

# Combined Effect of Shock Wave to Conventional Physical Therapy Program on Wrist Joint Pain Intensity in Treatment of Triangular Fibrocartilage Complex

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## ABSTRACT

**Background:** Triangular fibrocartilage complex (TFCC) is considered an important supportive structure of the wrist joint to stabilize the ulnar aspect of the wrist joint. Degenerative TFCC injury usually occurs due to overuse and accumulation of micro stresses. TFCC injuries are usually treated conservatively via rest or immobilization, activity modification to eliminate stress, ice application, and splint immobilization.

**Objective:** This study aimed to investigate the combined effect of shock wave to conventional physical therapy programs on wrist joint pain in the treatment of patients with degenerative TFCC, compared to conventional physical therapy rehabilitation alone.

**Subjects & methods:** Thirty male and female patients were diagnosed with degenerative TFCC & referred to Hand Clinic and Rehabilitation Center. Their ages ranged from 18 and 30 years. They all met the inclusion criteria and then signed a consent. They were randomly assigned into two equal groups: Control group (A) (n=15) that was treated by the conventional physical therapy program for TFCC injuries only that involved immobilization and activity reduction by an ulnar-based orthosis, proprioceptive training, and strengthening exercises, and study group (B) (n=15) that received the shock wave in addition to the conventional physical therapy program for TFCC injuries. Both groups' patients had evaluations before and after the course of therapy (6 weeks) for their pain via VAS.

**Results:** Through comparing the statistical findings post-treatment within and between both groups, group (B) showed significant improvements regarding the measured outcomes compared to baseline and group (A). Statistically, group (B) experienced a 74.35% decrease in VAS score compared to 40.82%, improvements in group (A). The net results gave the privilege of the intervention applied to the study group.

**Conclusion:** Adding shock wave to conventional physical therapy program seems to be more beneficial in relieving the wrist joint pain intensity than isolated conventional physical therapy program.

**Keywords:** Degenerative triangular fibrocartilage complex (TFCC), Pain, Shock wave.

## INTRODUCTION

Degenerative triangle fibro cartilage complex (TFCC), despite extensive worldwide research efforts, but still a challenging musculoskeletal system disorder for physicians and physiotherapists. The global incidence of TFCC injuries is around 27%, particularly among those aged around 30 years or even younger<sup>[1]</sup>.

The TFCC is a structural component that bears the load and is located between the lunate, triquetrum, and ulnar head. The primary role of this tissue is to provide stability to the ulnar portion of the wrist joint. The occurrence of sudden forceful or recurrent ulnar deviation motions is often associated with an increased susceptibility to TFCC injuries. Individuals who have sustained TFCC injury would exhibit clinical manifestations characterized by ulnar-sided wrist discomfort, this might show up as point discomfort or clicking between the ulnar head and the pisiform. The typical method for diagnosing such instances is by clinical examination, however, MRI may help verify the diagnosis of TFCC damage and assess its extent<sup>[1,2]</sup>.

Degenerative TFCC disorders often arise as a result of the accumulation of microstresses. It may limit the hand function and the wrist joint range of motion, particularly regarding ulnar deviation and rotation of the

distal radio-ulnar joint. In addition, it leads to altered wrist joint proprioception; in the form of diminished wrist joint rotation position sensation<sup>[3]</sup>. TFCC lesions either ignored or ineffectively treated, there would be negative effects such as gradual loss of joint mobility, grip strength as well as established arthritic alterations and limited hand function<sup>[3]</sup>. TFCC injuries are usually treated conservatively. The rehabilitation regimen involves rest or immobilization, activity adjustment to remove stress, ice treatment, and splint immobilization for 3 to 6 weeks. After immobilization, the patient should be enrolled in a physical therapy rehabilitation program comprised of proprioception and strengthening training. The rehabilitation program altogether may last up to 12 weeks<sup>[4,5]</sup>.

The shock wave (Gymna type) is regarded as a novel intervention for degenerative cases. It may be useful in expediting the process of rehabilitation and recovery of such instances<sup>[6]</sup>. The physiological impact of shock wave, it is an acoustic wave that transmits high energy to painful or degenerative musculoskeletal tissues in sub-acute and chronic diseases. This energy might enhance the regeneration of tendons and other soft tissue. It stimulates tissue healing and cell growth. It encourages new blood vessel development and

collagen synthesis. It might be beneficial in dissolving the calcified fibroblasts and disrupting pain mediators as substance p<sup>[6]</sup>.

