Comparative Effectiveness in Pain Alleviation, Range of Motion, Safety and Tolerability between Virgin Coconut Oil and Mineral Oil as Therapeutic Ultrasound Coupling Medium among Patients with Musculotendinous Injuries

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ABSTRACT

Objective. To compare the effectiveness of virgin coconut oil and mineral oil as an adjunct in the alleviation of pain and improvement of range of motion when used as a coupling medium in therapeutic ultrasound.

Methods. A randomized controlled double blind study was conducted in an industrial out-patient clinic in Pasig City. A total of 43 patients with musculotendinous pain were enrolled in the study and were randomized into two groups. The experimental group (n = 20) was given virgin coconut oil (VCO) and the control group (n = 23) was given mineral oil (MO), each used as a coupling medium during therapeutic ultrasound treatment. Four participants were not able to proceed with the study. All patients were given analgesics and/or nonsteroidal anti-inflammatory medications for the duration of the study. All participants underwent baseline evaluation and re-evaluation after three therapy sessions per week for a total of two weeks. The outcome measures used for the study were change in pain scores using the numerical rating scale and change in flexion and extension range of motion of involved joints using goniometric measurement from baseline to second follow-up and third follow-up. The results were analyzed using STATA statistical software with level of significance at $p<0.05$.

Results. Repeated measures ANOVA showed that there were reductions in the pain scores by visits, i.e., from baseline to first follow-up and from first follow-up to second follow-up were marginally significant ($p=0.07$). However, the difference between VCO and MO in terms of reduction of pain scores in all three visits was not statistically significant ($p=0.27$). There was no interaction between treatment groups and visits ($p=0.34$). As to the range of motion of the joints involved, there was statistically significant increase in range of motion noted for extension ($p=0.03$) as compared with flexion ($p=0.07$) from baseline to first follow-up. There were no reported adverse effects from the use of VCO and MO, physical therapy program and pain medications in both groups.

Conclusion. The use of virgin coconut oil is a relatively safe and well-tolerated coupling medium in therapeutic ultrasound. Virgin coconut oil was shown to be seemingly more effective as mineral oil in terms of the reduction of pain and more effective in improvement of flexion and extension range of motion of affected joint.

Key Words: phonophoresis, virgin coconut oil, mineral oil, coupling medium, pain, range of motion

Background

The topical use of virgin coconut oil (VCO) dates back from Ayurvedic medicine in the Philippines and has been applied to the painful body part of our ancestors as early as 1500 BC.[1]

There has been growing use of VCO as an anti-inflammatory and analgesic agent. Its rising popularity is evident in the availability of several commercial brands of VCO in the market. It is used in many commercial spas and massage centers for these purposes.

Introduction

Natural local remedies are used as agents in pain relief combined with non-steroidal anti-inflammatory medications and analgesics because of their perceived natural safety.[2] Natural agents have been shown to provide pain relief in tendinitis and other musculotendinous inflammation. McCarthy in 2003 conducted a study on homeopathic gel containing comfrey, poison ivy and marsh tea in homeopathic tinctures for external use and found that it is a well-tolerated nonsteroidal gel. The mean pain reduction was twice that of ordinary balm in four weeks time when it is applied three times daily.[3]

A study by McKay in 2002 investigated safflower, coconut oil and fish oil in mice exposed to pathogens. Investigation of their physical response showed both fish and coconut oil provided significant reduction in pain and inflammation.[3]

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Yip et al. in 2006 used aromatic lavender oil as an adjunct to treatment in patients with sub-acute nonspecific neck pains. Changes in outcome measures from baseline compared to end of the treatment were assessed using the visual analogue scale, stiffness, neck lateral and forward flexion, extension and interference with local activity. There was significant reduction in pain and stiffness with lavender oil. There were also improved neck flexion, lateral flexion and extension after eight treatment sessions.[4]

In the book "Oil You Want to Know About Coconut Oil", it was mentioned that VCO is useful for conditions with internal and external swelling especially if massaged twice daily.[5]

In general, tissue response to any type of injury is inflammation. This inflammatory state is the initial phase of healing and lasts approximately one to 14 days. Usually, the inflammatory process becomes self-perpetuating leading to the destruction of the surrounding tissues. As a consequence, this leads to the development of scars in place of proper tissue matrix in ligaments, tendons, muscles or bursae.[6]

