



# Effects of Radial Shockwave Therapy for Reducing Lower Back Pain Caused by Chronic Muscle Strain

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## ABSTRACT

The physiotherapy statistics from the Saraburi Hospital in Thailand show that patients with chronic lower back pain from muscle tearing have a higher tendency toward chronic pain, requiring continuous treatment. Most physiotherapists use radial shockwave therapy (RSWT) or radial pulse therapy to treat patients with chronic muscle tears. The aim of this study was to determine the immediate efficacy of RSWT on patients with lower back pain caused by chronic muscle strain. The purpose of this work is to assess the effectiveness of RSWT in the treatment of chronic back muscle pain. The type of this research is quasi-experimental research study. The location is this study is Physical Therapy Clinic at the Saraburi Hospital in Thailand. The study participants had pain intensities of greater than 5 out of 10. The experimental group (30 patients) received RSWT to the lower back for 10-15 minutes once a week for 6 weeks. The control group (30 patients) received ultrasound (US) treatments to the lower back using the semi-static technique with gel, but without turning the machine on, for 15 minutes once a week for 6 weeks. Both groups were taught to avoid bending and carrying heavy loads, as well as the correct way to lift heavy objects. None of the patients received medications, injections, massages, or acupuncture. The pain levels in both groups at work and at rest were measured using a visual analog scale. The treatment results were evaluated and compared at the 1<sup>st</sup>, 4<sup>th</sup>, and 6<sup>th</sup> treatments. The patient satisfaction was assessed at the 6 treatments as follows: 1 = most, 2 = high, 3 = moderate, 4 = low, and 5 = minimum. The effects on daily life and career performance were measured before the study and at the end as follows: 1 = most, 2 = high, 3 = moderate, 4 = low, 5 = minimum, and 6 = no effect. A statistical analysis was performed on the demographic data as well as on the pain level comparisons. The results of the RSWT and US treatments were measured while the patients were resting and working at 1, 4, and 6 months. Twelve and 18 of the patients were cured, respectively. In the US groups, 6 patients were statistically significantly better at the 1<sup>st</sup>, 4<sup>th</sup>, and 6<sup>th</sup> treatments (but no cures). The post-treatment satisfaction was not significantly different between the RSWT and US groups. Consequently, the use of RSWT to treat chronic

muscle strain can reduce pain immediately, and it can cure pain completely in some cases. Therefore, it should be used to treat more patients with chronic muscle strain. It should also be considered for use in chronic pain cases in which the patient does not respond to other conservative treatments.

**Keywords:** Radial shockwave therapy; RSWT; Lower back pain; Chronic muscle strain; Ultrasound; US

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## **1. Introduction**

Muscle strain is a symptom indicating that a muscle or tendon has been extended or used excessively until the muscle tears. There are three levels of severity: mild strain, moderate strain, and severe strain. Muscle strain can be found in all ages and genders, and it is associated with fast, heavy movements while maintaining the wrong posture or lifting a heavier load than usual. Any part of the body can be affected, including the neck, shoulder, back, knee, and ankle. The initial muscle strain pain treatment during the first phase of injury uses the principle of rest, ice, compression, and elevation (RICE), especially during the first 24–48 hours. The RICE treatment is conducted by resting the injured part, without movement or use, while applying a cold compress and bandage to reduce the swelling. The strained body part should be lifted (if possible) above the heart level. Sometimes, the initial care does not relieve torn muscle pain, and it eventually becomes chronic pain. At this point, a doctor must participate in the treatment of muscle strain patients via the use of medications, injections, acupuncture, and/or physical therapy. Physical therapy treatment can be administered by having the patient work out, stretch, or undergo treatment with physical therapy tools to reduce pain and inflammation, such as ultrasonography (US) [1], microwave diathermy (MWD), and radial shockwave therapy (RSWT)/radial pulse therapy (RPT) [2].

