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ULTRASOUND VERSUS LIGHT THERAPY IN THE TREATMENT OF TENDINITIS IN DIVISION III COLLEGIATE ATHLETES

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ABSTRACT

Bengel SE, Cowan LM, Dorn LB, Martin MM. Ultrasound Versus Light Therapy in the Treatment of Tendinitis in Division III Collegiate Athletes. *Journal of Undergraduate Kinesiology Research.* 2006; 2(1): 1-14. **Purpose:** To determine the efficiency of low-level laser light therapy in comparison to traditional ultrasound in the use of therapeutic modalities. **Methods:** Seven Division III Collegiate athletes, men and women, ages 18-23. Administered either light therapy or ultrasound for five total treatments. **Results:** Ultrasound and light therapy had very similar results when compared. Ultrasound increased range of motion in lower body while light therapy produced better results for upper body range of motion. The average range of motion for lower body comparing ultrasound and light therapy was an 8 degree increase. Upper body range of motion increased an average of 7 degrees with light therapy. Ultrasound decreased pain more with an average decrease of 11.7 units for upper body and 4.66 units for lower body. Light therapy proves to be a more time effective modality. **Conclusion:** This study adds research to the sparsely researched topic of light therapy in the use as a therapeutic modality.

Key Words: inflammation, therapeutic modalities, tendon, athletic injury, recovery, performance

INTRODUCTION

Tendinitis is the inflammation of a muscle tendon. This type of fibrous injury can occur in any anatomical joint due to overuse or repetitive use of the tendon in that joint. Common sites for tendinitis includes knee, shoulder, ankle, elbow and wrist tendons. Signs and symptoms of tendinitis include pain, inflammation, crepitus, decreased range of motion in involved joint and dysfunction during activity. Tendinitis has varying levels of pain dependant on level of severity the patient is experiencing. First degree tendinitis includes pain and slight dysfunction during activity. Second degree is decreased function as well as pain following activity. Third degree tendinitis is when the patient is experiencing constant pain that prevents activity (6). Ruptures or tears in the tendon can

occur following a single acute injury or a combination of prolonged minor traumas (6). Chronic tendinitis occurs when the prolonged microtraumas are left untreated, which is much more common in athletics.

Athletes involved in certain sports where a repetitive motion is used, are more susceptible to chronic tendinitis. Predisposing conditions for chronic tendinitis include poor conditioning or biomechanics, muscle tightness, increases in frequency or duration of training, changes in surfaces on which conditioning is performed (6). Sports that tendinitis is commonly found in include volleyball, basketball, football, soccer, cross-country, softball, track and tennis.

Ultrasound has traditionally been used as a modality in the treatment of tendinitis. Ultrasound is a deep heating agent that promotes healing and reduces inflammation by releasing histamine, accelerating the diminution of tendinitis (1).It is capable of producing tissue changes both thermally and non-thermally (7). Therapeutic ultrasound is the most common electrophysical agent used in treatment facilities around the world (2). Treatment protocols for ultrasound are based on the individual patient and injury. The efficiency of the treatment is dependant on the individual tissue response. As a result of this, there are no set timelines for recovery. Ultrasound helps decrease pain and discomfort as well as increasing range of motion and decreasing edema by providing a deep heat to the tissue (7).

A new product introduced into the world of therapeutic modalities is low-level laser therapy (LLT). LLT is capable of altering photoreceptors functional ability, altering cellular function and signaling (3). The use of LLTs results in increased ATP production, which in turn, increases cellular metabolism and function (3). Also, LLTs can aid in developing cell mitosis as well as proliferation of cells and repairing homeostasis (2). Usages for low-level laser therapy include wound healing, increasing tensile strength and stiffness of healing ligaments, improving tendon healing and decreasing pain (3, 4).

