CHAPTER III

METHODOLOGY

In this chapter Selection of Subjects, Selection of Variables, Experimental Design, Pilot Study, Criterion Measures, Reliability of Data, Reliability of Instruments, Tester’s Competency and Reliability of Tests, Subject Reliability, Description of different treatments, Test Administration, Collection of Data, Statistical Techniques for the analysis of data have been presented here.

3.1 SELECTION OF SUBJECTS

Since the purpose of the study was to find out the effect of short wave diathermy, ultrasound therapy, wax bath and massage therapy on soft tissue injury of shoulder, knee and ankle joints among elite volleyball and basketball players, care was taken to select subjects from elite volleyball and basketball players, who were having soft tissue injuries.

As per the assessment made by qualified Medical officer and Physiotherapist about 30 Subjects with complaints of soft tissue injury (Grade I) of the shoulder, Knee and Ankle were selected randomly from various basketball and volleyball positional players from Chennai city.

Such players with the consent of the authorities were carefully tested through qualified Medical Officer and Physiotherapist to identify the nature of their ailments. Based on the reports and classification of the injuries, the players
having soft tissue injuries of shoulder, knee and ankle joints were selected for this study. Among the soft tissue injured players, the investigator randomly selected 10 rotator cuff tear injured; 10 anterior cruciate ligament injured and 10 ankle sprained, consisting volleyball players and basketball players. Each of the 10 injured players of volleyball and basketball were randomly selected into three groups, namely, short wave diathermy treatment group, ultrasound therapy treatment group and wax bath and massage treatment group consisting of 10 injured players in each. Care was also taken to keep the age of the subjects selected were between 20(Twenty years) to 27(Twenty seven years) years. Diagram I shows the selection of subjects for different treatments for the study.
3.2 SELECTION OF VARIABLES

The present study was aimed to test the effect of short wave diathermy ultrasound therapy wax bath and massage therapy on soft tissue injury of shoulder, knee and ankle joints among elite volleyball and basketball players. Several researches in the field of sports injuries pointed out that the common soft tissue shoulder injury would be rotator cuff tear; the common soft tissue injury would be anterior cruciate ligament injury and the common soft tissue injury of ankle would be ankle sprain. The acute level of these injuries were determined
through three common variables, namely, perceived pain, swelling and range of motion. Thus, within these broader parameters, the investigator selected the following dependent and independent variables for this study.

The selected dependent variables for the study were as follows.

1. Perceived Pain of rotator cuff tear, anterior cruciate ligament injury and ankle sprain
2. Swelling due to rotator cuff tear, anterior cruciate ligament injury and ankle sprain

The selected independent variables for the study were as follows:

2. Ultrasound Therapy for rotator cuff tear, anterior cruciate ligament injury and ankle sprain.
3.3 CRITERION MEASURES

The following criterions were taken for this study, since it were standardized tests and had high correlation coefficient and reliability.

1. Pain was measured by using visual analog pain scale test.

2. Swelling was assessed by using flexible tape at the place injury (shoulder, knee or ankle)

3. Range of motion was measured by the Goniometric.

3.4 EXPERIMENTAL DESIGN

The methodology and design of experiments adopted in this study are discussed here. The study mainly aimed at finding out the effects of different treatments such as shortwave diathermy, ultrasound, wax therapy and massage on soft tissue injuries at shoulder, knee and ankle among basketball and volleyball players. The experimental design used in this study was random group design. 30 elite basketball and volleyball players consisting of 30 players who were suffered from rotator cuff tear, anterior cruciate ligament and ankle sprain were selected at random from professional players who attended the professional team. Each of the category of injured, namely, rotator cuff tear, anterior cruciate ligament and ankle sprain consisting of 10 each, were further divided in to three groups, consisting of
10 injured as experiment group I underwent shortwave diathermy, 10 injured as experimental group II which underwent ultrasound treatment, 10 injured as experiment group III which underwent wax therapy and massage. The experimental treatments were given to the subjects as per description and supervision of the experienced physiotherapist and medical doctor, for fifteen days continuously. All the subjects were tested prior to treatment and after completion of fifteen days of treatment on selected variables dependent variables, namely, perceived pain, swelling and range of motion. The difference between pre test and post test of pain, swelling and range of motion were considered as the effect of selected treatment on selected injury. To test the significance of the difference in means in each treatment on each of the injury, dependent ‘t’ test (pre test and post test means) was used. To find out the significance of the difference among the three different treatments on a particular dependent variable, Analysis of Covariance (ANCOVA) was used. In all the cases 0.05 level was fixed to test the hypothesis.