Narong Bensard and the board (2003) studied the working conditions and

frequencies of muscle and bone pain among professional rubber tappers in a case study conducted in Naklua in the Kantang Trang province of Thailand. They found that the frequency and severity in the muscle and bone pain groups were associated with the light and heavy work periods of the professional rubber tappers. With regard to the pain rates for the different areas of the body, during the first month, pain was found most often in lower back (55.8% during heavy work and 55.1% during light work), second most often in the hand or wrist (29.9% during heavy work and 23.8% during light work), and third most often in the legs (13.6% during heavy work and 10.3% during light work). Orawan Saetan and the board (2003) studied the disorder frequencies of the muscle structures of construction workers who temporarily migrated from the northeast. From May through July 2003, a total of 257 workers were included, and the frequency results were 33.5% for the lower back area, 19.5% for the knee, and 10.9% for the shoulder. In the study by Pornthip Raungrisomboon (2007), the health problem frequencies of private cleaning company employees (18 years old and older, 200 individuals in total) working in a university hospital in Bangkok were evaluated. The muscle and bone health problem frequencies were as follows: 51.4% occurred in the back and 48% occurred in the neck.

Based on the statistics from the Physical Therapy Medical Group at Saraburi Hospital, the causes of chronic lower back pain from torn muscles include lifting heavy items, using the wrong lifting posture, playing sports, and twisting the

body. In 2015, 2016, and 2017, 95, 135, and 159 patients were suffering from these injuries, respectively, and these numbers are expected to increase. Most patients have a routine working career that requires them to move and lift objects, causing chronic pain that requires long term treatment. Most of them undergo physical therapy, as mentioned above, especially RSWT/RPT, which uses a new machine for chronic muscle pain treatment. Therefore, this study was designed to determine the RSWT effectiveness and immediate results with regard to reducing pain in chronic muscle pain patients. Overall, there is a lack of research studies for physical therapists to refer to while considering the best treatments for their patients.

## 2. Materials and Methods

This was a quasi-experimental study of patients who suffered from lower back injuries from chronic muscular tears with pain intensities of greater than 5 out of 10. This research took place at the Restorative Medicine Group at the Saraburi Hospital in Thailand from March 2018 to June 2018. The 60 participants were divided into two groups of 30 patients each by simple random sampling.

### 2.1 Inclusion criteria

- Patients suffering from lower back injuries from chronic muscular tears diagnosed by doctors.
- Patients with pain levels of greater than 5 out of 10.
- Patients with illnesses with lower back pain for less than or equal to 3 months and elderly patients with lower back pain associated with muscle strain less for less than or equal to 3 months.
- Elderly patients with histories of treated lower back pain associated with muscle strain without a cure or without treatment for over 3 months.
- Patients with illnesses with lower back pain for over 3 months, specifically, newer patients with back pain

associated with muscle strain for more than 3 months.

- New patients with no history of treatment for lower back pain associated with muscle strain.

### 2.2 Exclusion criteria

- Patients with lower back pain caused by muscular defects and fibrosis.
- Patients with pain after spinal stenosis.
- Pregnant women.
- Patients with bleeding histories.
- There are lesions at the treatment.

### 2.3 Procedure

First, the patients were divided into two groups. The first group (30 individuals) received treatment (approximately 10–15 minutes) with an RSWT machine (DOULITH SD1 S/N BT 0495 series) using a 15-mm head (R15), frequency of 8 Hz, pressure of 2 bars, and 1,500 times the TrP of the lower back strained muscle once a week for 6 weeks. The patients were also instructed to avoid tilting and carrying heavy loads, and they were taught the correct way to lift a heavy object.

The second group (30 individuals, control group) underwent US treatments of the lower back at the strained muscle position, without turning the machine on, while using the gel media and the US semi-static technique for 15 minutes once a week for 6 weeks. The patients were also instructed to avoid tilting and carrying heavy loads, and they were taught the correct way to lift a heavy object.

During the study, neither group of patients received any other treatments, including medication, injections, massage, and acupuncture.

The pain levels of both patient groups were measured during treatment (while resting) using the visual analog scale (VAS) [3]. The results were evaluated and compared between the two groups during

the 1<sup>st</sup>, 4<sup>th</sup>, and 6<sup>th</sup> treatments. The patient satisfaction was measured after the 6 treatment sessions (end of research) by dividing the satisfaction into 5 levels: 1 = most, 2 = high, 3 = moderate, 4 = low, and 5 = minimal. The pain was also assessed according to its effects on daily life and career performance before joining the study and at the end of the study. This was divided into 6 levels: 1 = most, 2 = high, 3 = moderate, 4 = low, 5 = minimal, and 6 = no effect on daily life or career performance.