According to the literature and prior research, the conventional physical therapy program may last 12 weeks or perhaps longer<sup>[4, 5]</sup>. Adding the shock wave may be effective in accelerating the rehabilitation process and accelerating recovery in such conditions<sup>[7]</sup>. Up to researchers' knowledge, there is no prior study that evaluated the impact of shock wave therapy in the treatment of such conditions.

## SUBJECTS AND METHODS

**Subjects:** Thirty patients, aged between eighteen and thirty, who were identified as having degenerative TFCC, from both sexes were recruited in this study from Prof. Dr. Yasser EL- Safoury's private Hand Clinic and Rehabilitation Center, they were diagnosed as degenerative (TFCC) according to Palmer's classification with identified inclusion criteria included their ages were 18 to 30 years old, with positive results to provocative tests such as the ulnocarpal stress test and ulnar fovea sign test, and with stable distal radioulnar joint with no evidence of progressive arthritis. Additionally, there were no hand surgeries or injuries in the last 3 months, and no evidence of advanced osteoarthritis of the radio-carpal joint. The patients who did not fulfill the inclusion criteria were excluded from the study.

**Design:** This study, which is a randomized controlled was conducted between January 2020 to October 2023. Following meeting the inclusion and exclusion criteria, thirty patients were assigned to a rehabilitation clinic based on the sample size calculation. Individuals were randomly assigned using a random generator (www.randomization.com) into two equal groups: Group A (n = 15) underwent a conventional physical therapy program, and group B (n = 15) got a normal physical therapy program plus shock wave therapy. All patients in both groups received three treatment sessions per week for six weeks. The purpose and study methods were explained in detail to each patient. Recording data sheet: All data and information of each patient in this study including Patients' data (name, age, gender, occupation) and pain level were recorded.

### Procedures of the study:

Prior to beginning the trial, each patient had a brief medical history obtained to make sure they did not have any previous musculoskeletal procedures or injuries within the preceding 3 months and symptoms or investigations for advanced or progressive arthritis, or neurological diseases that affect mental or psychological state.

### 1. Measurement equipment and methods:

All patients were assessed by the same examiner by Measuring pain in both groups for all patients.

Assessment procedure performed before starting the treatment (Pre) and after 6 weeks (Post) of the treatment program.

**Pain degree,** The level of pain was assessed using the VAS. On a pain scale ranging from 0 to 10, the patient rated their degree of discomfort<sup>[8]</sup>.

### 2. Therapeutic procedures:

The treatment procedures were conducted following a period of immobilization using an ulnar-based orthosis. The whole therapy session lasted around 45 minutes for both groups according to the defined treatment techniques for each group. This was done every day for approximately 6 weeks. The procedures of treatment approaches were achieved under the following steps: for control group "A", each treatment session consisted of the conventional physical therapy program for TFCC injuries only that involved immobilization by an ulnar-based orthosis, proprioceptive training, and strengthening exercises, while for study group "B", each treatment session consisted of the conventional physical therapy program in addition to shock wave for four sessions once a week<sup>[9]</sup>.

#### A- The Conventional physical therapy program<sup>[9]</sup>:

This method was applied to both the study group (A) and the control group (B) and consisted of:

##### - The First Phase (6 weeks) *Splinting immobilization:*

An ulnar-based orthosis was worn for six weeks, roughly thirteen hours a day. Each patient was advised to wear the orthosis both day and night and to take it off only for exercise and personal hygiene. The brace was worn for roughly thirteen hours a day on average.

##### - The Second Phase (7<sup>th</sup>-8<sup>th</sup> week) *proprioceptive training exercise:*

Every patient was positioned with their backs supported, their elbows bent and resting on the table, their eyes closed, and their hands soundly placed at various angles of wrist flexion and extension. The patient then executed the angles using the wrist that was afflicted. Every session consisted of five repetitions of each, lasting five to ten minutes.