3.5 PILOT STUDY

Pilot study was conducted with players who were suffering from soft tissue injuries at shoulder, knee and ankle and does not form part of the experimental design of this study, to assess and to familiarize with the treatment and testing procedures. Ten players with different soft tissue injures selected for pilot study were from College Men Volleyball and Basketball players and they
were given the three different types of treatments as well as for the three different types of injuries on three dependent variables, pain, swell and range of motion. Through this process of pilot study, the investigator obtained adequate knowledge about the methods of treatments, namely, short wave diathermy, ultrasound, wax bath and massage on selected injuries rotator cuff tear, anterior cruciate ligament and ankle sprain; and measurement of its effects on perceived pain, swelling and range of motion.

3.6 RELIABILITY OF DATA

The reliability of data was ensured by establishing the instrument reliability, tester’s competency and reliability of tests.

3.7 RELIABILITY OF INSTRUMENTS

Visual Analog Scale (VAS) is the standard pain rating scale used to assess the perceived pain of the subjects is a standard one and being used by researchers extensively to determine the pain the subjects and this scale is found to be reliable for this study. The flexible measuring tape used in this study to measure the circumference of the place of the body in which the swelling is observed, is a standard one and its calibrations were compared with other tapes and found to be reliable for this study. Goniometer was used in this study to measure the range of motion of the subjects. This Goniometer is extensively used to measure the
selected variables and was found reliable. To determine the reliability of the instrument, measurements statistically on each of the tests were recorded several times under similar conditions using the same instruments. The obtained data on pre test and post test on the pilot study subjects were evaluated through Pearson Correlation of co-efficient and it was found that the instruments were reliable.

3.8 TESTER’S RELIABILITY

Tests for this research on selected dependable variables were conducted by the investigator and his assistants under the supervision of experienced physiotherapist. Moreover the testers were well experienced through the pilot study process to obtain accurate measurements on dependent variables. The obtained pre test and post test scores were correlated using Pearson’s Correlation Coefficient to test the reliability of the scores, which is presented in Table I.

### Table I

Intra Class Correlation Coefficient on Reliability of Criterion Variables

<table>
<thead>
<tr>
<th>Variables</th>
<th>Measuring Tools</th>
<th>Unit of Measurement</th>
<th>Obtained ‘r’</th>
<th>Required ‘r’</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pain Due to Rotator Cuff Tear</td>
<td>Visual</td>
<td>In numbers</td>
<td>0.86*</td>
<td>0.602</td>
</tr>
<tr>
<td></td>
<td>Analog Pain Scale</td>
<td>In numbers</td>
<td>0.82*</td>
<td>0.602</td>
</tr>
<tr>
<td></td>
<td></td>
<td>In numbers</td>
<td>0.87*</td>
<td>0.602</td>
</tr>
<tr>
<td>Pain Due to Anterior Cruciate Ligament Ankle Sprain</td>
<td>Flexible Tape</td>
<td>In centimeters</td>
<td>0.92*</td>
<td>0.602</td>
</tr>
<tr>
<td></td>
<td></td>
<td>In centimeters</td>
<td>0.93*</td>
<td>0.602</td>
</tr>
<tr>
<td></td>
<td></td>
<td>In centimeters</td>
<td>0.91*</td>
<td>0.602</td>
</tr>
<tr>
<td>Swelling Due to Rotator Cuff Tear</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Range of Motion</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Rotator Cuff Tear
### Anterior Cruciate Ligament
### Ankle Sprain