Records were made of the medications and other treatment methods in case the patients would have preferred being treated differently than the agreed upon methods. After the research, the patients were allowed to choose a different method of treatment.

#### **2.4 Statistical analysis**

Computer data analyses were used to test the statistical hypotheses of this research. The researcher determined the confidence level of the statistical experiment at a significance level of  $< 0.05$  as the criterion for accepting the hypothesis. The demographic characteristics were analyzed by using the mean, percentage, maximum, minimum, and standard deviation. The demographic data were compared using chi-squared statistics. The pain levels before and after the treatment were compared, and the treatment effect could reduce the pain level by 50% (pain level 5) when compared to the pain level before the first treatment. The curative effect between the groups was compared using an independent t-test.

### **3. Results and Discussion**

#### **3.1 Sample group**

The sample group used for this study (both before and after the study) consisted of a total of 60 people: 30 in the

experimental group and 30 in the control group.

#### **3.2 Experimental group**

Most of the participants were females (80%), and most were between 51 and 60 years old (36.7%), followed by 30–40 years old (33.3%). Most of the participants were government officials (26.7%) and employees (23.3%), and most had incomes between 20,001 and 30,000 baht (46.7%), followed by 30,001–40,000 baht (30%). The most common sickness period before joining the experimental group was less than or equal to 3 months (56.7%). The level of pain affecting the work performance for the majority of the participants before joining the experimental group was at the high level (73.3%).

#### **3.3 Control group**

Most of the participants were females (90%), and most of them were between 51 and 60 years old (47%), followed by 41–50 years old (26.7%). Most of them were private businessmen (36.7%) and government officials (26.7%), and most had incomes between 30,001 and 40,000 baht (56.7%), followed by 20,001–30,000 baht (33.3%). For most of the participants, the period of sickness before joining the control group was less than or equal to 3 months (50%). Moreover, for most of the participants, the level of pain affecting the work performance before joining the control group was high (66.7%).

When comparing the demographic characteristic differences, including the age, profession, income, pain affecting life and work before joining the research project, and period of pain before treatment, there was no difference between the experimental and control groups based on the chi-squared statistics.

**Table 1.** Demographic characteristics of the study participants.

Demographic characteristics	RSWT treatment group(n=30)		US treatment group (control)(n=30)		P-value
	Amount	Percentage	Amount	Percentage	
<b>Gender</b>					
Male	6	20	3	10	.286
Female	24	80	27	90	
<b>Age (years)</b>					
30 – 40	10	33.3	4	13.3	.248
41 – 50	5	16.7	8	26.7	
51 – 60	11	36.7	14	46.7	
More than 61	4	13.3	4	13.3	
<b>Job</b>					
Public servant	8	26.7	8	26.7	.388
Employee	7	23.3	4	13.3	
Private	6	20	11	36.7	
Businessman					
Housemaid	6	20	5	16.7	
Company	1	3.3	0	0	
employee					
Other	2	6.7	2	6.7	
<b>Income (in baht)</b>					
Less than 10,000	1	3.3	0	0	.269
10,001 – 20,000	2	6.7	1	3.3	
20,001 – 30,000	14	46.7	10	33.3	
30,001 – 40,000	9	30	17	56.7	
More than 40,000	4	13.3	2	6.7	
<b>Period of pain before treatment</b>					
Less than or equal to 3 months	17	56.7	15	50	.612
Over 3 months	13	43.315	15	50	
<b>Pain affecting life and work before participating in this study</b>					
Most	0	0	0	0	.581
High	22	73.3	20	66.7	
Moderate	8	26.7	10	33.3	
Low	0	0	0	0	
Minimum	0	0	0	0	

RSWT: radial shockwave therapy , US: ultrasonography

### 3.4 Pain affecting life and work

After 6 RSWT treatments, it was determined that most of the pain was gone, so it did not affect the life and work of 60% of the participants, or it had little effect on the life and work of 40% of the participants.