A study was done with the purpose to investigate ultrasound and LLT treatments for different physical conditions (5). This particular study compared ultrasound and LLT, done on patients with mild to moderate carpal tunnel syndrome, ultrasound as well as LLT showed changes in pain perception, and subjective and objective measurements of effect of treatment. The subjective measurements in this study included tenderness, pain, and disability. The objective measurement was determining muscle weakness secondary to pain. Also physical functioning in terms of muscular force was improved in both groups. The study also showed that ultrasound produced more of the desired effects than did LLT and the authors conclude that ultrasound can increase the normal resolution of inflammation and that among the effects of ultrasound on the body are relieving pain and increasing physical function (5).

In a study done by Saunders (1), thirty-six participants were treated for supraspinatus tendinosis either by LLT, ultrasound or no therapy. Laser therapy treatment resulted in less muscle weakness and pain in comparison to the ultrasound or control groups. Ultrasound was not found to be significantly different from the control group where laser was found to be more significant in alleviating pain and improving muscle force (1).

Traditionally, ultrasound has been used as a therapeutic modality for the treatment of tendinitis. However, recent studies have shown the effectiveness of LLT when used in conjunction with rehabilitation. The rationale behind our decision to complete this study is to provide more information on light therapy as a therapeutic modality. In our research, we found no information on light therapy however, LLT provides similar therapeutic results. Light therapy is also administered very similarly to LLT. The purpose of this study is to examine the difference between light therapy and ultrasound especially concerning length and quality of treatment of tendinitis in Division III college athletes. It is hypothesized that light therapy will be more effective in treating tendinitis than traditional ultrasound.

METHODS

Subjects

Seven division III college athletes including both men and women, ages 18-23 (n= 7). Subjects were recruited from the student athlete population at the university. Two athletes were assessed with biciptial tendinitis, five with infrapatellar tendinitis, and one with suprapatellar tendinitis by a Certified Athletic Trainer. Athletes participated in a variety of sports including: volleyball, football, gymnastics, tennis, and basketball. The mean age, height and weight are reported in Table 1. The height and weight of each athlete will be obtained from their pre-season health screening form. All subjects signed a written informed consent before volunteering for the study and the University Human Subjects Instructional Review Board approved all procedures.

Instrumentation

Ultrasound/Light Therapy Machine (Solaris 709: Dynatronics Corporation, 7030 Park Centre Drive, Salt Lake City, UT 84121) was the unit used throughout the course of the study. It includes both instruments for light therapy as well as ultrasound.

The McGill Short Form Pain Questionnaire was given to the subjects to fill out prior to the start of treatments or evaluations. This questionnaire included a pain rating index, intensity of pain and overall intensity of pain. This questionnaire had an associated grading scale to rate the subject's overall pain on a 1-100 scale.

Functional tests were used to assess functional ability and were chosen based on the location of the tendinitis. Lower body tendinitis subjects were asked to perform squats and lunges to test the strength of the legs. Range of motion tests in extension and flexion were used to evaluate the subject's flexibility of that joint. Resisted range of motion was used to assess strength as well as flexibility by completing manual muscle tests administered by the evaluator. Subjects with tendinitis found in the upper body were asked to perform an upper body strength test using a dynamometer as well as evaluating their range of motion. Strength was also assessed using manual muscle tests administered by the evaluator. Each athlete with tendinitis in the same injury site will be asked to perform the same exercises. Range of motion for each subject was measured using a G300 model goniometer by Whitehall Manufacturing.

The instruments we used were qualified by the manufacturing companies we obtained them from. In addition, they were checked and cleared by a certified equipment evaluator.

Procedures

Consent forms were given to the subjects to sign before any measurements or treatments were administered. The consent form discussed the purpose of this study, what the subject was expected to do as well as the length of the treatment. The subjects were assured that their names were not to be used in the study and their identity would remain anonymous.

The McGill Short-Form Pain Questionnaire was administered to the subjects prior to the first treatment as well as at the termination of treatments (table 3).

Range of motion measurements were also obtained at this time, with use of the goniometer. For upper body tendinitis, flexion, extension, internal rotation and external rotation were measured. Lower body tendinitis required measurements of flexion and extension. These measurements were also taken prior to initial treatment as well as at the completion of treatments.