<table>
<thead>
<tr>
<th>Rotator Cuff Tear</th>
<th>Biplance Goniometer</th>
<th>In Degrees</th>
<th>0.79*</th>
<th>0.602</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anterior Cruciate Ligament</td>
<td>In Degrees</td>
<td>0.81*</td>
<td>0.602</td>
<td></td>
</tr>
<tr>
<td>Ankle Sprain</td>
<td>In Degrees</td>
<td>0.78*</td>
<td>0.602</td>
<td></td>
</tr>
</tbody>
</table>

* Significant

### 3.9 SUBJECTS RELIABILITY

The investigator explained the procedure of the study to the subjects and their part during their treatment. He also narrated the testing procedure on selected variables. To ensure uniformity and reliability of the testing techniques, the investigator had a number of practice sessions in the testing procedures with the guidance of experts. Tester’s competency and reliability of tests were established by pre test-post test process and the coefficient of correlation obtained for testing the tester’s reliability is considered good for subjects’ reliability as similar subjects were treated for this research.

### TREATMENT SCHEDULE

The treatment was scheduled to fifteen days continuously. The duration of the treatment packages for the three treatments groups were tabled below.

The purpose of the study was to find out the effect of soft wave diathermy, ultra sound therapy, wax bath and massage therapy on soft tissue injury of shoulder, knee and ankle joints among elite volleyball and basketball players.
Hence, before planning different treatments, the investigator conducted pilot study and collected the detailed information of treatment and its methods

SHORT WAVE DIATHERAPHY TREATMENT

Description on the Equipment

Shortwave diathermy is most commonly used Physical Therapy applications used at a radiofrequencies of 27.12 Mhz. Diathermy literally means to heat through. Continuous SWD is a Therapeutic device that uses high frequency alienating current that oscillate at specific Radio frequencies between 10-50Mhz. Short wave diathermy (SWD) unit operates on continuous (or) pulsed mode (Cameron, 1999). Short wave diathermy is used when there is a need to provide deep heat to a larger area than normally covered by ultrasound

POSITION OF PATIENT

Shoulder Joint:

- The patients were positioned in supine lying with affected side abducted to 45° with a pillow between body and limb.
- Contra planar technique of SWD is applied (i.e.) one pad anterior and other posterior is applied.

Knee Joint:
• The patients were positioned in supine lying or long sitting.

• Contra planar technique of SWD is applied (i.e.) One pad superior and other inferior is applied.

**Ankle Joint:**

• The patients were positioned in supine lying with affected side abducted to 45° with a pillow.

• Contra planar technique of SWD is applied (i.e.) one pad medially and other laterally is applied.

<table>
<thead>
<tr>
<th>CONDITION</th>
<th>DURATION</th>
<th>DOSAGE</th>
<th>FREQUENCY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute</td>
<td>0-10 mins</td>
<td>Sub thermal</td>
<td>Daily for 7 days</td>
</tr>
<tr>
<td>Sub acute</td>
<td>10-15 mins</td>
<td>Mild thermal</td>
<td>Daily for 7 days</td>
</tr>
<tr>
<td>Chronic</td>
<td>15-30 mins</td>
<td>Thermal</td>
<td>Daily for 7 days</td>
</tr>
</tbody>
</table>

Therapeutic Frequency – 27.12 Mhz.