When compared to the control/sham US group, after 6 treatments, the pain affected the life and work of the participants equally at the average and low levels (43.3%), and with a minimal effect (3.3%). When testing the difference between the RSWT group and

the US group using the chi-squared statistics, there was a significant difference between them ( $p < .001$ ).

### 3.5 Satisfaction

#### Experimental Group

After 6 RSWT treatments, most of the participants were satisfied at the most and high levels of satisfaction (80% and 20%,

respectively). When compared to the US group, most of the participants were satisfied at the most level of satisfaction (66.7%), followed by the high and moderate levels of satisfaction (26.7% and 6.7%, respectively). When testing the differences using the chi-squared statistics, there was no difference between the RSWT group and the US group.

**Table 2.** Life after treatment and treatment satisfaction of the study participants.

Life after treatment and treatment satisfaction	RSWT treatment group(n=30)		US treatment group (control)(n=30)		P-value
	Amount	Percentage	Amount	Percentage	
<b>Pain affecting life and work after receiving 6 treatments</b>					
Most	0	0	0	0	.000
High	0	0	3	10	
Average	0	0	13	43.3	
Low	0	0	13	43.3	
Less	12	40	1	3.3	
No effect (recovered from back pain)	18	60	0	0	
<b>Treatment satisfaction</b>					
Most	24	80	20	66.7	.146
High	6	20	8	26.7	
Average	0	0	2	6.7	
Low	0	0	0	0	
Less	0	0	0	0	

RSWT: radial shockwave therapy , US: ultrasonography

After the first treatment, the average pain of the experimental group while resting was 2.20 and the standard deviation was 0.484. The average of the control group was 5.37 and the standard deviation was 0.850. When tested statistically, it was determined that while resting after the first treatment, the pain of the experimental group was statistically significantly different from that of the control group ( $p < .001$ ). After the fourth treatment, the average pain of the experimental group while resting was 0.97 and the standard deviation was 0.320. The average of the control group was 4.03 and the standard deviation was 0.890. When

tested statistically, it was determined that while resting after the fourth treatment, the pain of the experimental group was statistically significantly different from that of the control group ( $p < .001$ ). After the fourth treatment, the average pain of the experimental group while resting was 0.3 and the standard deviation was 0.466. The average of the control group was 3.73 and the standard deviation was 0.740. When tested statistically, it was found that while resting after the sixth treatment, the pain of the experimental group was statistically significantly different from that of the control group ( $p < .001$ ).

**Table 3.** Pain differences between the experimental group and control group while resting from work after treatment.

Data/sample groups	$\bar{x}$	SD	t-value	P-value	95% CI	
					Lower	Upper
<b>First treatment</b>						
Experimental group	2.20	.484	-17.726	.000	-3.526	-2.807
Control group	5.37	.850				
<b>Second treatment</b>						
Experimental group	1.60	.563	-20.629	.000	-3.291	-2.709
Control group	4.60	.563				
<b>Third treatment</b>						
Experimental group	1.23	.430	-20.596	.000	-3.476	-2.857
Control group	4.40	.724				
<b>Fourth treatment</b>						
Experimental group	.97	.320	-17.762	.000	-3.417	-2.717
Control group	4.03	.890				
<b>Fifth treatment</b>						
Experimental group	.60	.563	-18.231	.000	-3.588	-2.878
Control group	3.83	.791				
<b>Sixth treatment</b>						
Experimental group	.30	.466	-21.509	.000	-3.754	-3.113
Control group	3.73	.740				

SD: standard deviation, CI: confidence interval

After the first treatment, the average pain of the experimental group while working was 2.77 and the standard deviation was 0.568. The average of the control group was 6.57 and the standard deviation was 1.040. When tested statistically, it was determined that while working after the first treatment, the pain of the experimental group was statistically significantly different from that of the control group ( $p < .001$ ).

After the fourth treatment, the average pain of the experimental group while working was 1.13 and the standard deviation was 0.346. The average of the control group was 5.07 and the standard deviation was 0.98. When tested

statistically, it was determined that while working after the fourth treatment, the pain of the experimental group was statistically significantly different from that of the control group ( $p < .001$ ).