The treatment and rehabilitation of musculotendinous soft tissue injuries can be divided into overlapping phases, namely: 1) control of pain and inflammation, 2) mobilization of the affected area, and 3) strengthening and functional training. Anti-inflammatory and analgesic medications are utilized during the acute phase of treatment. All nonsteroidal anti-inflammatory drugs (NSAIDs) have dosage ceilings. Patients should be advised to take the lowest dose that is effective for relieving pain and inflammation to avoid adverse effects from these medications. A variety of heating modalities can be utilized after 24 to 48 hours of injury. These modalities can be prescribed to diminish painful muscle spasms and increase blood flow to the area enhancing the healing process.

Phonophoresis is the introduction of medications to a local area by use of a deep heating modality such as therapeutic ultrasound. The acoustic energy provides deep heat and pain relief, and can drive molecules penetrating up to four to six centimeters from the skin. A coupling medium is required to provide contact between the skin and the therapeutic ultrasound head. The coupling medium should be slick and with low friction to allow the ultrasound head to glide. Agents used as coupling medium include mineral oil and water miscible creams and gels. Ultrasound gels are used as the more popular coupling medium but mineral oil has been a cheap and effective alternative. In phonophoresis, the coupling medium is also being used as the medication vehicle. The ultrasound opens pathways that allow the medications to diffuse through the skin and pass into the tissues.

It has also been shown that topical administration of ketoprofen results in peak plasma concentrations that are much lower than after oral administration of anti-inflammatory medications. Plasma concentration after topical administration is generally lower. Synovial fluid concentrations are also lower, but concentrations in the meniscus or cartilage are four to seven times higher than oral administration. Concentrations in tendon sheath are several hundred times the plasma concentrations after topical administration as reported by Cagnie et al. in 2003. There is evidence that ketoprofen achieves higher concentrations in the subcutaneous tissue, muscle and tendon sheath compared with blood concentrations after three days of topical administration to the knee capsules.[7, 8]

Coconut oil which is characteristically sediment-free, has a pleasing odor and low viscosity, and is free from rancid color,[9] making it an excellent coupling medium and a potent analgesic[10] and anti-inflammatory agent for phonophoresis without potential adverse effects. Virgin coconut oil may have additional anti-inflammatory effect compared with mineral oil which is purely a coupling medium with no pharmacologic or therapeutic properties.

This study intends to investigate whether the use of virgin coconut oil as a coupling medium in phonophoresis is more effective than mineral oil in the alleviation of pain and improvement of range of motion (ROM) of involved joints among patients with musculotendinous injuries especially in the shoulder and the elbow in a randomized controlled double blind trial.

Objectives

General Objective:

To compare the efficacy, safety, and tolerability between virgin coconut oil and mineral oil used for phonophoresis in therapeutic ultrasound treatment in the alleviation of pain and improvement of range of motion in the rehabilitation of musculotendinous injuries.

Specific Objectives:

1. To determine the effect of virgin coconut oil compared with mineral oil as a coupling medium on change in pain intensity using the numerical rating scale.
2. To determine the effect of virgin coconut oil compared with mineral oil as a coupling medium on change in ROM of the involved joint using flexion and extension range of motion measurements.
3. To determine the proportion of participants with adverse events from treatment with virgin coconut oil compared with mineral oil.

Methods

Study Design

The study was conducted using a randomized controlled double blind study design.

Participants

Patients ranging from 22 to 52 years old diagnosed with acute to sub-acute musculotendinous injuries of two weeks duration described as moderate to severe pain in the affected area were included. These conditions included tendinitis of the rotator cuff, bicipital tendon, hamstrings, patella and Achilles' tendon; lateral and medial epicondylitis; De Quervain's tenosynovitis; and sprains and strains. These were patients seen in a private industrial out-patient clinic in Pasig City from December 2006 to February 2007.

Musculotendinous injuries are disorders of the soft tissues secondary to repetitive motions, localized contact stress, awkward positions, vibrations and forceful exertion of two weeks duration. Clinical examination and laboratory studies to rule out bone and joint diseases were performed as part of the diagnostic process.

