

# EFFECTS OF ULTRASOUND THERAPY, INTERFERENTIAL THERAPY AND COMBINATION OF ULTRASOUND THERAPY WITH INTERFERENTIAL THERAPY ON ANTERIOR CRUCIATE LIGAMENT (ACL) INJURY (SPRAIN) OF KNEE IN SPORTS

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**Abstract:** The goal of today's competitive sport is to exhibit one's excellence and to win. People who participate in sports are more likely than others have injuries. In this research the researcher is interested to find out effects of ultrasound therapy, interferential therapy and combination of ultrasound therapy with interferential therapy in treatment of anterior cruciate ligament (ACL) injury (sprain) of knee. Even though there are different knee injuries, the investigator selected only ACL injury (sprain) of knee for this study. To test the effect of these different treatments, namely, ultrasound therapy, interferential therapy and combination of ultrasound therapy with interferential therapy on the players who were suffering from ACL injury. The researcher selected perceived pain, swelling and range of motion as dependent variables. 30 players suffering from ACL injuries of knee were selected as subjects for this study. The subjects were in the age group of 16 to 25 years. The differences between means of initial and final scores on selected criterion variables were subjected to statistical treatment using analysis of covariance (ANCOVA). The results of the study proved that ultrasound therapy, interferential therapy and combination of ultrasound therapy with interferential therapy were significantly contributed for the treatment of ACL injury of knee as measured through pain, swelling and range of motion. Among the treatment groups, combination of ultrasound therapy with interferential therapy was significantly better than the other two treatment groups, namely, ultrasound therapy group and interferential therapy group in reducing pain, swelling and improving range of motion for ACL injury of knee in the players.

**INDEXTERMS:** Ultrasound Therapy, Interferential Therapy, Anterior Cruciate Ligament, Pain, Swelling, Range of Motion.

## I. INTRODUCTION

The goal of today's competitive sport is to exhibit one's excellence and to win. In modern age athletes are trained scientifically to improve their physical fitness, technical and tactical ability to attain better performance. People who participate in sports are more likely than others have injuries. This certainly doesn't mean you should avoid sports. Everyone from well-conditioned athletes to weekend warriors can suffer a sports injury. Sports injuries are most commonly caused by poor training methods, structural abnormalities, and weakness in muscles, tendons, ligaments and unsafe exercising environments. The medical community is playing an increasing active role in encouraging fitness enhancement whether by threats (the dangerous of high cholesterol or LDL, osteoporosis, or cardiovascular disease) or promises (enhanced competitive performance or lowered body fat) (Ried DC, 1992). At least some portion of organized medicine appears to be encouraging the fitness movement. At the same time, such support might be applied more thoughtfully if it is possible to better predict the injury consequences of participation. It is useful to attempt to identify risk factors and suggest what might be done to cater these factors. On average, athletes are eight times more likely to suffer anterior cruciate ligament [ACL] injuries (sprain) in competition, than practice. Ligamentous injuries at the knee joint are the most common sporting injuries especially in jumping sports (e.g., basketball, volleyball, etc.). They are not always well managed. Associated injuries are frequently not diagnosed and the rehabilitation of ligamentous injuries is often inadequate leading to a high rate of recurrence (Khan K and Bruker P, 1998). Physiotherapy plays an integral part in the multi-disciplinary approach to the management of sports injuries. The aim of physiotherapy is to treat and fully rehabilitate the athlete post-injury, post-operatively, to prevent further injury and to return the athlete to sport in the shortest possible time. Effectiveness of therapeutic ultrasound for pain, musculoskeletal injuries and soft tissue lesions remains questionable. Study has proven that ultrasound helps in enhancing the metabolic activities of cells. Thus, ultrasound treatment helps in tissue repair, especially in soft tissue injuries (Kerry G Baker, et al., 2001). IFT along with ultrasound can be applied to ease pain and swelling symptoms as well. This well applied together to the nerve tract of irritated or inflamed tissue can shorten the inflamed region and reduce pain (Heidt RS, et al., 1996 and McConnell J, 2002). Thus, there are different physiotherapy methods are being used to treat the knee ligament injuries,

