



Effect of Ultrasound Therapy and Cryotherapy over Taping Technique in Patients with Acute Lateral Ankle Sprain

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Abstract: The sudden twisting of ankle which overstretches the ligaments to torn or sprain around the ankle joint can lead to pain and swelling. Pain and swelling is one of the major causes of concern in patients with acute lateral ankle sprain while performing physical and daily activity. The study aim was to find the effect of ultrasound therapy and cryotherapy over taping technique among patients with acute lateral ankle sprain. A total of 30 subjects with acute lateral ankle sprain participated in this study. Group A was given ultrasound therapy with cryotherapy for 30 minutes; Group B was given taping technique additional to ultrasound and cryotherapy. Pre and post test was done after 10 sessions of treatment. The outcome was measured for the participants by VAS score. Student's t-test, Mann Whitney test, Wilcoxon signed rank test were used to analyze data in this study. Group A and B have shown significant improvement after treatment. Comparative study found Group B, had significant changes by ultrasound therapy, cryotherapy and ankle taping technique over the Group A with $P < 0.001$, on reducing pain, swelling and improving earlier active performance. On the basis of the result, the study concluded that treatment with cryotherapy, ultrasound therapy and taping technique is better compared with cryotherapy and ultrasound therapy, and has more effect in reducing pain, swelling and improving earlier active physical performance.

Keywords: Lateral Ankle Sprain, Pain and Swelling, Ultrasound therapy, Cryotherapy, Ankle Taping Technique, Visual Analog Scale (VAS).

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Received On 29 January 2021

Revised On 11 May 2021

Accepted On 29 May 2021

Published On 01 July 2021

Funding This research did not receive any specific grant from any funding agencies in the public, commercial or not for profit sectors.

Citation Dr. Ramamurthy, Dr. Jibi Paul, Dr. Hepsibah Sharmil, Dr. Sathya P , Effect of Ultrasound therapy and Cryotherapy over Tapping technique in patients with Acute Lateral Ankle Sprain..(2021).Int. J. Life Sci. Pharma Res.11(4), 9-15
<http://dx.doi.org/http://dx.doi.org/10.22376/ijpbs/lpr.2021.11.4.L9-L15>

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1. INTRODUCTION

The term injury to the ligament is conventionally described as sprain. Ligament sprain is the most common injury to the foot and ankle joint. Ankle sprain is the most common type of ankle injury, as a sprain is stretching and tearing of ligament¹. Based on anatomical consideration, the ankle joint is a very complex mechanism and is also called Talocrural joint. Ankle joint is a big joint, modified hinge variety, synovial type of joint and the socket is formed by the distal articular surface of tibia and fibula, the intervening tibiofibular ligament and the articular surface of the malleoli, and these together constitute the ankle mortise². Acute lateral ankle ligament sprain is common in young athletes with 15-35 year of age³. Incidence and prevalence of ankle injury shows that ankle sprain is a common problem in acute medical care occurring at a rate of about 1 injury per 10,000 people a day injury in the lateral ligament complex of the ankle from a quarter of all sport injury³. Ankle ligament injuries are the most common sports trauma, accounting for 10 to 30 percent occur during plantar flexion, supination, and inversion. They are most common in soccer players but they also occur in basketball, volleyball and all sports that involve jumping and side stepping⁴⁻⁵. Lateral collateral ligament is weak compared to medial collateral ligament of Ankle joint. Medial collateral ligament (deltoid ligament) is a strong ligament on the medial side of the ankle joint. Calcaneofibular, posteriolateral fibular and anteriolateral fibular ligaments provide stability of the lateral side of the ankle joint. Any twist or sudden assault to the lateral side of the ankle joint leads to injury of those ligaments which lead to functional instability, pain and swelling around the joint⁶⁻⁹. The sudden twisting of the ankle overstretches the ligament causing them to get torn or sprained then torn around the ankle joint which can lead to pain and swelling. Pain and swelling is one of the major causes of concern in patients with acute lateral ankle sprained while performing physical and daily activity of life. This study was aimed to find the effect of ultrasound, cryotherapy and taping technique in patients with acute lateral ankle sprain. And also to compare the effect of ultrasound, cryotherapy combined with ankle taping over subjects receiving ultrasound and cryotherapy.