Symptoms of tendon and muscle problems include pain, tenderness, redness, warmth, and/or swelling near the injured tendon. Pain may increase with activity. Symptoms of tendon and muscle injury may affect the precise area where the injured tendon and muscle is located or may radiate out from the joint area, in contrast to arthritis where pain tends to be confined to the joint. Pain and stiffness may be worse during the night or when getting up in the morning. Stiffness may occur in the joint near the affected tendon. Movement or mild exercise of the joint usually reduces the stiffness. However, a tendon injury typically gets worse if the affected tendon is not allowed to rest and heal. Too much movement may worsen existing symptoms or bring the pain and stiffness back after improvement. In terms of treatment, studies by Trudel et al. and Klaiman et al. showed that phonophoresis has been effective in lateral epicondylitis and other common musculoskeletal conditions.[11,12]

Excluded were patients with: 1) hypersensitivity or allergy to VCO; 2) acquired or congenital joint laxities, fractures in any bone; 3) previous intervention such as surgery and steroid injections of the area within one month from start of the study; 4) intake of blood thinning agents; 5) gastrointestinal ulcerations, bleeding, perforations, and obstructions; 6) infections, cancer, epilepsy, epiphyseal injuries and those with previous joint cement fixations.

Informed consent written in Filipino was secured from patients who were qualified for the study. Patients were randomized into two groups. Patients in the experimental group received virgin coconut oil (VCO) while patients received mineral oil (MO) in the control group. Numbers for the sequence in randomization were concealed in sealed opaque envelopes. Both the investigator (who was also the outcome assessor) and the patients were not knowledgeable of the treatment assignments of the participants. These treatment assignments were only revealed after collection of the data.

Intervention

Each patient was assigned a case number and randomly assigned to either VCO or MO as an agent for phonophoresis during therapeutic ultrasound treatment. The virgin coconut oil that was used in the study was manufactured by the Philippine Coconut Authority. The mineral oil was provided by a reputable company. The patients had either VCO or MO as the coupling medium during standard therapeutic ultrasound treatment as part of their physical therapy program for management of elbow or shoulder disorders for six sessions over a period of two weeks. The coupling medium was applied over the skin area to be treated. Pulsed ultrasound was used at 1 watt/cm^2 and with a 1-megahertz head. Two dedicated senior physical therapists (PTs) for the study underwent training prior to the study. The PTs were not blinded to the treatment assignments. The physical therapy program consisted of a superficial heating modality and therapeutic exercise program of non-vigorous strengthening and flexibility exercises of the involved part. The patients were given celecoxib 200 mg/capsule, one capsule once daily for five days and paracetamol 500 mg/tablet, one tablet three times daily on an as-needed basis.

Common side effects of VCO and MO reported in the literature are rashes and photosensitivity reactions. Increase in pain and swelling with application of deep heating modalities are potential side effects of therapeutic ultrasound. Exercises when prescribed and implemented with supervision are usually without serious side effects.

Outcome Measures

1. Primary Outcome – Pain as assessed by the numerical rating scale. During each evaluation, each patient was asked to rate the worst pain experienced in the past 24 hours from a scale of 0 for no pain at all to 10, the worst pain experienced. Decrease in pain score based on the numerical rating scale of at least two values was used as an indicator of improvement.[10]
2. Secondary outcome – Increase in flexion and extension range of motion (ROM) (Table 1). The ROM was taken using standard goniometry following standard techniques of determining ROM of the affected parts. Normal values were based on the normal range of flexion and extension of the shoulder and elbow based on the study by Gunal et al.[13] Increase in ROM measurement in any quantity was interpreted as improvement.

Table 1. Normal Values for Joint Range of Motion (ROM)

Joint	Average Range of Joint Movement (degrees)			
Shoulder	Abduction (45º)	150º	Adduction	30º
	Forward elevation (30º)	150º	Extension	40º
	External Rotation (20º)	90º	Internal Rotation	40º
Elbow	Flexion (100º	150º	Extension	0º
	Supination (0º)	80º	Pronation	80º
Wrist	Dorsiflexion (30º)	60º	Palmar Flexion	70º
	Ulnar Deviation (0º)	30º	Radial	20º
Hip	Flexion (25º)	100º	Extension	30º
	Abduction (0º)	40º	Adduction	20º
	Internal Rotation (0º)	40º	External	50º
Knee	Flexion (10º)	150º	Extension	0º
Ankle	Dorsiflexion (0º)	20º	Plantar Flexion	40º
	Inversion (0º)	30º	Eversion	20º
Cervical	Flexion (0º)	45º	Extension	45º
Spine	Right Lateral Flexion (0º)	45º	Left Lateral Flexion	45º
	Right Rotation (0º)	80º	Left Rotation	80º
Thoraco-	Flexion (0º)	90º	Extension	30º
Lumbar	Right Lateral Flexion (0º)	30º	Left Lateral Flexion	30º
Spine	Right Rotation (0º)	30º	Left Rotation	30º