especially anterior cruciate ligament (ACL) injuries of knee for the players. To facilitate for speedy recovery from the injury, it is much essential to select the right treatment. In this research the researcher is interested to find out effects of ultrasound therapy, interferential therapy and combination of ultrasound therapy with interferential therapy in treatment of anterior cruciate ligament (ACL) injury (sprain) of knee. Even though there are different knee injuries, the investigator selected only anterior cruciate ligament [ACL] injury (sprain) of knee for this study. To test the effect of these different treatments, namely, ultrasound therapy, interferential therapy and combination of ultrasound therapy with interferential therapy on the players who were suffering from ACL injury (sprain). The researcher selected pain, swelling and range of motion as dependent variables.

### **Sports Injuries**

Sports injuries are injuries that occur in athletic activities or while exercising. Sports injuries may be classified as hard tissue injuries, soft tissue injuries, capsular injuries, and cutaneous injuries. Out of which, soft tissue injuries and hard tissue injuries are most commonly occurring injuries in present sports, and both may be mild to severe.

### **Knee Injuries**

Knee is made up of many important structures, any of which can be injured. The most common knee injuries include fractures around the knee, dislocation, sprains, strains, bursitis and tears of the meniscus. In many cases, injuries involve more than one structure in the knee. Pain, swelling and reduced range of motion are the most common signs of knee injury.

### **Anterior Cruciate Ligament (ACL) Injury (Sprain) of Knee**

Anterior cruciate ligament (ACL) knee injury is common in sports that involve sudden changes of direction, such as football, basketball, etc. An anterior cruciate ligament injury is the over-stretching or tearing of the anterior cruciate ligament (ACL) in the knee. An ACL tear may be partial or moderate or complete.

### **Physiotherapy for ACL Knee Injuries**

When undergoing treatment for knee injuries, healing of the injured ligament with out loss of mechanical stability is the main treatment goal. Whether is an injury to the meniscus, ligament or cartilage, the principles of the treatment are the same. The exercises used are basically the same for all types of injuries during the treatment and rehabilitation period. However, the progression may differ as to when the various exercises begin and when the resistance, number of repetitions, and speed are changed.

### **Ultrasound Therapy**

The first large scale application of ultrasound was around World War II. Sonar systems were being built and used to navigate submarines. It was realized that the high intensity ultrasound waves that were using were heating and killing fish. This led to research in tissue heating and healing effects. Since the 1940's ultrasound has been used by physical therapists for therapeutic effects in an effective manner. Therapeutic ultrasound refers generally to any type of ultrasonic procedure that uses ultrasound for therapeutic benefit. Ultrasound is a method of stimulating the tissue beneath the skin's surface using very high frequency sound waves, between 800,000 Hz and 2,000,000 Hz, which cannot be heard by humans.

### **Interferential Therapy (IFT)**

Interferential therapy was developed by Dr. Hans Nemeč in 1950. Interferential therapy is an effective therapy option used by many physiotherapy clinics to relieve pain and accelerate the self-healing process, getting your body back to a healthy, pain free state. The high frequency signals of an IFT penetrate through the skin into deeper lying muscle tissues. Electrodes are placed on patient's skin around the injured body part. The interferential current device then transmits electrical impulses in minute quantities through the skin. Underlying tissues and nerves are stimulated which begins the healing properties. These impulses are not painful in the least. Frequencies produced by the IFT have been proven to stimulate endorphins, the body's natural pain killers. This can help to create a self-healing process without the need to for medications.

### **Statement of the Problem**

The purpose of this study was to trace out the effects of ultrasound therapy, interferential therapy and combination of ultrasound therapy with interferential therapy in the treatment of anterior cruciate ligament (ACL) injury (sprain) of knee in sports.

### **Hypotheses**

In the light of the theoretical foundations laid so far on the treatment effects, the investigator hypothesized the following for the purpose of this study. It was hypothesized that the three treatments, namely, ultrasound therapy, interferential therapy and combination of ultrasound therapy with interferential therapy would significantly reduce pain and swelling, and improve range of motion for the anterior cruciate ligament (ACL) injury among injured players of knee.