2. METHODOLOGY

Research approach, population, setting, sampling and selection tool, inclusion and exclusion (selection criteria), data collection, intervention procedure and analysis are the most important steps in the methodology.

2.1 Population

The subjects those who fulfill the selection criteria were the population of this study. All patients with acute lateral ankle sprain will constitute the population.

2.2 Setting of the Study

This study was conducted in the department of physiotherapy, ACS Medical College and Hospital, Dr. MGR. Educational and Research Institute, Chennai, India.

2.3 Sample and sampling method

The samples were acute lateral ankle sprain subjects with age groups between 20 to 35 year, selected for the study from the department of physiotherapy, ACS Medical College and Hospital, Chennai. Sampling method chosen for this study

was purposive random sampling method. Those subjects who fulfill the inclusion criteria were equally divided for group A and group B. Here 30 subjects were selected randomly and 15 subjects each were equally allotted to group A and group B by lottery method.

2.4 Inclusion Criteria

Subjects with acute lateral ankle sprain, age group between 20 to 35 year, both the gender (male and female), moderate pain screened by VAS, and subjects with unilateral acute ankle sprain were included in this study.

2.5 Exclusion Criteria

Metal implants, Sensory deficit, Open wound, Fracture, Bilateral acute lateral ankle sprain and subjects who undergoing analgesics & anti-inflammatory drugs also were excluded from the study.

2.6 Data Collection

Pre and post treatment assessment of both the groups were taken with Visual Analogue Scale (VAS) for pain, a post assessment was taken after 20 days with the same tool for pain.

2.7 Selection of Tool

In our research work for to be accurate and reliable the selection of tools by the researcher were assured for accuracy, valid and properly supported by the literature.

Tools used in the study

2.8 Visual Analog Scale

This tool is used to measure pain among the subjects with lateral ankle injury. In this scale, zero to ten score is marked and subjects are asked to mark the level of severity of pain. In this study, VAS of 10 cm was used and marked according to the standardized format, where zero indicating no pain, 10 indicating unbearable pain. The patients were asked to mark according to the level of self-assessment. Both pre and post VAS scores were taken for the group A and group B.

2.9 Orthopedic Assessment Chart

In assessment chart all the subject information was used in the study. The main use of this chart is for collecting and categorizing the data obtained in the correct format, which helps the researcher for making the master chart. All the subjects of both group A and group B were using the same orthopedic assessment chart in order to maintain the validity and reliability of the research work.

2.10 Material used

Ice pack, Ultrasound machine, Adhesive tape, tapping scissor, micropore (pre tape material)

2.11 Ice Pack

It is one of the best methods of treatment for immediate relief of pain and swelling in acute soft tissue injuries.

The crushed ice pack is kept in a plastic bag wrapped in a towel and it is molded to the foot and ankle, thereby increasing the contact area for 15-20 minutes^{9,10}.

2.12 Ultrasound machine

It is a mechanical radiant energy derived from the application of an electric current on a crystal, which results in a vibratory motion. Ultrasound therapy has applied pulse mode. The wave shows in short pulses which accelerate the tissue healing. It is used in sprain, strain and muscle tear with a starting dose in acute, 0.8w/cm square for 5 minutes twice daily and 3 times per week and in chronic and 2.0w/cm square for 10 minutes and 3 times per week^{8,14,15}.

2.13 Grouping of patients

After screening the subject for inclusion and exclusion criteria, informed consent were taken from each subject in this study and subject's age was 20-35 year. 30 subject were equally divided into group A (n =15), group B (n =15). In group A, age group of 20 year were 1 (6.7%) subjects. Age group of 21-25 year was 6 (40.0%) subjects, age groups of 26-30 year were 3 (20.0%) subjects, and ages of 31-35 year were 5 (33.3%). In group B, age group of 20 year were 1(6.7%) subjects, age group of 21-25 year were 4 (26.7%) subjects, age group of 26-30 year were 5 (33.3%) subjects. Age groups of 31-35 year were 5 (33.3%) subjects who have participated in our study. In this study both male and female subjects were included. In group A 9 (100.0) male and 6 (100.0) female were participated. In group B 10 (100.0) male and 5 (100.0) female participated. Samples were sex matched. Before starting the treatment the subject is positioned

comfortably and assessed thoroughly about his or her condition. Pre and post test using visual analog scale were evaluated for both the groups

