International Journal of Childhood and Development Disorders

E-ISSN: 2710-3943
P-ISSN: 2710-3935
IJCDD 2024; 5(1): 43-47

https://www.rehabilitationjournals.com/childhood-development-disorders/
Received: 23-03-2024
Accepted: 25-04-2024

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Effectives of ultrasound and plyometric training on pain range of motion and functional ability among football players with lateral ankle sprain -a simple experimental study

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Abstract
Background of the study: Ankle sprain is the common musculo skeletal injury in sports. It is due to inversion of a supinated plantar flexed foot. When roll, twist or turn the ankle leads to stretch or tear the ligament. It is caused by falls (ankle twist) poor landing during jumping, playing.
Objectives: The study's primary objective was to find out the effectiveness of multiple therapeutic interventions consisting of ultrasound therapy and plyometric training on lateral ankle sprain subjects.
Subjects and Methods: A Pre-test and post-test simple experimental study design was used. A criteria –based convenient sampling was used to recruit patients (N=15) diagnosed with lateral ankle sprain. A single group was exposed to ultrasound therapy and plyometric training for the period of 8 weeks. The effectiveness of treatment was measured through Foot and Ankle Disability Index Scale and Sports Module and Goniometer. The paired 't' test was employed to study treatment effectiveness. A p- value ≤ 0.05 was considered significant.
Result: The group which was exposed to the treatment of ultrasound therapy and plyometric training showed a better reduction of pain (Pre and post –test mean difference 41.7 and 85.0) in the Foot and Ankle disability index scale and sports module and improvement of functional ability (Pre and post – test mean difference of Dorsiflexion 19.67 and 30.37, Plantar flexion 5.33 and 12.67, Inversion 9.33 and 15.67, Eversion4.33 and 7.33) in the Goniometer. So the ultrasound therapy and plyometric training at 0.05 levels of significance.
Conclusion: There is a significant reduction in pain and improvement in functional ability following the application of 8 weeks of ultrasound therapy and plyometric training in lateral ankle sprain subjects.
Clinical implication: Ultrasound therapy and plyometric training are produce a significant effect to manage lateral ankle sprain subjects.

Keywords: Lateral ankle sprain, ultrasound therapy, plyometric training, foot and ankle disability index and sports module, goniometer

Introduction

The ankles are important parts that play the role of weight bearing and the role of adjusting lower limb movements during walking and exercise, which are important in daily living [1]. Ankle sprain is the common musculoskeletal injury in sports. It is due to inversion of a supinated plantar flexed foot. The ligaments plays an important role in stabilizing the joints and preventing excessive movements [2]. When roll twists or turns the ankle leads to stretch (or) tear the ligament. The lateral ligament is mainly is affected by twisting movements of the sports [3]. Anterior talofibular ligament (ATFL) provides stability for movement of the talus such as inversion. Posterior Talofibular ligament (PTFL) resist ankle dorsiflexion, adduction, etc. Calcaneo fibular ligament used to stability against maximum inversion (sub talar joint). Anterior talofibular ligament followed by calcaneo fibular ligament [4]. Plantar flexion due to excessive elongation and tension of the anterior talofibular ligament. It combined with forced inversion and plantar flexion because increased ligament stress and strain beyond the stretch point (or) ever ultimate failure strain complete tear. Generally, acute conditions are those that have been present for 7 to 10 days, sub-acute conditions have been present for 10 days to 7 weeks, and chronic conditions or symptoms have been present for longer than 7 weeks [5].

The ankle is one of the most common sites of injury in sports, with ankle sprains accounting for 85% of all ankle injuries. It is estimated that 70% of all high school players have a history of an ankle sprains, with an 80% recurrence rate.