### **Selection of Subjects**

The subjects were the students studying Master of Physical Education (M.P.Ed.), Bachelor of Physical Education (B.P.Ed) and Diploma in Physical Education (D.P.Ed.) in Rayalaseema College of Physical Education, Proddatur and also the students of other nearby Degree and P.G. Colleges in Proddatur, YSR Kadapa District, Andhra Pradesh, who got ACL injury and approached Physiotherapy Department of Rayalaseema College of Physical Education for treatment during the academic years 2014-15 to 2017-18. The players who reported pain, swelling and reduced range of motion were selected as subjects, by administering a brief questionnaire. 30 players suffering from ACL injuries of knee were selected as subjects for this study. The subjects were in the age group of 16 to 25 years. Further the subjects were randomly sub-divided into three groups consisting of 10 in each. Group I underwent ultrasound therapy, Group II underwent interferential therapy and Group III underwent combination of ultrasound therapy with interferential therapy.

### **Selection of Variables**

Several researches in the field of sports injuries pointed out that the common injury of knee is ACL injuries (SPRAIN). The acute level of the injury was determined through three common variables, namely, 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. **Pain** at and around the knee joint
2. **Swelling** may be of any degree near the knee joint and
3. **Range of Motion** due to ACL injury or bursitis of knee.

The selected **Independent Variables** for the study were as follows:

1. Ultrasound Therapy
2. Interferential Therapy
3. Combination of Ultrasound Therapy with Interferential Therapy

## II. Methodology

### Research Design of the Study

The methodology and design of experiments adopted in this study are discussed here. The experimental design used in this study was Random Group Design. Prior to the experimental treatments, all the subjects were measured pain, swelling and range of motion at knee joint. The experimental treatments were given to the subjects as per description and supervision of the experienced physiotherapist for fifteen days. All the subjects were tested prior to treatment and after completion of fifteen days of treatment on selected dependent variables namely, perceived pain, swelling and range of motion. The difference between initial and final means of pain, swelling and range of motion were considered as the effect of selected treatment on selected injury.

### Selection of Criterion Measures

The tests selected for this research are highly standardized, relevant to the study and ideal to assess the selected variables. Having the expert consultation in the field of physiotherapy, physical education and sports sciences, and scanning various literatures related to the study, the investigator has selected the following test items as criterion measures and used to collect the relevant data on selected dependent variables.

### Selection of Tests

After reviewing the available literature, the following standardized tests were selected and used to collect the relevant data on the selected dependent variables and they are presented in Table 1.

**Table1. Selection of Tests**

Variables	Test	Unit of Measurement
<b>Pain</b> due to ACL Injury (sprain)	Visual Analogue Pain Scale	In numbers
<b>Swelling</b> due to ACL Injury (sprain)	Swelling Measurement	In centimeters
<b>Range of Motion</b> due to ACL Injury (sprain)	Goniometric Measurement	In degrees

### Selection of Treatments

The following experimental treatments were given to the subjects as per the description given below under the supervision of medical officer and the investigator, who is a qualified physiotherapist.

#### Ultrasound Therapy

Experimental Group I underwent 15 days ultrasound therapy. The following mode of treatment was followed for ultrasound therapy.

#### Mode of Treatment

Mode of treatment	:	Continuous mode
Duration of treatment	:	10 minutes
Intensity	:	1.2W/cm <sup>2</sup>
Sitting per day	:	1 session
Duration	:	15 days

#### Interferential Therapy

Experimental Group II underwent 15 days Interferential therapy. The following mode of treatment was followed for interferential therapy.

Duration of treatment	:	10 minutes
Sitting per day	:	1 session
Total Duration	:	15 days

#### Combination of Ultrasound Therapy and Interferential Therapy

Experimental Group III underwent combination of ultrasound therapy with interferential therapy for 15 days. The following mode of treatment was followed.

For this group both ultrasound treatment with interferential therapy has given to the subject at the same time.