The functional exercises were also completed prior to the initial treatment as well (table 2). Participants were asked to complete different exercises dependant on their location of tendinitis. Individuals with upper body tendinitis were asked to resist the evaluator as they moved them through various motions as well as test strength with a hand dynamometer. Lower body tendinitis participants were tested by completing lunges and squats as well as resisting various ranges of motion the

evaluator administered. Functional exercises were completed by the subjects prior to initial treatment and after the final treatment session.

Prior to treatments, subjects were given instructions as to what they should expect and what each treatment did to the individual's body.

Treatments were administered to each tendinitis site by the evaluators every other day, as the subject's schedule allowed, until their five treatments had been completed. Ultrasound treatment was set at 3.3 mHz at 1.0 W/cm^2 Notes regarding the subject's improvement, pain level and movement ability were noted during every treatment session. Treatments were administered in the athletic training room in Olson Addition at the University of Wisconsin – Eau Claire.

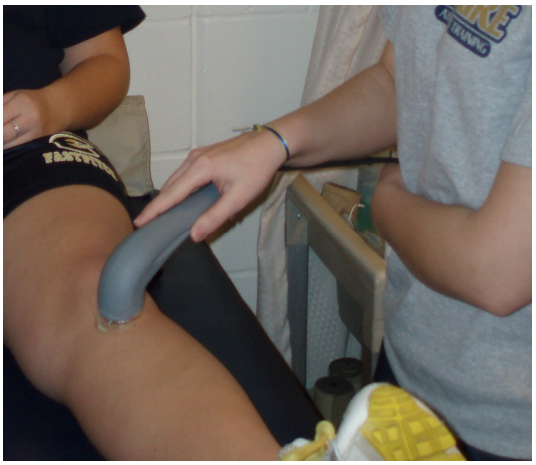

Image 1. Ultrasound to Infrapatellar Tendon

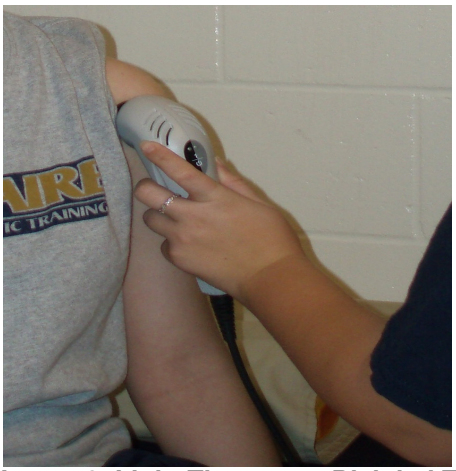

Image 2. Light Therapy to Bicipital Tendon

Statistical Analyses

Mean ± Standard Deviation was calculated for all variables. Dependent variables for this study included resolution of injury, pain reduction, and range of motion increase, strength increase, and quality of treatment. Sample size was accumulated based on the number of athletes who were suffering from tendinitis. They were also asked to participate in the study based on their availability, their desire to treat their injury and their dedication to the study.

RESULTS

The beneficial results of ultrasound per our study revealed an increase in range of motion of the involved joint, increased joint strength (tables 4,5) and decrease in pain level (tables 8,9). Benefits of light therapy were similar, showing increases in range of motion, increased joint strength (tables 6,7) and decrease in pain level (tables 10,11). Lower body functional testing, including range of motion and strength were more improved with the use of ultrasound in comparison to light therapy. Light therapy was more beneficial in the upper body in comparison to ultrasound.

The functional results showed ultrasound increased range of motion more in lower body testing than light therapy. The average range of motion increase with ultrasound in squats was 4.7 degrees, lunges were 22.5 degrees, knee flexion was 2.5 degrees, and knee extension was 2.3 degrees. Functional results showed light therapy increased range of motion more in upper body testing. Average range of motion increase with light therapy compared to ultrasound in shoulder flexion 2 degrees, shoulder extension 5 degrees, internal rotation 1 degree, and external rotation 20 degrees.