The high rate of injury and especially reinjure seen either ankle sprains has challenged the clinical community to provide better rehabilitative as well as prophylactic strategies to reduce the incidence rate [6]. The ankle sprain is probably the single most common injury in sports. 85% of ankle injuries being ankle sprain, approximately 27000 ankle sprains daily in the United States. Survey comprised of (male 112, female 101) basketball players of an age groups 17 to 25 years in Punjab [6]. In systematic review and meta-analysishave 181 studies were considered female: male ratio (13.6:6.94) Athletics 7 / 1000 [7]. Ankle sprain are common in athletes (especially in runners and joggers). This may affect future athletic performance and put the athlete greater risk for re – injury. The athlete ‘’going over on’’ the ankle, so the sole of the foot faces inwards and results in pain, swelling, and limitations of movements. While injury to the ligaments may result in decreased mechanical instability of the ankle, neuromuscular deficits are also likely to occur as aresult of injury to the nervous and musculo – tendinous tissue [8]. Restriction of dorsiflexion would normally be expected to limit gait and other functional activities. At least 10 degrees of dorsiflexion is required for normal walking, descending stairs and kneeling, whereas running requires 20 to 30 degrees of dorsiflexion [9]. Gait limitations have been reported, people with ankle sprains walk slowly and take smaller steps.

Ankle sprain has three grades

Grade 1: No laxity, minimal pain and mild swelling.

Grade 2: Mild to moderate laxity, soft tissue swelling anterior drawer and talar tilt is slight positive. Grade 3: Severe swelling and pain the anterior drawer and talar tilt is highly positive.

The causes of ankle sprain are Falls, Poor landing during jumping, Playing, Another person landing an foot during sports activities such as running, walking, etc.

The clinical symptoms are, Pain, Swelling, Tenderness, Stiffness, Inability to put weight Redness and warmth [10]

The conservative management to treat ankle sprain are, PRICE (Prevention, Rest, Ice, Compression, and Elevation) drugs improve healing and speeds recovery, Mobilization, strengthening, taping, PNF, etc. [14].

The mechanism of injury in ankle sprains usually occur during a rapid shift of body center of mass over the landing or weight bearing foot. The ankle rolls outwards, whilst the foot turns inward causing the lateral ligament to stretch and tear. When a ligament tears or is overstretched its previous elasticity and resilience rarely returns. Lateral ankle sprains are referred to an inversion ankle sprains or as supination ankle sprains. It is usually a result of a forced plantar flexion/inversion movement, the complex of ligaments on the lateral side of the ankle is torn by varying degrees.

Ultrasound therapy works by alternating compression and rarefaction of sound waves with a frequency of more than 20,000 cycles per second. Therapeutic ultrasound may have two types of benefits, namely thermal and non -thermal effects. Thermal effects aid in pain relief whereas non – thermal effects in enhance cell repair effects of the inflammatory response. Reduction in pain and induce tissue repair helps in regaining their ROM.

Plyometrics has roots in the greek word “’pleythyein ’which means to increase or augment. Plyometrics is a type of exercise which utilizes the stretch shortening cycle of musculotendinous tissue. Eccentric stretching is followed by concentric shortening of the same muscles. Often involves rebound activities. The combination of eccentric and concentric action forms of a natural type of muscle function called the stretch shortening cycle. Plyometrics activities may facilitate neural adaptation that enhances proprioception, kinesthesia, and muscle performance characteristics. Plyometrics jump training continued over a long period of time during adolescent growth may increase peak bone mass. Exercise aimed at combining strength, speed and explosive force are defined as plyometric exercises. Plyometrics are exercises in which muscle exerts maximum force in short intervals of time, with the goal of increasing power. This training focuses on learning to move from a muscle extension to a contraction in a rapid or explosive manner.

The phases of plyometrics are

- Eccentric phase (Loading phase)
- Amortization (Coupling or time to rebound phase)
- Concentric phase (Rebound phase)

Most sports require various kind of high and low muscle strength with fast or slow speed. Plyometrics training is widely used as a method to develop explosive power capacity in sports that require jumping ability. Plyometric training is a type of muscle strength exercise that can improve the basic physical strength. It has been extensively studied for its ability of improving exercise performance. It uses muscle stretch reflexes and stretch shortening cycles to develop lower extremity muscle. Plyometrics training leads to the development of explosive power and reactive speed of the muscle system based on the improvement of the CNS reactivity and the power, which is needed for absorbing the stress when loading. This method is based on there flexes of muscle fiber contraction, which gives a response to the quick stretch caused mostly by kinetic energy during the deceleration movement phase. In addition to contractile and elastic muscle attributes, there is improvement in the muscle proprioception and toleration for the stretching (stretching produces elastic energy and along with it the energy of muscle contraction is growing). This can influence muscle activity even with a well-trained athlete and can evoke not only an adaptation of the neuromuscular function, but also a metabolic function.