Duration of Treatment Frequency of Treatment
<table>
<thead>
<tr>
<th>Mode of Treatment</th>
<th>Time Range</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute Inflammation</td>
<td>10 - 15 min</td>
<td>Daily for 1-2 Weeks</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2-3 Times Daily</td>
</tr>
<tr>
<td>Chronic Conditions</td>
<td>15 – 30 min</td>
<td>2 weeks to 1-Month</td>
</tr>
</tbody>
</table>
The following table shows the mode of treatment of Shortwave Diathermy

<table>
<thead>
<tr>
<th>Mode of treatment</th>
<th>Intermittent mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duration of treatment</td>
<td>15 minutes</td>
</tr>
<tr>
<td>Electric Field Intensity</td>
<td>300 V/m</td>
</tr>
<tr>
<td>Magnetic Field Intensity</td>
<td>0.8 A/m</td>
</tr>
<tr>
<td>Power Density</td>
<td>25 mW/cm</td>
</tr>
<tr>
<td>Sitting / day</td>
<td>5 sessions</td>
</tr>
<tr>
<td>Duration</td>
<td>15 DAYS</td>
</tr>
</tbody>
</table>

**Procedure**

The subjects were given short wave diathermy treatments. Apply separate medium consisting of electrode to the part being treated against the coupling medium. The unit should never be turned on without coupling medium because the crystal may over heat. Keeping the electrode moving slowly, turn the electric field intensity 300 V/min; magnetic field intensity 0.8 A/m and power intensity 25 mW/cm. To avoid bony prominences, keep the electrode parallel to the skin as much possible as can. The subject may get a mild sense of warmth. If the subject gets too hot, or uncomfortable, the watts should be reduced to a tolerable level treatment applied for 3 minutes. After a break of 2 minutes, the same treatment
was given to another 3 minutes. Similarly the subjects were provided with short wave diathermy treatment for five times within a period of 30 minutes in a day.

**ULTRA SOUND**

Sound waves more than 20000Hz is called Ultra Sound.

- Therapeutic Frequency: 800 KHz.
- Therapeutic Intensity: 0.25 to 2.0 w.cm$^2$
- Treatment Duration: 5 – 8 Minutes
- Frequency of Treatment: 12-15 Settings

**Therapeutic Ultra Sound**

Ultra Sound is a deep heating modality causing temperature elevation in tissue to depth of 3cm for more,

**ULTRASOUND TREATMENT PARAMETERS:**

Sound Waves more than 20,000 HZ is called ultrasound.

**Product Description**
Sound waves promote tissue heating and blood flow to speed the recovery process and injury rehabilitation. The machine makes treating easy, comfortable and convenient, increasing the consistency and frequency of ultrasound treatments.

**Mode of Treatment**

The following is the mode of treatment of ultrasound therapy.

<table>
<thead>
<tr>
<th>Mode of treatment</th>
<th>Continuous mode</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Duration of treatment</td>
<td>(5-8) mins</td>
</tr>
<tr>
<td>-----------------------</td>
<td>------------</td>
</tr>
<tr>
<td>Intensity</td>
<td>(0.2-2.0W/cm²)</td>
</tr>
<tr>
<td>Sitting / day</td>
<td>(1-2) sessions</td>
</tr>
<tr>
<td>Duration</td>
<td>(12-15) DAYS</td>
</tr>
</tbody>
</table>

**Procedure**

**Position:**

**Position for shoulder Joint:**

Patient need to be in high sitting with elbow flexed at 90°.

**Position for knee joint:**

Patient need to be in supine lying or long sitting. Move the clothes upwards from the affected knee joint. Keep one pillow under the knee joint.

**Position for ankle joint:**

Patient to be in long sitting. Keep one pillow under the knee joint.

The subjects were given ultrasound treatments. Apply coupling medium to
the part being treated and place the transducer against the coupling medium. The unit should never be turned on without coupling medium because the crystal may overheat. Keeping the transducer moving slowly, turn the intensity up to 0.8 W/cm². To avoid bony prominences, keep the transducer parallel to the skin as much possible as can. The subject may get a mild sense of warmth. If the subject gets too hot, or uncomfortable, the wattage should be reduced to a tolerable level treatment applied for 15 minutes.