After the sixth treatment, the average pain of the experimental group while working was 0.53 and the standard deviation was 0.507. The average of the control group was 4.53 and the standard deviation was 0.728. When tested statistically, it was determined that while working after the sixth treatment, the pain of the experimental group was statistically significantly different from that of the control group ( $p < .001$ ).

**Table 4.** Pain differences between the control and experimental groups while working after treatment.

Data/Sample Groups	$\bar{x}$	SD	t-value	P-value	95% CI	
					Lower	Upper
<b>First treatment</b>						
Experimental group	2.77	.568	-17.562	.000	-4.236	-3.364
Control group	6.57	1.040				
<b>Second treatment</b>						
Experimental group	1.93	.521	-22.700	.000	-4.318	-3.616
Control group	5.90	.803				
<b>Third treatment</b>						
Experimental group	1.37	.490	-24.117	.000	-4.332	-3.668
Control group	5.37	.765				
<b>Fourth treatment</b>						
Experimental group	1.13	.346	-20.726	.000	-4.318	-3.548
Control group	5.07	.980				
<b>Fifth treatment</b>						
Experimental group	1.07	.365	-24.885	.000	-4.000	-3.400
Control group	4.77	.728				
<b>Sixth treatment</b>						
Experimental group	.53	.507	-24.897	.000	-4.358	-3.708
Control group	4.53	.728				

SD: standard deviation, CI: confidence interval

#### 4. Conclusion

This study showed the RSWT treatment and US (control) treatment results of the participants while they were resting and working during the 1<sup>st</sup>, 4<sup>th</sup>, and 6<sup>th</sup> treatments. The RSWT treatment results included a reduction in the chronic muscle strain pain of the lower back in 12 patients, and it cured 18 patients completely, which is in accordance with the study by Maier M et al. (2002) [4]. They studied and described the RSWT benefits, such as stimulating the repair of tissues by increasing the blood circulation at certain positions, creating new blood vessels, repairing chronic inflammatory processes, and inhibiting the pain receptors, which reduce pain and inflammation, justifying the use of RSWT in the treatment of soft tissue pain. Previous research has found evidence that the use of shockwaves does not cause harmful complications, and it is effective in the treatment of muscular and bone system diseases. In this research, there were no complications in any of the patients, which

corresponds with the research conducted by Zhao Z et al. [5], Magdolin M et al. [6], Tascioglu F et al. [7], and Loyola-Sanchez A et al. [8], who found that RSWT and US both result in pain reduction, with a statistically significant difference between the values before and after the treatment. Both RSWT and US use similar principles to reduce pain (reduce chronic inflammatory processes and stimulate tissue repair), but in this study, the researchers did not turn the US on during the treatment (control US group). The control group treated with the US 6 times reported that, after the treatment, the pain was improved at the 1<sup>st</sup>, 4<sup>th</sup>, and 6<sup>th</sup> treatments, but it was not completely cured, despite the fact that the researchers did not turn on the machine. The researchers believe that in this control US group, the therapists interacted with the patients and gave them physical examinations, which were enough to inspire a placebo effect [9] or a placebo phenomenon. It appeared that the control US group exhibited a statistically significantly reduced level of pain from

chronic muscle strain of the lower back at the 1<sup>st</sup>, 4<sup>th</sup>, and 6<sup>th</sup> treatments ( $p < .001$ ). The symptom improvement in these patients came from faith and trust in the treatment of the physical therapists, who created positive feelings toward the treatment in the patients. Such phenomena often occur in the medical industry. With regard to the comparison between the treatment satisfaction of the RSWT group and the US group, no difference was found, even though US has been used in several clinical situations [10] to reduce chronic pain and inflammation, thus affecting emotions and stress [11]. It is likely that the patients believed in the value of US treatment for a long time, unlike RSWT therapy, which is a new tool that is just starting to be used to treat pain and inflammation. This could explain the close levels of satisfaction between the experimental and control groups, even though, in actuality, RSWT is faster and better at reducing pain.

In summary, the RSWT treatment for chronic muscle strain can reduce pain immediately, causing a complete curative effect of chronic lower back muscle strain pain. Therefore, it should be used to treat more patients with chronic muscle strain pain. Moreover, it should be considered for use in patients with chronic pain symptoms who do not respond to other conservative treatments.

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