### Collection of Data

Prior to the start of the treatments, namely, ultrasound therapy, interferential therapy, and combination of ultrasound therapy with interferential therapy, scores on pain, swelling and range of motion 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 subjects. It was considered as a post test.

### Statistical Techniques

The differences between means of initial and final scores on selected criterion variables were subjected to statistical treatment using analysis of covariance (ANCOVA). When a significant difference among the treatment group was detected, a pair-wise comparison of the programs was done by Scheffe's post hoc test to identify significant differences between the treatment groups. In all the cases, 0.05 level of confidence was fixed to test the significance, which was considered as appropriate. The data were analyzed by computer using statistical packages.

### III. Analysis of the Data and Results of the Study

The data on each criterion variable of ACL injury (sprain) of the knee were analyzed separately and the results are presented below.

#### Results on Pain of ACL Injury (sprain) of Knee

The descriptive statistics on obtained data on pain of ACL injury (sprain) of knee due to ultrasound therapy (UST), interferential therapy (IFT) and combination of ultrasound therapy with interferential therapy (USIFT) are presented in table 2.

**Table 2. Analysis of Covariance for the Pre Test, Post Test and Adjusted Post Test Data on Pain of ACL Injury of Knee with Ultrasound Therapy (UST), Interferential Therapy (IFT) and Combination of Ultrasound Therapy with Interferential Therapy (USIFT) Groups.**

Tests / Groups		UST Group	IFT Group	USIFT Group	S O V	Sum Squares	df	Mean Squares	F ratio
Pre Test	$\bar{X}$	7.60	7.10	7.30	B	1.27	2	0.63	0.62
	$\sigma$	0.84	1.10	1.06	W	27.40	27	1.02	
Post Test	$\bar{X}$	3.30	3.00	1.20	B	25.80	2	12.90	5.83*
	$\sigma$	1.64	1.83	0.79	W	59.70	27	2.21	
Adjusted Post Test	$\bar{X}$	3.71	2.57	1.43	B	25.95	2	12.98	5.27*
					W	64.06	26	2.46	

\*Significant at 0.05 level of confidence.

SOV: Source of Variance; B: Between, W: within

The Table value for significance at 0.05 level with df 2 and 27 and 2 and 26 are 3.35 and 3.37 respectively.

The table 2 shows that the pre test means on pain of ACL injury of UST, IFT and USIFT groups are 7.60, 7.10 and 7.30 respectively. The obtained F ratio of 0.62 for pre test means is less than the table value of 3.35 for df 2 and 27 required for significance at 0.05 level. This shows that there was no significant difference in means of the groups at initial stage. The post test means on pain of ACL injury of UST, IFT and USIFT groups are 3.30, 3.00 and 1.20 respectively. The obtained F ratio of 5.83 for post test means is greater than the table value of 3.35 for df 2 and 27 required for significance at 0.05 level. This shows that there was significant difference in means of the groups at the end of treatment. The adjusted post test means on pain of ACL injury of UST, IFT and USIFT groups are 3.71, 2.57 and 1.43 respectively. The obtained F ratio of 5.27 for adjusted post test means is greater than the table value of 3.37 for df 2 and 26 required for significance at 0.05 level. The result of the study indicates that there is a significant difference among adjusted post test means of UST, IFT and USIFT groups on pain of ACL injury of knee. To determine the significance difference among the three paired means, the Scheffe's test was applied as post hoc test and the results are presented in Table 3.

**Table 3. Scheffe's Post hoc Analysis for the difference between the Adjusted Post Test Paired Means on Pain of ACL Injury of selected groups**

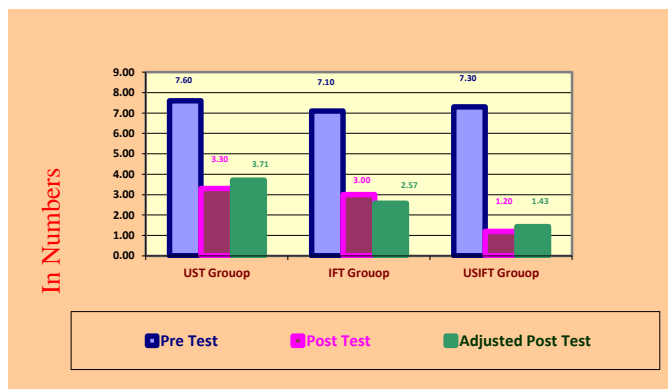
Adjusted Post Test Means			Mean Differences	Confidence Interval
UST Group	IFT Group	USIFT Group		
3.71	2.57	--	1.14	2.23
3.71	--	1.43	2.28*	2.23
--	2.57	1.43	1.14	2.23

\*Significant at 0.05 level of confidence.

