Effect of cyclic stretch exercise on lateral ankle sprain

Ahmed. M. Attia.[1], Amira. H. Mohammed. *[2], Nader I. El Sayed[3].

[1]Level Five, Faculty of Physical Therapy, Delta University for Science and Technology, Egypt.

*[2]Lecturer in the Department of Physical Therapy for Pediatric, Faculty of Physical Therapy, Delta University for Science and Technology, Egypt.

[3]Lecturer in the Department of Physical Therapy for Musculoskeletal Disorders and its Surgery, Faculty of Physical Therapy, Heliopolis University, Egypt.

Abstract:

Background: Patients with lateral ankle sprain often suffer from pain, swelling and instability at the lateral side of the ankle due to inversion injury of the ankle.

Aim: The purpose of this study was to investigate the effect of cyclic stretching exercise on pain severity and swelling of the ankle in patients suffering from lateral ankle sprain.

Methods: Sixteen patients participated in this study suffered from the lateral ankle sprain. Patients were treated by cyclic stretching exercise, each cycle of stretch is held between 5 to 10 seconds. Cyclic stretch was applied as 2 bouts/each bout/4 cycles per min. All subjects were assessed just before the session and immediately after the finishing the session of cyclic stretch for severity of pain and ankle swelling by using the visual analogue scale and tape measurement respectively.

Results: There was a significant reduction in pain severity and ankle swelling for patients treated by cyclic stretching exercise.

Conclusion: Cyclic stretch was effective in the treatment of lateral ankle sprain.

Keywords: lateral ankle sprain, cyclic stretch, pain, VAS, swelling, tape measurement.

Corresponding author Address: 69 Al Kaser Al-Ani Street, Cairo City.

Tel: +2 01144495063 / +2(02) 23683225.

E-mail addresses: amira.hussien@deltauniv.edu.eg (A. H. Mohammed), Naderibrahim2002@yahoo.com (N. I. El Sayed).

1. Introduction:

Ankle Joint is a hinge joint formed by the distal end of the tibia, tibial and fibular malleoli and dome of the talus. It is confined by a relatively fragile capsule. It is supported medially by the medial collateral ligament and laterally by the lateral collateral ligaments: anterior talofibular (ATFL), posterior talofibular (PTFL) and calcaneofibular (CFL) [1]. Talocrural joint (TC) is inclined fourteen degrees from the transverse plane and twenty-three degrees from the frontal plane. The oblique orientation of this axis mandates that motion at the TC joint occurs in a triplanar fashion, but that the majority of motion occurs within the sagittal plane [2, 3].

The axis of subtalar joint motion is considered to be approximately forty-two degrees superior to the transverse plane and sixteen degrees medial to the sagittal plane allow a great range of inversion and eversion [4]. Anterior talofibular (ATFL) stretched in inversion and plantar flexion movement. The injury is often caused by excessive inversion or by horizontal plane adduction (internal rotation) of the ankle, especially when combined with plantar flexion. This ligament is the most common injured between three lateral ankle ligaments [5]. Calcaneofibular (CFL) ligament primarily resists inversion and injury is often caused by excessive inversion movement. This ligament is commonly injured after ATFL [6]. Posterior talofibular (PTFL) is the strongest of the lateral ligament complex and rarely injured. It limits excessive abduction (external rotation) of the talus and inversion, especially when the ankle is fully dorsiflexed [7].

Inversion ankle sprains are the most common; represent 85% of all ankle sprains. It is known that the incidence of lateral ankle ligament sprain is the most common amongst the sporting population and the consequence of not rehabilitating after an initial injury increases the chances of recurrence [8]. Swelling below lateral malleolus is one of the most notable signs in lateral ankle sprain injury due to tissue soft irritation and inflammation, swelling in lateral ankle ranges between mild, moderate and severe [9]. Functional ankle instability after ankle sprain has been attributed to a proprioception deficit. Mechanoreceptors or proprioceptors are sensory neurons or peripheral afferents located within joint capsular tissues, ligaments, tendons, muscle, and skin. There is four type of mechanoreceptor I, II, III, IV [10, 11]. Cyclic stretch is a relatively short-duration stretch force that is repeated but gradually applied, released, and then reapplied. Cyclic stretch is applied for multiple repetitions during a single treatment session [12].