WAX BATH AND MASSAGE TREATMENT

Description of Wax Bath Vessel

Rectangular mobile wax bath is being used for storing and melting of wax at desired temperature level. The glass wool insulated double wall device is available in two different sizes i.e. 14”x9”x7” and 20”x14”x10”. The whole unit is made of glossy Aluminium. The unit is designed with concealed heaters to reduce the recurring cost of wax.

PARAFFIN WAX BATH

Paraffin was bath is an efficient source of specified heat modality with temperature about 45°C – 54°C

It has low specific heat which mean that it does not feel as hot or water of the same temp. So less risk for burn.
It conducts heat more slowly than water at the same temperature, allowing tissue to heat up more slowly.

(Paraffin wax) - 1 (Oil)

Duration of Rx - 10-20min

Temperature Suggested - 47°C

Frequency of Rx - daily 2-3 weeks.

The following is the mode of treatment for wax bath.

<table>
<thead>
<tr>
<th>Treatment mode</th>
<th>Toweling or bandaging method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sitting per day</td>
<td>Two applications per day</td>
</tr>
<tr>
<td>Duration of treatment time</td>
<td>15 minutes</td>
</tr>
<tr>
<td>Duration of treatment</td>
<td>15 days</td>
</tr>
<tr>
<td>Position of patient</td>
<td>Sitting / Lying</td>
</tr>
</tbody>
</table>
Procedure

It is learnt the benefits of thermal effects on the human body. By this method heat can be applied on the affected part smoothly and safely for perfect contact of the skin. When the affected part is immersed into the wax then that part is surrounded by the melted wax (Mixture of wax and paraffin) then the part is wrapped by a polythene paper for 20 to 30 minutes for absorption of heat in the tissues.

The nature of wax treatment is explained and the area to be treated is inspected for contraindication. Look for any wound, skin infection, rashes etc. on the part to be treated. Cleaned the skin using tissue paper or cotton. The patient was told in brief about temperature of the wax and benefits Drip down few drops of molten wax on the dorsal surface of the hand to check the temperature. This is done before; the patient so that he can prepare psychologically and fear of heat is minimized. After
the above step the patient is always found to cooperate and fear of molten wax and heat is removing from the mind.

The part to be treated must be cleaned by soap and moisture to be soaked by towel. Position of the patient should be such that the part to be treated comes closer to the wax bath container. Before application one must ensure that there should be no moisture on the body tissues otherwise burn could occur. The warm wax is placed on the body tissues by various techniques and the treatment is given for about 10-20 minutes by using toweling or bandaging method: A towel or a roll of bandage is immersed in molten paraffin wax and then wrapped around the body part. Several layers can be made over the body part. This method is preferably used for treating proximal parts of the body.

After removal of wax start active movement as soon as possible, in case of restricted movement start passive movement at maximum extent. When a shoulder, neck or back is to be treated the wax can be painted on the part with a brush. The wax coating can be kept in place for several hours, thereby maintaining hyperemia. Patient can prepare at home by collection of pure bees wax and liquid paraffin in a container. The mixture must be 7 : 1 wax and paraffin and the temperature 120°F. This penetrating heat relieves pain and stiffness, optimal for patients suffering from arthritis, bursitis, muscle spasms and chronic joint inflammation.
MASSAGE TREATMENT PARAMETERS

The treatment mode of the massage treatment is given in the following table.