The results showed that for pain reduction in the upper body, ultrasound proved to be more effective overall. For the upper body pain questionnaire, ultrasound resulted in a 9.0 unit decrease in T-PRI, a 49.0 unit decrease in PPI-VAS, and a 2.0 unit decrease in overall pain intensity. Light therapy resulted in a 0.0 unit decrease in T-PRI, a 22.0 unit decrease in PPI-VAS, and a 3.0 unit decrease in overall pain intensity. Likewise, ultrasound lower body resulted in a 2.6 unit decrease in T-PRI, a 10.0 unit decrease in PPI-VAS, and a 0.7 unit decrease in overall pain intensity. Light

therapy resulted in a 4.6 unit decrease in T-PRI, a 0.0 unit decrease in PPI-VAS, and a 1.0 unit decrease in overall pain intensity. On average, ultrasound was also more successful in relieving pain than light therapy for lower body tendinitis.

Based on the results received following the completion of this study, both modalities are found to be relatively equal therapeutic agents. Light therapy can be administered in a more time efficient manner in comparison to ultrasound because of the shorter time needed for a full treatment.

DISCUSSION

Our results were similar to recent studies with ultrasound and light therapy achieving similar results and ultrasound being more effective in functional tests (5).Our study showed ultrasound to be more effective in pain relief in contrast to Saunder's study in which Laser Therapy was more pain relieving (1).

The pain level results are based on the assumption that the subjects were answering the questions honestly and to the best of their knowledge. We were under the assumption that they were not over training for their sport or doing any other strenuous activity. The subjects were also instructed to not receive additional treatments throughout the course of the study.

Limitations for this study included the participants' time allowance for the study, the evaluators schedule and availability for treatments; because of these limitations, the number of treatments originally intended had to be cut in half, leading to less dramatic results. The number of participants obtainable for the study was limited because of low numbers of athletes suffering from tendinitis during the time the study was conducted. Time constraint of the study itself and deadlines for the study also contributed to the low output. This study was conducted throughout various portions of sports seasons, and some individuals were still receiving treatments for the study at the conclusion of their season. This could have influenced their results because their activity level was decreased and there was less stress to the involved joint.

This study could be altered in many ways for future research. Including a larger numbers of subjects in a similar study would also be beneficial for comparing the two modalities. Also, comparing the same injury bilaterally, comparing the two modalities on one individual, excludes the subjective differences on how individuals perceive pain. Another area of potential interest for research could be on the successfulness of light therapy on tendinitis in different areas of the body such as achilles tendinitis and supra-patellar tendinitis. Changing the treatment settings for the modalities for example, increasing the time frame or increasing the joules, could also be tested to see if different settings change the results for example. Also, testing the general population's response to the treatment as well as potentially comparing to the physically active population, showing the complete effectiveness of the light therapy unit.

CONCLUSIONS

Findings from this study reveal that while ultrasound and light therapy yield similar results in the treatment of tendinitis, light therapy is a more time effective modality. These findings can be valuable for future health care professionals such as Athletic Trainers, Physical Therapists, and Occupational Therapists. Athletes at all ages in various settings suffering from tendonitis could benefit from more efficient pain reduction. Insurance companies benefit from shorter treatment time when billing for treatment services. Since this is a new, previously unrehearsed modality, the research results will help further the use of this modality for concise treatment.

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Tables

	Mean ± SD	N
Age (years)	**21.0 ± 1.8**	**8**
Height (cm)	**178.4 ± 12.8**	**8**
Weight (kg)	**86.5 ± 30.5**	**8**

Table 1. Demographics

Questionnaire: Ultrasound vs. Light Therapy

Demographic Information:
Gender: male / female
Age:
Height:
Weight:
Sport:
Year of Eligibility:

Location of Tendinitis:
Duration of Symptoms:

Functional Test Results:

	Pre-Treatment	Post-Treatment
Upper Body		
Hand Dynamometer		
ROM (Goniometer) Shoulder Flexion, Extension, Internal Rotation, External Rotation		
RROM (1-5)		
Lower Body		
Squats		
Lunges		
ROM (Goniometer) Knee Flexion, Extension		
RROM (1-5)		