Data were also collected for the following variables: age, sex, onset of pain, concomitant illnesses, primary sport activity, concomitant medications taken and previous interventions such as surgeries, injections, complementary and alternative medicine treatments, and use of orthosis. The baseline evaluation also included physical examination findings including pain distribution; presence or absence of erythema, swelling, and tenderness; motor strength, reflexes, pulses and findings from relevant special tests such as the Hawkins and Neers impingement test. The participants underwent baseline evaluation and two re-evaluations, each follow-up scheduled after three therapy sessions within a period of two weeks (Figure 1).

Statistical Analysis

As this is a pilot study and in the light of the limited literature on the prevalence of musculotendionus injuries, the sample size was not computed. The study included all participants who were diagnosed with musculotendinous injuries during the study period. After the data collection was completed, results of the outcome measures were encoded for analysis. This study followed intention to treat analysis.

Data was checked for accuracy, completeness and consistency by the investigator. Excel software was used for the data encoding. Statistical analysis was done using the STATA statistical software. Data was also analyzed using descriptive statistics including frequencies, means and standard deviations.

The mean for each outcome measure (change in pain score, change in flexion ROM, change in extension ROM) in the VCO group and in the MO group was computed. The mean change in pain scores, and flexion ROM and extension ROM in the VCO group and the MO group were also computed and compared for each visit (baseline, on first follow-up, on second follow-up). Between-group comparisons were also made. Comparisons of baseline characteristics between the two groups were performed using the Chi square test and T-test with level of significance at $p<0.05$. The Fisher's exact test was used to analyze baseline characteristics specifically on the variable sex. The overall comparisons between the efficacy of VCO and MO were done using repeated measures ANOVA since there were three measurements involved in the course of treatment for two weeks. The mean for each outcome measure (change in pain score, change in flexion ROM, change in extension ROM) in the VCO group and in the MO group was computed. The mean value was then compared with the visits (baseline, first follow-up, second follow-up) using within-group comparisons. Between-group comparisons were also made.

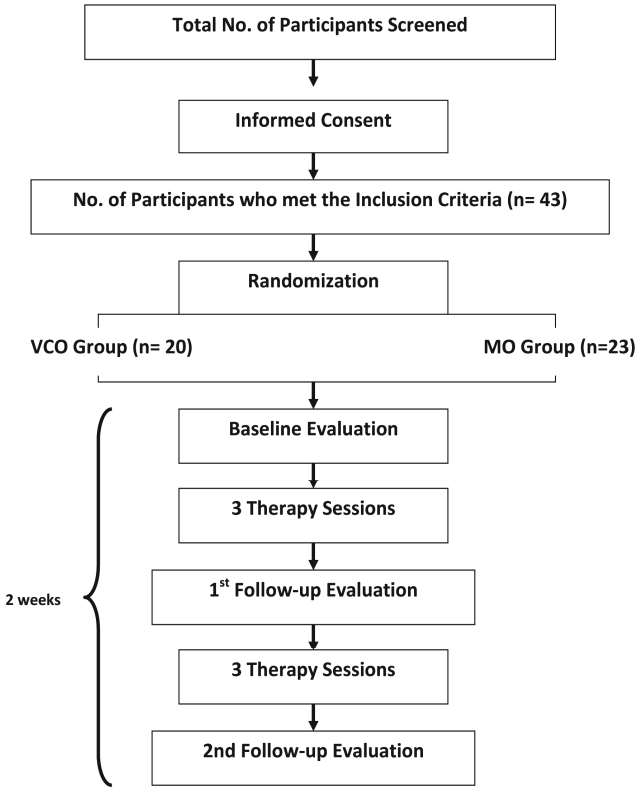


Figure 1. The data collection flowchart

Ethical Considerations

A written informed consent was accomplished by each participant prior to the start of the study. Each patient was given complete information regarding the study procedures, treatment benefits and treatment side effects. The study was approved by the administration of the facility. In the event that the participants experienced adverse events from the use of VCO or MO, or from physical therapy, the participants were instructed to notify the investigator;

evaluation and treatment would be provided. If treatment of adverse effects required medical and/or additional care, expenses incurred were to be shouldered by the investigator.

