there is no linear relationship between the variables.

There are a number of different correlation coefficients that might be appropriate depending on the kinds of variables being
studied. Pearson's product moment correlation coefficient, usually denoted by $r$, is one example of a correlation coefficient. It is a measure of the linear association between two variables that have been measured on interval or ratio scales, such as the relationship between height in inches and weight in pounds. However, it can be misleadingly small when there is a relationship between the variables but it is a non-linear one.

The correlation coefficients of the study were calculated using Pearson's Product moment correlation coefficient with the help of the formula (Garrett: 1967).

$$
r = \frac{\sum x'y' - \left( \frac{\sum fx'}{N} \right) \left( \frac{\sum fy'}{N} \right)}{\sqrt{\left( \frac{\sum fx'^2}{N} - \left( \frac{\sum fx'}{N} \right)^2 \right) \left( \frac{\sum fy'^2}{N} - \left( \frac{\sum fy'}{N} \right)^2 \right)}}
$$

where $r$ = Correlation coefficient

$f'$ = Frequency corresponding to respective scores

$x'$ = Deviation of the measures $(x)$ from the assumed mean class interval

$y'$ = Deviation of the measures $(y)$ from the assumed mean class interval

$N$ = Sample size
The obtained correlation has been interpreted using significance of 'r' tested against the null hypothesis (viz $r=0$). The coefficients have also been verbally interpreted by the following conventions:

1. $r$ from 0.00 to ±0.20 denote insignificant or negligible relationship
2. $r$ from ±0.20 to ±0.40 denotes low correlation present, but slight
3. $r$ from ±0.40 to ±0.70 denotes considerable correlation
4. $r$ from ±0.70 to ±1 denotes high to very high relationship.