Table 3 shows that the adjusted post test mean difference on pain of ACL injury between UST group and USIFT group is 2.28 which is greater than the confidence interval value 2.23. It may be concluded from the result that there is a significant difference between UST group and USIFT group on pain of ACL injury. Further the table III shows that the adjusted post test mean difference on pain of ACL injury between UST group and IFT group, and between IFT group and USIFT groups are 1.14 and 1.14 respectively

which are lesser than the confidence interval value 2.23. It may be concluded from the result that there is no significant difference between UST group and IFT group and between IFT group and USIFT groups on pain of ACL injury. The adjusted post test mean values on pain of ACL injury of ultrasound therapy (UST), interferential therapy (IFT) and combination of ultrasound therapy with interferential therapy (USIFT) groups are graphically depicted in Figure 1.

**Figure 1:** Bar Diagram Showing Pre Test, Post Test and Adjusted Post Test Means on ACL Injury Pain of UST, IFT and USIFT groups.



#### IV. Results of the Study and Discussion on Hypotheses

The results presented in tables II and III show the descriptive statistics, ANCOVA results and post analysis respectively on pain of anterior cruciate ligament (ACL) injury (sprain), due to the treatments, namely, ultrasound therapy (UST), interferential therapy (IFT) and combination of ultrasound therapy with interferential therapy (USIFT). The results proved that all the three treatment groups were able to reduce pain of ACL injury significantly. The formulated hypothesis No. 1 that the three treatments, namely, ultrasound therapy, interferential therapy and combination of ultrasound therapy with interferential therapy would significantly reduce pain of ACL injury of knee was accepted at 0.05 level. Further the results proved that the combination of ultrasound therapy and interferential therapy (USIFT) was found to be significantly better than the other two treatments, i.e. ultrasound therapy (UST) and interferential therapy (IFT) in reducing the pain of ACL injury at knee. The formulated hypotheses No. 4 that the combination of ultrasound therapy and interferential therapy (USIFT) would significantly reduce perceived pain of ACL injury, when compared to the other two treatments i.e., ultrasound therapy (UST) and interferential therapy (IFT) was accepted at 0.05 level.

#### V. Conclusions

From the analysis of the data, the following conclusions were drawn:

1. It was concluded that the three treatments, namely, ultrasound therapy, interferential therapy and combination of ultrasound therapy with interferential therapy have significantly reduced pain of anterior cruciate ligament (ACL) injury (sprain) of knee. It was further concluded that combination of ultrasound therapy with interferential therapy was significantly better when compared with the two other treatments, namely, ultrasound therapy and interferential therapy in reducing pain of anterior cruciate ligament (ACL) injury of knee.
2. It was concluded that the three treatments, namely, ultrasound therapy, interferential therapy and combination of ultrasound therapy with interferential therapy have significantly reduced swelling of anterior cruciate ligament (ACL) injury (sprain) of knee. It was further concluded that ultrasound therapy was significantly better when compared with the two other treatments, namely, interferential therapy and combination of ultrasound therapy with interferential therapy in reducing swelling of anterior cruciate ligament (ACL) injury of knee.
3. It was concluded that the three treatments, namely, ultrasound therapy, interferential therapy and combination of ultrasound therapy with interferential therapy have significantly improved range of motion of anterior cruciate ligament (ACL) injury (sprain) of knee. It was further concluded that combination of ultrasound therapy with interferential therapy was significantly better when compared with the two other treatments, namely, ultrasound therapy and interferential therapy in improving range of motion of anterior cruciate ligament (ACL) injury of knee.

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