Cyclic stretch stimulates type II mechanoreceptors which are low-threshold, rapidly adapting receptors. These receptors become motivated for very brief moments (1 second or less) at the onset of joint movement. The type III receptors become active or stimulated where the ligamentous structures become stretched in response to stress applied in the joint ligaments, the type III receptor will become actively stimulated [13]. Mechanical stretch increases the production of Tgf-B1 which stimulates mRNA expression of type I and type III collagen in the ligament by cyclic stretch [14]. Cycle stretch improves the strength and flexibility in the musculoskeletal structures [15].

Physical therapy management for patients suffering from lateral ankle sprain includes immobilization, tape, bandage, or a brace, the range of motion exercises and neuromuscular exercise for ankle stability. Also, electro muscular stimulation and laser therapy play an important role in reducing edema, decreasing pain, or improving function following acute lateral ankle sprain [16, 17, 18, 19].

No previous studies investigate the effect of cycle stretch in pain and swelling reduction for the patients suffering from the lateral ankle sprain. So, the purpose of this study was to explore the effect of cyclic stretch on a lateral ankle sprain.

2. Materials and methods:

2.1.Subjects:

Sixteen patients participated in this study (eight males and eight females) with mean age 32.48 ± 11.47 years, all of them suffering from the lateral ankle sprain. They were conducted after 21 days of injury and the removing cast. These patients referred from the orthopedist, Pain was assessed before and immediately after the treatment session by using visual analogue scale (VAS), and also swelling was assessed before and immediately after the treatment session by using tape measurement. All subjects met the following inclusion criteria: 1) their age was between 20 to 60 years, and 2) suffered from grade 1 or 2 lateral ankle sprains. Subjects were excluded if they reported: 1) bilateral ankle instability, a history of ankle fracture, a history of neuromusculoskeletal or vestibular disorders, patients suffered from Syndesmotic injuries or high ankle sprain, and osteoporosis.

2.2.Instrumentations:

Ankle pain severity was assessed by using the visual analogue scale (VAS). The pain was represented by 100 mm horizontal line where 0 means no pain and 100 mm means worst pain. The patient placed a mark on that line to show the severity of pain that he felt. A higher score indicates greater pain intensity. Scale Based on pain intensity as none, mild, moderate, or severe, the following cut points on the pain VAS have been recommended: no pain (0–10 mm), mild pain (10-40 mm), moderate pain (40–70 mm), and severe pain (70–100 mm), reliability is (r= 0.94, P= 0.001), its validity ranges between (0.71–0.78 and 0.62–0.91 respectively) [20].

The tape measurement is pulled medially toward the distal side of the tuberosity of the navicular proximal to the base of the 5th metatarsal then pulled across the tibialis anterior tendon and continues distally to the medial malleolus. From the medial malleolus, the tape measurement can be drawn across the Achilles tendon around the ankle ending just distal to the lateral malleolus. From the lateral malleolus, the measurement can be ended where the measurement was begun. The reliability of tape measurement is 0.99 and demonstrates criterion-related validity when compared to foot volumetry [21, 22].

2.3. Procedures:

Patients were treated by cyclic stretching exercises. Each cycle of stretch is held between 5 to 10 seconds. Cyclic stretch was applied 2 bouts/each bout/4 cycles per min. The patient lies in the prone position with flexed knee 90 degrees and ankle in neutral position. The Therapist stood beside the patient ankle with his proximal hand stabilized the distal leg and the distal hand grasped above the calcaneus, fig (1). From the previous mentioned position, the therapist distal hand moved the foot on inversion with ankle plantar flexed to stretch anterior talofibular (ATFL), fig (2), inversion with ankle in neutral position to stretch calcaneofibular (CFL), fig (3), and dorsiflexion with foot abduction to stretch posterior talofibular (PTFL), fig (4).