2.14 Protocol for the treatment

2.14.1 Group A

The group A was treated with ultrasound and cryotherapy alone for 30 minutes for 10 sessions. Frequency of the total treatment for group A was 10 sitting on alternative days. Post tests have been done after 10 sessions of treatment. In each sitting, subject of the group A received an ice pack for 20 minutes and followed by ultrasound in pulse mode of 1:4 ratio and intensity of 0.3 w/cm square for 10 minutes. Subject were made to lie down on plinth in side lying position with flex hip, knee and ankle joint placed in normal lateral view and one pillow is given under the head and another under the knee for proper comfortable position during the treatment session. Both treatment modalities, cryotherapy and ultrasound has given in side lying position. Before giving the ultrasound therapy affected area should be clean with cotton swab with water, then therapist applies little gel to the lateral side of ankle over the skin and places the head of the ultrasound machine on the skin, moving in small circle. Frequency of ultrasound treatment was 10 minute, ultrasound is applied in acute lateral sprain in pulse mode of 1:4 ratio and intensity of 0.3w/cm square for 10 minutes. After finishing the ultrasound treatment session , affected area were cleaned with cotton swab for hygienic purpose and the patient is prepared to receive cryotherapy (ice pack)



Fig.2: Subject receiving ultrasound therapy on Ankle Lateral Sprain

Again before giving the ice pack treatment, the patient is made to lie in a comfortable position and explained properly. Generally ice packs can be made by placing crushed ice in a plastic bag is wrapped in a towel. Rest period was given for next treatment session for some time to relax the patient and the patient is prepared for the next treatment. Rest time is not included in the treatment session. Treatment was given once in a day for 30 minutes in alternative days for 10 sittings. After 10 session of treatment program the subject's pain in acute lateral ankle sprain and improvement of physical function and pain was assessed by visual analog scale in a similar way to the pre-treatment evaluation

2.15.2 Group B

The group B was treated with ultrasound, cryotherapy and ankle taping for 30 minutes for 10 sessions. Frequency of total treatment for group B was 10 sittings on alternative days. Posttests have been done after 10 sessions of treatment. In each sitting, subject of the group B received ice pack for 20 minutes and followed by ultrasound in pulse mode of 1:4 ratio and intensity of 0.3 w/cm square for 10 minutes. Subjects were made to lie down on plinth in side lying position with flex hip, knee and ankle joint placed in normal lateral view and one pillow is placed under the head

and another under the knee for proper comfortable position

during treatment session



Fig.3: Subject Receiving Cryotherapy on Ankle Lateral Sprain

Both treatment modalities, cryotherapy and ultrasound was given in side lying position, and before giving the ultrasound therapy the affected area was kept clean with cotton swab with water. The therapist applied little gel to the lateral side of ankle over the skin and placed the head of the ultrasound machine on the skin, usually it move in a small circle⁸. Frequency of ultrasound treatment is 10 minute, ultrasound is applied in acute lateral sprain in pulse mode of 1:4 ratio and intensity of 0.3w/cm square for 10 minutes, after finishing the ultrasound treatment session affected area kept clean with cotton swab for hygienic purpose then prepare the patient to receive cryotherapy (ice pack)¹⁰.

2.16 Subject receiving ultrasound therapy on Ankle Lateral Sprain

Again before giving the ice pack treatment, the patient is made to be in a comfortable position and explained properly. Generally ice packs is made by placing crushed ice in a plastic bag and is wrapped in a towel. A good alternative is using a bag of pre packed frozen corn kernels wrapped in a towel. Such an ice pack allows it to get molded to the foot, thereby increasing the contact area. Ice packs are usually placed for 20 minutes. Ice pack is the first line of anti-inflammatory treatment, and if used appropriately, it significantly decreases the healing time and also minimizes swelling. Rest was given before the next treatment session for some time just to relax the patient and preparation of next treatment was made as soon as finishing the ultrasound treatment immediately the ice pack was placed. Rest time does not

include the treatment session. Treatment was given once in a day for 30 minutes for alternative days for 10 sittings. After 10 sessions of the treatment program, the subject's pain in acute lateral ankle sprain improvement of physical function was assessed by visual analog scale in a similar way to the pre-treatment evaluation. At the end of each sitting, subject in group B was immobilized at the ankle with adhesive tape. When the total treatment session has completed, the subject in both the groups were taken for post VAS score measurement.