Table 2. Demographics/ Functional Testing

McGill Short Form Pain Questionnaire

I. Pain Rating Index (PRI):
The words below describe average pain. Place a check mark (✓) in the column that represents the degree to which you feel that type of pain. Please limit yourself to a description of the pain in your injury site only:

			None		Mild		Moderate		Severe
a	Throbbing	0		1		2		3	
	Shooting	0		1		2		3	
	Stabbing	0		1		2		3	
	Sharp	0		1		2		3	
	Cramping	0		1		2		3	
	Gnawing	0		1		2		3	
	Hot-Burning	0		1		2		3	
	Aching	0		1		2		3	
	Heavy	0		1		2		3	
	Tender	0		1		2		3	
	Splitting	0		1		2		3	
b	Tiring-Exhausting	0		1		2		3	
	Sickening	0		1		2		3	
	Fearful	0		1		2		3	
	Punishing-Cruel	0		1		2		3	

II. Present Pain Intensity (PPI)–Visual Analog Scale (VAS). Tick along scale below for injury site pain:

No pain ——————————— Worst possible pain

III. Evaluative overall intensity of total pain experience. Please limit yourself to a description of the pain in your injury site only. Place a check mark (✓) in the appropriate column:

Evaluative		
0	No pain	
1	Mild	
2	Discomforting	
3	Distressing	
4	Horrible	
5	Excruciating	

IV. Scoring:

		Score
I-a	S-PRI (Sensory Pain Rating Index)	
I-b	A-PRI (Affective Pain Rating Index	
I-a+b	T-PRI (Total Pain Rating Index)	
II	PPI-VAS (Present Pain Intensity-Visual Analog Scale)	
III	Evaluative overall intensity of total pain experience	

Table 3. Pain Questionnaire

LOWER BODY	Pre-Treatment	Post-Treatment	Change	N
Squats (degrees)	94.3 ± 35.6	104.0 ± 31.7	9.7	3
Lunges Left (degrees)	89.0 ± 0.0	117.0 ± 31.1	28.0	3
Lunges Right (degrees)	95.0 ± 0.0	95.0 ± 0.0	0.0	3
ROM Flexion Left (degrees)	130.0 ± 7.9	134.5 ± 6.4	4.5	3
ROM Flexion Right (degrees)	128.0 ± 1.4	129.5 ± 0.7	1.5	3
ROM Extension Left (degrees)	3.3 ± 4.7	-1.5 ± 2.1	4.8	3
ROM Extension Right (degrees)	5.5 ± 2.1	3.0 ± 4.2	2.5	3
RROM Flexion Left (1-5)	4.0 ± 1.4	4.5 ± 0.7	0.5	3
RROM Flexion Right (1-5)	4.5 ± 0.7	4.5 ± 0.7	0.0	3
RROM Extension Left (1-5)	5.0 ± 0.0	5.0 ± 0.0	0.0	3
RROM Extension Right (1-5)	4.5 ± 0.7	4.5 ± 0.0	0.0	3

Table 4. Ultrasound Results – Lower Body

UPPER BODY	Pre-Treatment	Post-Treatment	Change	N
Hand Dynamometer (kg)	25.0	24.0	1.0	1
ROM Flexion (degrees)	155.0	155.0	0.0	1
ROM Extension (degrees)	50.0	39.0	11.0	1
ROM Internal Rotation (degrees)	89.0	91.0	2.0	1
ROM External Rotation (degrees)	35.0	41.0	6.0	1
RROM Flexion (1-5)	3.0	5.0	2.0	1
RROM Extension (1-5)	5.0	5.0	0.0	1
RROM Internal Rotation (1-5)	5.0	5.0	0.0	1
RROM External Rotation (1-5)	4.0	5.0	1.0	1