3. Results:

3.1.Descriptive data:

It is worth mentioning that the ages (mean ± standard deviation) of the subjects were 32.48 ± 11.47 years and the distribution of males and females in subjects was 50% and 50%, respectively, table (1). Also, the means and standard deviation of visual analogue scale and swelling for pretreatment and posttreatment measurements were represented in the table (1).

Fig (1): Starting position for the cyclic stretch.

Fig (2): Cyclic stretch to anterior talofibular (ATFL).

Fig (3): Cyclic stretch to calcaneofibular (CFL).

Fig (4): Cyclic stretch to posterior talofibular (PTFL).

3.2. Pre and post-treatment values of visual analogue scale:

Comparing the pre and post-treatment mean values of the visual analogue scale was revealed significant improvement as ($p < 0.05$), table (2).

3.3. Pre and post-treatment values of swelling:

Comparing the pre and post-treatment mean values of swelling was revealed significant improvements as ($p < 0.05$), table (3).

3.4. The correlation between visual analogue scale and swelling:

As shown in the table (4), there was no significant relationship between visual analogue scale and swelling which was found to have insignificant relationships at 5% significance level.

Table (1): Descriptive data for age, visual analogue scale (vas) and swelling.

Item	Minimum	Maximum	Mean	Std. Deviation
Age	20.00	60.00	32.48	11.47
VAS pretreatment	3.00	8.00	5.81	1.33
VAS posttreatment	0.00	3.00	1.13	1.31
Swelling pretreatment	53.00	66.00	59.00	3.92
Swelling posttreatment	51.00	63.00	56.38	3.46

4. Discussion:

In this study, there was a significant reduction for pain severity and swelling when comparing the before and after measurement in response to cyclic stretch. It came in agreement with Clelik who mentioned that both shoulder flexibility and strength in young female volleyball players were improved in response to cycle stretch [15].

Table (2): Comparing the pre and post-treatment mean values of visual analogue scale.

Items	Mean ± Std. Deviation	Mean difference	Change (%)	*t* value	*P* value
Pretreatment	5.81± 1.33	4.69	80.72%	23.638	0.000*
Posttreatment	1.13±1.31				

Table (3): Comparing the pre and post-treatment mean values of swelling.

Items	Mean ± Std. Deviation	Mean difference	Change (%)	*t* value	*P* value
Pretreatment	59.00± 3.92	2.63	4.46%	9.652	0.000*
Posttreatment	56.38± 3.46				

Table (4): The correlation between visual analogue scale and swelling.

		Visual analogue scale		Significant
Pearson Correlation	Swelling	Correlation Coefficient	Sig. (2-tailed)	Insignificant
		0.241	0.368	

It also came in agreement with Maeda et al., who reported that cyclic stretch improves the flexibility of muscle tissue and muscle strength [23]. Also, the Ankle joint stiffness was decreased by 30% after the cyclic stretches [24].

Improvements detected in the study may be attributed to the following changes occur in response to applied cyclic stretch. Ligaments creep when a load is applied for an extended period of time and so, the tissue elongates. Low-magnitude loads, usually in the elastic range and applied for long periods, increase the deformation of connective tissue and allow gradual rearrangement of collagen fiber bonds (remodelling) and redistribution of water to surrounding tissues [25].

Lateral ankle ligaments cyclic stretch extends from 5 to 10 seconds allows rapid recovery of ligament injury to its original size and therefore, periodically, allow for remodelling and healing. This type of short duration Stretch within the elastic region allows recoverable deformation with no failure or creeping produce. Cyclic stretch stimulates type II and III mechanoreceptor which work together as proprioceptive to inhibit nociceptive transmission to spinal cord and brain according to pain gate control theory [26].

Remodelling of the tissues is caused by applying internal and external mechanical stress. Tension by gentle movements in functional directions orientates the collagen and breaks any weak or unnecessary crosslinks that may have formed [27]. Elevate ankle above the level of the heart is the ideal position to relieve swelling below lateral malleolus due to soft tissue injury [28].

5. Conclusion:

From our study we concluded that cyclic stretch was effective in treatment lateral ankle sprain; there was a significant reduction in the severity of pain and ankle swelling.

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Conflict of interest

Authors have not declared any conflict of interest.

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