<table>
<thead>
<tr>
<th>Treatment mode</th>
<th>Massage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sitting per day</td>
<td>Two applications per day</td>
</tr>
<tr>
<td>Duration of treatment time</td>
<td>15 minutes</td>
</tr>
<tr>
<td>Duration of treatment</td>
<td>15 days</td>
</tr>
<tr>
<td>Position of patient</td>
<td>Sitting / Lying</td>
</tr>
</tbody>
</table>

APPLICATION OF MASSAGE

Pressure Manipulation Massage

Description

The essential feature of this technique is the application of deep compression to the body with constant touch. These techniques are directed particularly towards the muscular tissue. The maximum mechanical movement between different fibers is achieved in these techniques, by application of deep localized pressure. According to the nature and direction of pressure application,
techniques of this group can be divided into three major subgroups, Kneading, Petrissage and Friction

These technique produce almost similar physiological effects on the soft tissue. Kneading and petrissage, involves application of intermittent pressure whereas in friction the application of pressure is constant.

Purpose

The purpose of pressure manipulation massage on the subject was to relieve pain and increase mobility in the ankle.

Instructions

The subjects were instructed to feel to ‘pain’ during application of massage. They were also instructed not to move the ankle during treatment.

Precaution

The subjects were advised to report immediately if there was any uncomfortable feeling during the treatment

PROCEDURE
Position of the Patient

Ask the subject to remove all clothing from the appropriate arm and shoulder. Shoulder straps should also be slipped off.

A blanket has to be put over the other shoulder and wrap it obliquely across both aspects of the trunk to cross under the axilla of the arm to be massage.

Provide a higher table with a about the size of a standard pillow. Place a pillow on the table. Subject’s arm on the pillow so that it rest in a comfortable degree of shoulder abduction and elbow flexion and pronated finger tips just reach the front of the table.

POSITION OF THE THERAPIST

Therapist should stand in walk standing at the end of the table.

MANIPULATIONS

EFFLEURAGE

The arm may be effleurage on its own, starting at the elbow and finishing at the axilla.
- Lateral surface of the arm to the axilla
- Anterior surface of the arm to the axilla
- Medial surface of the arm to the axilla

**KNEADING**

Biceps is kneaded with the therapist’s inner hand with counter pressure with the therapist’s other hand over the mid-point.

**PICKING UP**

The therapist’s finger tips and length of his thumb lie in front of the adjacent bony borders of humerus. The therapist’s palm is in full contact. The therapist’s forearm is in parallel with the Subject’s forearm. The therapist’s other hand stabilize on the back of the elbow.

Move out of the way to the outside of the wrist which is lifted and the palm supinated. So that the working hand can continue to the tendon of insertion of biceps.

**HACKING**

Hacking is usually performed successively to first one aspect of the upper limb. Turn the forearm to supination and lift the elbow medially, so that the limb rests comfortably on the support. Start at the axilla and work down the front of the biceps.
STROKING

Stroking manipulation is performed by therapist one hand usually on a narrow area. Two hand simultaneously one each side on a broad area Right and left hands followed one another on a narrow area. A technique called thousand hands in which one hand performs a short stroke. Second hand does the same overlapping the first.

The hands pass over one another to gain contact as the manipulation proceeds down the length of the part under treatment.

Experimental group III underwent wax therapy and massage on alternate days as explained above for 15 days.

ADMINISTRATION OF THE TESTS

PAIN (Visual analog pain scale)

The procedure to measure the intensity of pain was explained as follows:

Visual Analogue Scale

The purpose of Visual Analogue Scale was to find out subjective evaluation and measurement of the intensity of pain. The Visual Analogue Scale is the test procedure which is used to find out the intensity of pain. This test
involves a 10 cm long non-segmental horizontal line with the left extreme indicating ‘no pain’ and the right extreme indicating ‘worse pain ever’. At the right angles in the horizontal scale, indicates the level of pain at the time of testing, as shown in the Diagram.

**Figure II: Visual Analogue Scale**

![Visual Analogue Scale Diagram](image)

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**Procedure and Scoring**

The subject indicated the intensity of pain by marking on the 10 cm long segmental horizontal line. This numerical index of the severity of pain was used as the score. The scoring was made before and after experiment.