Results

There were 43 participants randomized to either the experimental (VCO) group or the control (MO) group, 20 participants to VCO and 23 to MO. Four patients did not proceed with the study (three randomized to VCO and one randomized to MO) leaving only 39 participants with complete data for analysis.

The majority of the study participants were from 40 to 49 years of age (56.4%), with 45.5% of the MO group and 70.6% of the VCO group. Majority of the participants were male (79.5%). The most commonly affected area was the shoulder comprising 23.1% (18.2% in the MO group and 29.4% in the VCO group) followed by the elbow at 17.9% (18.2 % in the MO group and 17.6 % in the VCO group) (Table 2). The majority (97.4%) of the participants did not have concomitant illness; however, 2.6% of the participants had hypertension.

Table 2. Distribution of Study Participants by Area

Area	Mineral Oil		Virgin Coconut Oil		Total	
	No.	%	No.	%	No.	%
Ankle	3	18.2	2	11.8	6	15.4
Cervical	1	4.5	1	5.9	2	5.1
Elbow	4	18.2	3	17.6	7	17.9
Hand	2	9.1	3	17.6	5	12.8
Knee	3	13.6	1	5.9	4	10.3
Legs/Ankle	1	4.5	0	0.0	1	2.6
Lumbar	1	4.5	1	5.9	2	5.1
Shoulder	4	18.2	5	29.4	9	23.1
Wrist	2	9.1	1	5.9	3	7.7
Total	22	100.0	17	100.0	39	100.0

Exact Test p-value= 0.943

There was no statistically significant difference in age (p=0.463), area (p=0.943) and concomitant illness (p=0.744); however, there was a statistically significant difference in sex among the participants in the MO and VCO groups by Fishers exact test (p=0.013).

In terms of diagnosis, 15.4% of the cases had rotator cuff tendinitis, and 12.4% had lateral and medial epicondylitis (Table 3). Badminton was the most reported sport among patients, representing 33.0% of the total.

All of the patients (n=39) complained of pain but only 43.3% presented with limitation in flexion and 42.8% with limitation in extension (Table 4).

In terms of pain, the mean duration of onset of pain to baseline visit was 6.7 ± 3.6 days for the MO group and 5.9 ± 3.7 days for the VCO group, with an average of 6.4 ± 3.6 days. The mean onset of pain from baseline to first follow up was 4.3 ± 5.4 days while that from baseline to second visit was 9.7 ± 6.8 days. There was no statistically significant difference between the two groups on T-test (p=0.531 on baseline, p=0.892 on first follow up and p=0.663 on second follow up).

Table 3. Distribution of Study Participants by Diagnosis

Diagnosis	Mineral Oil		Virgin Coconut Oil		Total	
	No.	%	No.	%	No.	%
Achilles Tendinitis	2	9.1	2	11.8	4	10.3
Adhesive Capsulitis	1	4.5	1	5.9	2	5.1
Biceps strain	1	4.5	0	0.0	1	2.6
Bicipital tendinitis	1	4.5	0	0.0	1	2.6
De Quervains	1	4.5	0	0.0	1	2.6
Epicondylitis	2	9.1	3	17.6	5	12.8
Hamstring tendinitis	1	4.5	1	5.9	2	5.1
Myofascial Pain	1	4.5	1	5.9	2	5.1
Patellar Tendinitis	2	9.1	0	0.0	2	5.1
Rotator cuff tendinit	2	9.1	4	23.5	6	15.4
Sprain	3	13.6	1	5.9	4	10.3
Strain	3	13.6	1	5.9	4	10.3
Tenosynovitis	1	4.5	3	17.6	4	10.3
Thumb tendinitis	1	4.5	0	0.0	1	2.6
Total	22	100.0	17	100.0	39	100.0

Table 4. Mean and SD of Flexion and Extension Motion at Baseline using Percentage of Current Motion to Full Range of Motion among Participants with Limited Range of Motion at Baseline

	Mineral Oil	Virgin Coconut Oil	Total
Flexion			
Mean (±SD)	42.4(±26.1)	45.3(±28.2)	43.3(±25.8)
t-test p-value=0.8457			
Extension			
Mean (±SD)	42.2(±24.8)	43.8(±23.2)	42.8(±23.2)
t-test p-value=0.8917			

Pain was reported to be localized at baseline and on first follow up in 97.4% of patients. There were no erythema, swelling and tenderness noted during all three visits. Muscle strength of affected extremities was graded normal to good and pulses at the affected limbs were noted to be strong in all three visits.