2.17 Ankle Taping Procedure (Closed Basket Weave Technique)

At the end of each sitting, subject in group B were immobilized with the ankle taping (adhesive tape), by closed basket weave technique. This technique is effective on soft tissue healing by supporting the injured area. A 2 inch non elastic tape, taping scissor, pre tape material was used (micro pore). Patient was asked to sit on a taping table or bench with legs extended at the edge of it with the foot in 90 degree dorsiflexion. Taping is applied directly to the skin over the heel and lace area which provided additional adherence and lessen the irritation to the injured side. Prior to the application, the body part was cleaned, dry and freed of hairs. Step one is to apply one layer of pre tape material followed by using 2 inch non elastic tape ((adhesive tape), two anchor strips were applied around the distal lower leg, inferior to the gastronomies with moderate roll lesion.



Fig.3: Subject receiving taping on Ankle Lateral Sprain

An anchor strip can be placed around the mid foot, proximal to the fifth metatarsal head, if needed. If this anchor strip is applied, monitor roll lesion to prevent constriction as the foot expands upon weight bearing. Pre tape material of 2 inch width was used for these anchors to prevent constriction. In the third step the medial lower leg is stirred up by preventing and treating inversion sprain and proceeded down over the posterior medial malleolus. Then round the plantar surface of the foot and followed up over the posterior lateral malleolus with moderate roll lesion.

2.18 Ethical Clearance

This study has obtained ethical clearance to conduct from the Faculty of Physiotherapy, DR.MGR. Educational and Research Institute, Chennai, with reference number: F-13/PHSIO/IRB/2018-19 dated 08/04/2019.

3 STATISTICAL ANALYSIS

Data analysis was done by using SPSS version 20.0 software with 95% confidence interval. 30 samples were recruited for the study. Demographic data of Group A and B was studied descriptive data analysis. Comparison of VAS score within Group A and B was analyzed Using Wilcoxon Signed Rank Test and Comparison of VAS Score between Group A and B was analyzed using Mann-Whitney test.

4 RESULTS

After screening the subject by inclusion and exclusion criteria, informed consent was taken from each subject. The subjects were aged between 20-35 year. 30 subjects were equally divided into n=15 to each Group A and Group B.

Table-1: Age and sex distribution of Group A subjects

Age (yrs)	Male Number (%)	Female Number (%)	Total Number (%)
≤20	1 (11.1)	-	1 (6.7)
21-25	3 (33.3)	3 (50.0)	6 (40.0)
26-30	2 (22.3)	1 (16.7)	3 (20.0)
31-35	3 (33.3)	2 (33.3)	5 (33.3)
Total	9 (100.0)	6 (100.0)	15 (100.0)

Table-2: Age and sex distribution of Group B subjects

Age (yrs)	Male Number (%)	Female Number (%)	Total Number (%)
≤20	1 (10.0)	-	1 (6.7)
21-25	2 (20.0)	2 (40.0)	4 (26.7)
26-30	4 (40.0)	1 (20.0)	5 (33.3)
31-35	3 (30.0)	2 (40.0)	5 (33.3)
Total	10 (100.0)	5 (100.0)	15 (100.0)

Table-3: Comparison Of VAS Score Within Group A Using Wilcoxon Signed Rank Test

Time Interval	No. Of Subjects	Mean	SD	Z-Test	P-Value
Pre-test	15	7.07	1.39	2.720	<0.007
Post-test	15	5.80	1.47		

The VAS score in the present study (Table-3) was analyzed using Wilcoxon signed rank test. It has revealed that in the group A, the Mean \pm SD of pain, the pre-test was 7.07 ± 1.39 , which has got decreased in post-test to 5.80 ± 1.47 , which is found to be statistically highly significant ($z=2.720$, $p<0.007$) which indicates that there was a significant improvement in the reduction of pain after intervention. Thus, the selected ultrasound therapy and cry therapy has produced significant improvement in the reduction of pain of the subjects.