Methodology

Study design: A pre – test and post- test simple experimental study was used with single group to assess the effectiveness of Ultrasound therapy And plyometric training on pain range of motion and functional ability among football players with lateral ankle sprain

Subjects: All those patients complaining of pain and limited functional ability visiting the outpatient department of PPG college of physiotherapy, Coimbatore formed the population for this study. Among them, those patients (N=15) are diagnosed to have lateral ankle sprain were recruited using criterion based sampling approach. Before selection, all the subjects were examined by the physician to exclude Neuromuscular disorder, Acute inflammation around the

ankle joint, History of fracture of foot or ankle, Marked ankle instability, Post-surgery history of ankle ligaments. Grade 1and 3 ankle sprains. The criteria adopted to include the subjects with lateral ankle sprain consists of Age between 18 to 25 years, Male football players, Grade 2 Ankle sprain (SUB –ACUTE), Pain intensity 5 to 7 on visual analogue scale, Subjects with restricted ROM Positive anterior drawer test and Talar tilt test.

Methods: After obtaining the informed consent, the single group consist of 15 subjects using a purposive sampling technique before applying the planned therapeutic interventions. The demographic characteristics of the subjects are shown in table 1. All the subjects (N=15) were identical before the application of selected therapeutic interventions (p>0.05). The single group subjects were exposed to ultrasound therapy and plyometric training. All the therapeutic interventions were 8 weeks. In order to study the effectiveness of the therapeutic interventions Goniometer and foot and ankle disability index score and sports module outcome parameter were chosen.

Description of experimental intervention

Ultrasound therapy: Ultrasound used to reduce pain, repairing inflammatory cells, and increased ROM in ankle sprain. The position of the patient is supine lying and the position of the therapist is standing by the side of the patient. The Preparation of the patient is skin should be washed and dirt should be removed. Then check for local contraindications. The nature of the treatment is explained to the patient. Method of application: The treatment head is moved continuously over the surface while even pressure is maintained to iron out irregularities in the sonic field. The emitting surface must be kept parallel to the skin surface to reduce the reflection and pressed firmly to prevent air bubbles. The method of application id concentric circles and overlapping circle should be performed. The technique of application is direct contact method. The Mode is Continuous mode. The Frequency is 0.75to 1MHz (penetrate deeply). The Intensity is 0.1 to 0.25 /CM^2

- **Plyometric exercise:** Plyometric are exercise in which muscles exert maximum force in short interval of time, with the goal of increasing power. Studies suggest that the functional performance is increased by plyometric exercises. Totally 6 weeks .3 days per week.10-15 min of warm up (slow walking). 25-40 min of plyometric program. 10-15 min of cool down (slow jogging and slow stretching). First 3 weeks -3 sets*12 repetitions.Next 3 weeks – 4 sets*12 repetitions.1 minute rest in between each sets and 15 sec between repetitions.

The plyometric exercises are Box jump, Drop jump, overhead slam, plyometric pushups, split squat jump, squat jump.

Statistical analysis

Data were analyzed by using Goniometer, Foot and ankle disability index score and sports module. The pre and post test scores were documented. The pre and posttest is increase (p≤0.05) after receiving the therapeutic interventions.

Results: The group which was exposed to the treatment of ultrasound therapy and plyometric training showed a better reduction of pain (Pre and post –test mean difference 41.7 and 85.0) in the Foot and Ankle disability index scale and sports module and improvement of functional ability (Pre and post –test mean difference of Dorsiflexion 19.67 and 30.37, Plantar flexion 5.33 and 12.67, Inversion 9.33 and 15.67, Eversion4.33 and 7.33) in the Goniometer. So the ultrasound therapy and plyometric training at 0.05 levels of significance.

Table 1: Comparison of the improvement of functional ability of the subjects with lateral ankle sprain among single experimental group between the pre-intervention and post- intervention phase.