Since data for primary and secondary outcomes were collected in three time periods during a follow-up of two weeks, repeated measures ANOVA analysis was done. Pain reduction seemed to be greater for the VCO group compared with the MO group (Figure 2). Results also showed that there was reduction in pain scores from baseline to second follow-up but this was not statistically significant (p=0.075) (Table 5). However, the difference between VCO and MO in terms of reduction of pain scores in all three visits was not statistically significant (p=0.27).

Considering all patients in both groups, the average improvement in flexion motion of all joints from baseline to second follow-up for the MO group was 73.8% of the full range while that for the VCO group was 83.9% (Table 6). This finding suggests that the VCO group had more improvement in flexion motion compared with the MO

group. However, this was not found to be statistically significant (p=0.34).

The extension motion for the MO group was 71.1% of the full range while that for the VCO group was 76.8% (Table 6). The VCO group had more gains in extension motion compared to the MO group. The difference, however, was not statistically significant (p=0.594).

Table 5. Mean and SD of Pain at Baseline to Second Follow-up

Pain	Mineral Oil	Virgin Coconut Oil	Total
Baseline Mean (±SD)	7.23(±1.49)	7.06(±1.61)	7.15(±1.52)
t-test p-value=0.737			
First Follow-up Mean (±SD)	4.68(±1.94)	4.29(±1.57)	4.51(±1.78)
t-test p-value=0.506			
Second Follow-up Mean (±SD)	2.73(±1.58)	1.82(±1.46)	2.33(±1.57)
t-test p-value=0.075			

Table 6. Mean and SD of Flexion and Extension Motion at Baseline using Percentage of Current Motion to Full Range of Motion

	Mineral Oil	Virgin Coconut Oil	Total
Flexion			
Mean (±SD)	73.8(±34.0)	83.9(±29.3)	78.2(±32.0)
t-test p-value=0.335			
Extension			
Mean (±SD)	71.1(±34.2)	76.8(±31.9)	73.6(±32.9)
t-test p-value=0.594			

Among participants with limited movements for flexion at baseline to first follow-up in the VCO group, there was more improvement in ROM compared with the MO group but this was found to be marginally statistically significant (p=0.073) (Table 7). The mean flexion ROM improved from 45.3% to 86.2% of the full movement for the VCO group compared with the MO group which increased from 42.4% to 60.1%. Results also showed that among participants with limited extension at baseline to first follow-up in the VCO group, there was greater improvement in ROM compared with the MO group which was statistically significant (p=0.03). The mean extension ROM improved from 43.8% to 90.1% of the full movement for the VCO group while the MO group improved only from 42.2% to 63.7% (p=0.03) (Table 7).

Figure 3 shows the trend in improvement in flexion motion among participants with limited motion of the affected joints (p=0.056). Figure 4 represents the trend in improvement for extension motion among participants with limited motion of the affected joints (p=0.044). There were no reported adverse events with the use of the coupling medium in either the VCO group or MO group and to the other interventions (medications, physical therapy) given to both groups.

Table 7. Mean and SD of Flexion and Extension Motion from Baseline to Second Follow-up using Percentage and Current Motion to Full Range of Motion among Participants with Limited Range of Motion

	Mineral Oil	Virgin Coconut Oil	Total
Flexion			
Baseline Mean (±SD)	42.4 (±26.1)	45.3 (±28.2)	43.3 (±25.8)
t-test p-value = 0.846			
First follow-up Mean (±SD)	60.1 (±28.9)	86.2 (±8.3)	68.8 (±26.8)
t-test value = 0.073			
Second Follow-up Mean (±SD)	86.1 (±27.8)	97.5 (±5.6)	89.9 (±23.2)
t-test p-value = 0.389			
Extension			
Baseline Mean (±SD)	42.2 (±24.8)	43.8 (±23.2)	42.8(±23.5)
t-test p-value = 0.8917			
First Follow-up Mean (±SD)	63.7 (±29.9)	90.1 (±9.6)	74.0(±27.1)
t-test p-value = 0.03			
Second Follow-up (±SD)	87.4 (±26.7)	98.2 (±4.7)	91.6 (±21.4)
t-test p-value = 0.308			

Discussion

Four participants failed to follow up and complete the study. Two of these participants reported improvement in symptoms as evidenced by decrease in pain scores of two or more values using the numerical rating scale while the other two could not follow up due to tight work schedule.