#### As a progression:

a) The progression began with a 1-pound medicine ball and was increased based on the patient's tolerance if there was an improvement in joint sense position. With their elbows resting on the table, each patient was asked to flex and extend their wrists while clutching a medical ball while being seated with his/her back supported. Through two sets of ten repetitions, each patient worked out throughout the session. To avoid a clinched hand, which might increase the pressure on the carpal ligaments, the medical ball was used rather than a dumbbell.

b) Each patient was asked to stand, press against the wall with a softball, and then engage in regulated weight-bearing exercises on the wrist.

- **The third Phase, Strengthening exercises were performed within the pain tolerance:**

**9<sup>th</sup> week:** Softball squeeze, and dynamic self-resistance wrist movement.

**10<sup>th</sup> week:** Racquetball squeeze, dynamic self-resistance supination, and pronation and thera-band exercise flexion and extension).

**11<sup>th</sup> week:** Tennis ball squeeze, towel wringing exercise, thera-band exercise supination & pronation, and thera-band exercise ulnar & radial deviation.

**B- The Shock wave therapy (Gymna type):**

This approach was done only with the study group (B) during the first phase of the conventional physical therapy program. Each patient in this group received shock wave therapy in addition to a previous conventional physical therapy program. Shock wave therapy is provided during the first phase of treatment using a frequency of 10–12 Hz, 1000 shots, and a power of 1.5–2.5 bar for four sessions once a week. Each patient was positioned with their wrist supported by a towel and their back supported. The shock wave was then applied to the ulnar side of the wrist joint. The ice application was instructed for the patient after each session [10,11].

**Ethical approval: The Ethics Committee of Cairo University's Faculty of Physical Therapy accepted the study (No. P.T.REC/012/003766). Following receipt of all information, signed consent was provided by each participant. The Helsinki Declaration was adhered to at every stage of the investigation.**

**Statistical analysis**

Parametric analysis was done, and the data had a normal distribution. Version 21.0 of SPSS was utilized to perform the statistical analysis. To visualize the

qualitative data, relative percentages and frequencies were employed. The X<sup>2</sup>-test was used to find the difference between two or more sets of qualitative variables. To communicate quantitative data, the mean ± SD were employed. The t-test was used to compare two independent sets of parametric data, which are regularly distributed variables. A significance threshold of  $p \leq 0.05$  was used to all statistical tests.

**RESULTS**

In the current study, a total of 30 patients participated and they were randomly distributed into 2 groups (15 patients/group). No significant differences existed in the demographic data for age ( $P=0.15$ ;  $P>0.05$ ), gender ( $P=0.26$ ;  $P>0.05$ ), between group (A) and group (B) (Table 1).

**Table (1):** Comparison of demographic data between both groups

Items	Groups		P-value
	Group (A) (n=15)	Group (B) (n=15)	
Age (year)	27.67 ±2.46	26 ±3.64	0.15
Gender (males/females)	7 (47%) : 8 (53%)	10 (67%) : 5 (33%)	0.26

Pairwise comparison tests (Post hoc test) for VAS, showed that there was a significant decrease in VAS score ( $P=0.001$ ;  $P<0.05$ ) after-treatment compared to before-treatment within group A and group B. Group (B) improved VAS (74.35%) than group (A) (40.82%). Moreover, pairwise comparison tests (Post hoc test) for VAS between both groups indicated no significant differences ( $P>0.05$ ) pre-treatment of VAS. While after-treatment, there were significant differences in VAS score (MD= -2.86;  $P=0.001$ ;  $P<0.05$ ), between-group (A) and group (B) (Table 2).

**Table (2):** Mixed MANOVA within and between group comparison for outcomes variables

Outcomes variables	Items	Groups (Mean ±SD)		Mean difference	P-value
		Control group (n=15)	Study group (n=15)		
VAS score	Pre-treatment	8.33 ±1.11	8.07 ±1.48	- 0.26	0.58
	Post-treatment	4.93 ±1.03	2.07 ±0.88	- 2.86	0.001*
	Mean difference	3.4	6		
	Improvement %	40.82%	74.35%		
	P-value	0.001*	0.001*		

\* Significant ( $P<0.05$ ).