Dependent variable	Groups	Pre-intervention stage		Post – intervention stage		T value
Functional ability	Single group	Mean 41.7	SD 1.97	Mean 85.0	SD 2.89	16.3

*Significant at 0.05 levels (p≤0.05)

From the table 2, it is inferred the singe group was exposed to the treatment combinations of ultrasound therapy and plyometric training showed a better reduction in pain and improvement in functional ability (Pretest mean 41.7and posttest mean 80.5) at 0.05 levels of significance.

Discussion

This study is the documentation of the effectiveness of ultrasound therapy and plyometric training on pain and functional ability among football players with lateral Ankle sprain. Ankle sprain is the common musculoskeletal injury in sports. It is due to inversion of a supinated plantar flexed foot. The ligaments plays an important role in stabilizing the joints and preventing excessive movements [2]. When roll twists or turns the ankle leads to stretch (or) tear the ligament. The lateral ligament is mainly is affected by twisting movements of the sports [3]. Anterior talofibular ligament (ATFL) provides stability for movement of the talus such as inversion. Posterior Talofibular ligament (PTFL) resist ankle dorsiflexion, adduction, etc. The high rate of injury and especially reinjure seen either ankle sprains has challenged the clinical community to provide better rehabilitative as well as prophylactic strategies to reduce the incidence rate [6]. The ankle sprain is probably the single most common injury in sports. 85% of ankle injuries being ankle sprain, approximately 27000 ankle sprains daily in the United States. Survey comprised of (male 112, female 101) basketball players of an age groups 17 to 25 years in Punjab [6]. In systematic review and meta-analysishave 181 studies were considered female: male ratio (13.6:6.94) Athletics 7 / 1000 [7]. Ankle sprain are common in athletes (especially in runners and joggers)**.** The causes of ankle sprain are Falls, Poor landing during jumping, Playing, Another person landing an foot during sports activities such as running, walking, etc. The clinical symptoms are, Pain, Swelling, Tenderness, Stiffness, Inability to put weight Redness and warmth [10].

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Therefore, this study implies to investigate the functional ability to performance after the 8 weeks in ultrasound therapy and plyomteric traning among football players with lateral ankle sprain. The vital scope of the study is to find out effects of ultrasound therapy and plyomteric traning among football players with lateral ankle sprain subjects.

The study design was simple experimental study. The subject selected using a purposive sampling technique. The age groups of the participants included in this study 18 to 25 years. In this study 15 male football players were included. Totally 15 subjects were take under the inclusion criteria for this study.

The need and objective of the study was clearly explained to ethical committee of PPG college of physiotherapy. After getting the approval, the study was conducted at PPG institution, Coimbatore.

The ankle sprain patients showed significant improvement in performance following 8 week of ultrasound therapy and plyometric training.

The statistical tools used for the data analysis is paired t test. The paired t test is used to find out the statistical significance between pre -test and post- test of lateral ankle sprain patients. The statistical report to shows that there was significant improvement in post- test values than the pre-test values of functional ability which are assessed by using goniometer and foot and ankle disability index score and sports module. The calculated t value of above-mentioned tests was greater than the table t value 2.145 for degree of freedom (df-14) at 5% level of significance.

Hence, the null hypothesis is rejected and the alternative hypothesis is accepted. Further this study suggests that the ultrasound therapy and plyometric training can be recommended for the reduction pf pain and improvement in functional ability among lateral ankle sprain subjects.

Limitations

1. Size of the sample was very small.
2. The study duration was of short duration.
3. The outcome was measured by Foot and ankle disability index scale and sports module and goniometer.
4. It is a simple experimental study; comparative study can also be done.

Further direction of this study

1. Further studies can be conduct with a large sample size is required to establish the effect of treatment.
2. Further studies can be done with more treatment time.
3. Further studies can be conducted with more subjects.
4. Future research can be conducted with a bigger sample size, wider age group, different variables, more consistent outcome measures and different treatment durations.

Conclusion

The study finally concluded that there was statistically significant reduction in pain improvement in functional ability and range of motion after ultrasound along with plyometric training for 8 weeks among patients with lateral ankle sprain.

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