Table-4: Comparison Of VAS Score Within Group B Using Wilcoxon Signed Rank Rest

Time Interval	No. Of Subjects	Mean	SD	Z-Test	P-Value
Pre-test	15	7.53	1.41	3.430	<0.001
Post-test	15	3.00	1.20		

The VAS score in the present study (Table-4) was analyzed using Wilcoxon signed rank test. It has revealed that in the group B, the Mean \pm SD of pain, the pre-test was 7.53 ± 1.41 , which has got decreased in post-test to 3.00 ± 1.20 , which is found to be statistically highly significant ($z=3.430$, $p<0.001$) which indicates that there was a significant improvement in the reduction of pain after intervention. Thus, the selected ultrasound therapy, cry therapy and ankle tapping technique have produced significant improvement in the reduction of pain of the subjects.

Table-5: Comparison of VAS Score between studies groups using Mann-Whitney test

Time interval	Study group	No. of subjects	Mean	SD	Z-value	P-value
Pre-test	Group A	15	7.07	1.39	0.828	>0.408
	Group B	15	7.53	1.41		
Post-test	Group A	15	5.80	1.47	4.204	<0.001
	Group B	15	3.00	1.20		

In this study it was noticed that (Table-5) the comparison of the variables of VAS score between the group A and group B, the pre-test scores of pain in both group A and group B were compared for analysis. The pretest score of Mean \pm SD of group A was 7.07 ± 1.39 and for group B was 7.53 ± 1.41 . However, there was not statistical significance ($z=0.828$, $p>>0.408$) during pretest. Nevertheless, during post-test, scores of both group A and group B were compared for analysis, showing that the post test score of pain in group A was Mean \pm SD 5.80 ± 1.47 and for group B was 3.00 ± 1.20 , and it was observed that there is a statistical significance between the groups ($z=4.204$, $p<0.001$) which implies that the group A has less mean VAS compared to group B, and thus indicates that the cryotherapy, ultrasound therapy and tapping technique is better compared with the cryotherapy, ultrasound therapy

5 DISCUSSION

The term injury to the ligament are conventionally described as sprain. Ligament sprain is the most common injuries to the foot and ankle joint. Ankle sprain is the most common type of ankle injury, as a sprain is stretching and tearing of lateral ligament^{10, 11}. Acute lateral ligament ankle sprain is characterized by pain, swelling, bruising, loss of function and loss of movement that can be treated with ultrasound therapy, cryotherapy and ankle taping. To compare the effect of ultrasound therapy and cryotherapy over taping technique in patients with acute lateral ankle sprain have received considerable attention by the research community^{8,9,10,12}. Many studies have supported the effect of cryotherapy on reduction of pain and swelling in acute soft tissue injuries. It has immediate and deep analgesic effect on severe pain and it accelerates tissue healing process by reflex vascular dilatation and followed by the vascular contraction¹³. This study, analyzed the influence of combined effect of ultrasound therapy and cryotherapy over Taping techniques in patients with acute lateral sprain subjects. This was assessed with visual analog scale score¹⁴. Effect of ultrasound therapy and

cryotherapy over taping techniques combined with ultrasound therapy and cryotherapy in patients with acute lateral ligament sprain, has been evaluated in this study. The subjects in group A were treated with ultrasound and cryotherapy, the subject in group B was treated with ultrasound, cryotherapy and ankle taping. The effectiveness of the intervention was assessed with visual analog scale¹⁵. Group A treated with ultrasound and cryotherapy. Group B treated with ultrasound, cryotherapy and ankle taping, showed better improvement than the Group A.

6 CONCLUSION

In the field of health care systems including medicine, physiotherapy and even mechanical engineers have attempted in different ways to find solutions for reducing the pain, swelling and improving their physical function activities. Physiotherapy has developed different types of treatment modalities systematically for pain, swelling and physical functional activities in acute lateral ankle sprain. The data analysis also showed the reduction of pain, swelling and improvement of physical function during the post test in both the groups after treatment in patients with acute lateral ankle sprain.

7 AUTHORS CONTRIBUTION STATEMENT

Dr. Ramamurthi has been involved in the conceptualization of the study and data collection, Dr. Jibi Paul has contributed towards the methodology and discussion part in manuscript. Dr. Hepsibah Sharmil was involved in analysis and interpretation of results and Dr. P. Sathya contributed to the introduction and writing of the manuscript. All authors collectively contributed their valuable work for the final manuscript.

8 CONFLICT OF INTEREST

Conflict of interest declared none.

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