## DISCUSSION

The TFCC functions as a stress absorber across the ulnocarpal joint and as a supportive structure to the distal radio-ulnar joint (DRUJ). According to **Casadei et al.** [2], individuals suffering from TFCC injury will commonly display ulnar-sided wrist pain, which may also involve clicking or point soreness.

The purpose of this study was to investigate the effect of adding shock waves to conventional physical therapy in the treatment of degenerative TFCC and its influence on pain, functional impairment, and hand grip strength in patients with degenerative TFCC. This research is the first study to evaluate the effect of adding shock wave to routine physical therapy programs for the treatment of degenerative TFCC. The primary outcomes were measured using the following parameters: The visual analogue scale (VAS) score for pain severity assessment. Before therapy began (Pre), and six weeks later (Post), these factors were evaluated for both groups. The results of this study indicated a major gain in hand function and grip strength coupled with a significant decrease in pain with a notable difference in the VAS score between the combination of shock wave with conventional physiotherapy and conventional physiotherapy alone. As for the VAS score the current study showed that there was a significant decrease in pain with a notable difference in the VAS score.

It could be explained that immobilization, activity reduction, ice application, splint immobilization, proprioception, and strengthening exercises are widely utilized in the treatment of TFCC injuries [4, 5]. Wrist splint fixation is clinically validated by the finding that TFCC symptoms tend to become better at rest and grow worse when you move. Reduced ulnar side pressure and an increase in weight-bearing capacity are the treatment outcomes. Yet, there is not enough evidence to establish overall effectiveness [5, 12]. ESWT in TFCC may provide benefits due to regeneration and anti-inflammatory pathways, even if its exact mechanism is yet unknown [13]. Strengthening activities promote healing and reduce exacerbation of symptoms, whereas proprioceptive retraining, a therapeutic approach, may improve pain, neuromuscular control, and functional results in individuals with persistent wrist pain [4].

An effective course of traditional physical therapy may boost loading capacity, minimize pain, and potentially stabilize the ulnar side region [9]. Shock waves are brief pressure disturbances that occur in three dimensions and consist of a series of fast auditory pulses with intense pressure peaks, abrupt pressure surges, and brief durations [14]. One noninvasive treatment method is ESWT. It is produced in vitro and is intended for a specific bodily part. It usually uses coupling gel and fluid (water) as a conductive medium to transfer to biological tissues. Numerous studies have also demonstrated its medicinal benefits [15].

According to **Cheung et al.** [16], In response to pressure, extracorporeal shockwave therapy (ESWT) increases structural NO synthase production in soft

tissues and increases physiologic levels of the potent inflammatory inhibitor. Further a research done by **Takahashi et al.** [17] has shown that one possible mechanism for pain relief might be a decrease in the synthesis of calcitonin gene-related peptides in dorsal root ganglion neurons. According to **Menges et al.** [18], ESWT may also enhance muscular sensitivity, aiding in the promotion of functional recovery. According to the study done by **Li et al.** [19], they found that the benefit of conventional treatment, that is more extensively used clinically, and its success is backed by more data. Nevertheless, it requires lengthy time therapy and can't immediately influence inflammation and degeneration. In comparison, one noninvasive treatment is ESWT. Its intensity level, length of each treatment, frequency of treatments, and course of treatments may all be altered to better suit the patient's needs and cause less issues. ESWT could promote healing. ESWT showed in animal experiments to promote angiogenesis and tissue repair. According to a research by **Ogden et al.** [20], they believed to be achieved via both direct shock wave effects and indirect cavitation effects, which cause localized cell death and hematoma development, according to several studies. According to the study done by **Vahdatpour et al.** [15], they found that there haven't been any documented severe side effects of ESWT therapy in the literature up to this point. While **Wild et al.** [21] observed that after ESWT therapy, there may be transient discomfort, skin redness, or the creation of a minor hematoma, however, these disappear on their own.

## LIMITATIONS

The limitations of the study were mostly due to: (a) Lack of data and previous results to be a comparable basis, and this research is the first study to evaluate the effect of adding shock wave to routine physical therapy program for the treatment of degenerative TFCC. (b) There was no follow-up in this study.

## CONCLUSION

Adding the shock wave to conventional physical therapy program seems to be more beneficial in relieving the wrist pain than isolated conventional physical therapy program.

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