Table 5. Ultrasound Results – Upper Body

LOWER BODY	Pre-treatment	Post-treatment	Change	N
Squats (degrees)	114.3 ± 22.9	109.3 ± 26.8	5.0	3
Lunges Left (degrees)	100.0 ± 10.4	102.0 ± 7.1	2.0	3
Lunges Right (degrees)	99.3 ± 5.5	107.0 ± 4.2	7.7	3
ROM Flexion Left (degrees)	142.0 ± 2.0	142.5 ± 0.7	0.5	3
ROM Flexion Right (degrees)	142.0 ± 1.0	141.5 ± 4.9	0.5	3
ROM Extension Left (degrees)	-1.7 ± 1.5	0.0 ± 0.0	1.7	3
ROM Extension Right (degrees)	-0.7 ± 1.5	-0.5 ± 0.7	0.2	3
RROM Flexion Left (1-5)	5.0 ± 0.0	4.5 ± 0.7	0.5	3
RROM Flexion Right (1-5)	5.0 ± 0.0	5.0 ± 0.0	0.0	3
RROM Extension Left (1-5)	5.0 ± 0.0	5.0 ± 0.0	0.0	3
RROM Extension Right (1-5)	4.7 ± 0.6	5.0	0.3	3

Table 6. Light Therapy Results – Lower Body

UPPPER BODY	Pre-Treatment	Post-Treatment	Change	N
Hand Dynamometer (kg)	29.7	32.0	2.3	1
ROM Flexion (degrees)	172.0	174.0	2.0	1
ROM Extension (degrees)	47.0	63.0	16.0	1
ROM External Rotation (degrees)	74.0	100.0	26.0	1
ROM Internal Rotation (degrees)	43.0	44.0	1.0	1
RROM Flexion (1-5)	3.0	4.0	1.0	1
RROM Extension (1-5)	5.0	4.0	1.0	1
RROM External Rotation (1-5)	4.0	5.0	1.0	1
RROM Internal Rotation (1-5)	3.0	3.0	0.0	1

Table 7. Light Therapy Results – Upper Body

LOWER BODY	Pre-treatment	Post-treatment	Change	N
S-PRI (units)	7.7 ± 3.1	5.3 ± 2.1	2.4	3
A-PRI (units)	0.7 ± 0.6	0.3 ± 0.6	0.4	3
T-PRI (units)	8.3 ± 3.2	5.7 ± 1.5	2.6	3
PPI-VAS (units)	52.0 ± 18.5	42.0 ± 24.8	10.0	3
Overall (units)	3.0 ± 1.0	2.3 ± 1.5	0.7	3

Table 8. Ultrasound Pain Results – Lower Body

UPPER BODY	Pre-Treatment	Post-Treatment	Change	N
S-PRI (units)	12.0	4.0	8.0	1
A-PRI (units)	2.0	1.0	1.0	1
T-PRI (units)	14.0	5.0	9.0	1
PPI-VAS (units)	57.0	8.0	49.0	1
Overall (units)	3.0	1.0	2.0	1

Table 9. Ultrasound Pain Results – Upper Body

LOWER BODY	Pre-treatment	Post-treatment	Change	N
S-PRI (units)	9.3 ± 4.2	5.3 ± 2.3	4.0	3
A-PRI (units)	2.0 ± 2.6	1.3 ± 1.5	0.7	3
T-PRI (units)	11.3 ± 6.8	6.7 ± 3.8	4.6	3
PPI-VAS (units)	36.3 ± 10.7	36.3 ± 8.0	0.0	3
Overall (units)	2.0 ± 0.0	1.0 ± 0.0	1.0	3

Table 10. Light Therapy Pain Results – Lower Body

UPPER BODY	Pre-Treatment	Post-Treatment	Change	N
S-PRI (units)	11.0	14.0	3.0	1
A-PRI (units)	3.0	0.0	3.0	1
T-PRI (units)	14.0	14.0	0.0	1
PPI-VAS (units)	98.0	76.0	22.0	1
Overall (units)	5.0	2.0	3.0	1

Table 11. Light Therapy Pain Results – Upper Body