Using a visual pain scale is more beneficial than a descriptive version ("I feel terrible") because it helps one rate his relative level of pain without other thoughts and preconceived notions getting in the way. By not having to verbalize and describe the pain, one can get a truer understanding of what the level of pain actually is.
Scoring

The perceived pain as determined through the visual analogue scale is the score of the subject’s pain level. All the subjects were tested of their pain level using this analogue scale.

SWELLING (MEASUREMENT)

Purpose:

The aim of this test is to measure the swelling of a joint, or a particular part of the body which is important for injury prevention and execution of many sporting movements.

Equipment required:

Measuring tape, paper and pencil.

Procedure to Measure Ankle Swelling

The following is the protocol for measuring swelling about the talar and subtalar joints using a tape measure in a figure of 8. 1) The ankle is maintained in a neutral position for eversion and inversion while flexed to 90 degrees (if range of motion permits), 2) the patient is in a long sitting position. Mark the following
landmarks with a skin pencil (Figs. 1 and 2): 1) tuberosity of the navicular; 2) base of the 5th metatarsal; 3) distal tip of the medial malleolus; 4) distal tip of the lateral malleolus; and 5) tibialis anterior tendon.

**Placement of the tape measure**

**Subtalar Joint**

1) The beginning of the tape is placed midway between the tibialis anterior tendon and lateral malleolus; 2) the tape is drawn medially across the instep and placed just distal to the tuberosity of the navicular; 3) pull the tape across the arch and up just proximal to the base of the 5th metatarsal; and 4) cross the tibialis anterior tendon.

**Talar Joint**

1) Continue the tape around the ankle joint just distal to the distal tip of the medial malleolus; 2) pull the tape across the Achilles tendon; 3) place the tape just distal to the distal tip of the lateral malleolus; and 4) end the measurement at the start of the tape. The talar joint protocol may be altered to measure swelling present at the anterior tibiofibular ligament. In this case, the tape encircles the malleoli proximal to the distal tip at the level of the sprained ligament. All measurements are recorded in centimeters.
For rotator cuff tearing swelling and anterior cruciate ligament swelling, measurements were taken using the tape in an encircled manner at the maximum swelling part of that area.

**Scoring:**

The measurement taken from one end to the other end of 8 or the circumference was the score of swelling on that particular part of the body.

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**RANGE OF MOTION (Goniometer)**

**Purpose:**

The aim of this test is to measure the flexibility of a joint or a part of the body which is important for injury prevention and assessment of rehabilitation for the sports injuries and execution of many sporting movements.

**Equipment required:**

Goniometer
Procedure:

To measure the range of motion at a joint, the center of the goniometer is positioned at the axis of rotation of a joint, and the arms of the goniometer are aligned with the long axis of the bones of the adjacent segments or to an external reference.
Scoring:

The measurement is the angle in degrees as read off the goniometer.

COLLECTION OF DATA

Prior to the start of the treatments, namely, short wave diathermy, ultrasound therapy and wax bath and massage, scores on perceived pain, swelling and range of motions were collected, which formed the pre test scores of the subjects. On completion of fifteen days of treatment tests were again conducted to measure variables such as pain, swelling, and range of movement using Visual analog pain scale, flexible tape and goniometer among the elite basketball and volleyball players. It was considered as a post test. The collected data on pre test and post test were treated with the following statistical techniques to test the hypothesis set for this study.

STATISTICAL ANALYSIS

The following statistical techniques were adopted to treat the data in connection with the established hypothesis and objectives of the study.

1. Dependent t-tests were used to test the effect of treatment groups individually between pre and post –tests of all the groups on variables used in the present study.
2. An analysis of covariance was used to determine significant differences among the ultrasound treatment group, massage therapy group, and wax therapy group on pain, swelling and range of motion variables elite of basketball and volleyball players.

3. When a significant difference among the treatment group was detected, a pair-wise comparison of the programs was done by Schfee’s post hoc test to identify significant differences between the treatment groups.