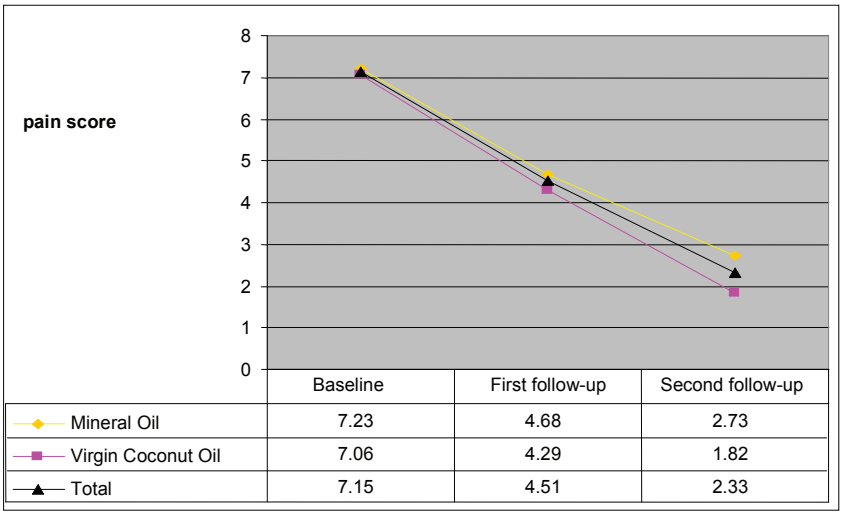
The male employees outnumbered the female employees. This explains the statistically significant difference in the variable sex in the socio-demographic profile of the participants.

There was reduction in pain scores from baseline to second follow-up. Pain reduction seems to be greater for the virgin coconut oil group compared with the mineral oil group (Figure 2).

For participants with limited ROM at baseline, there were statistically significant differences in extension and flexion ROM between the virgin coconut oil and mineral oil groups from baseline to the first follow-up, with more improvement in range of flexion and extension with the virgin coconut oil group.

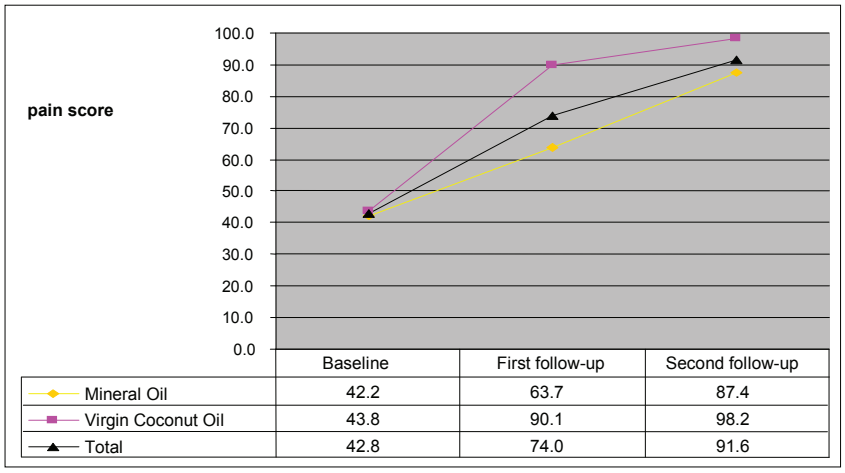
Greater improvement was seen with extension motion compared with flexion motion. The greater improvement in extension movements can be due to the fact that the movement of extension is gravity assisted and can be less painful compared with flexion which is a movement against gravity.

There have been published studies on the use of other types of oil for the treatment of musculotendinous pain but as to the author's knowledge, this study is the first study examining the use of coconut oil for pain alleviation and improvement of ROM.



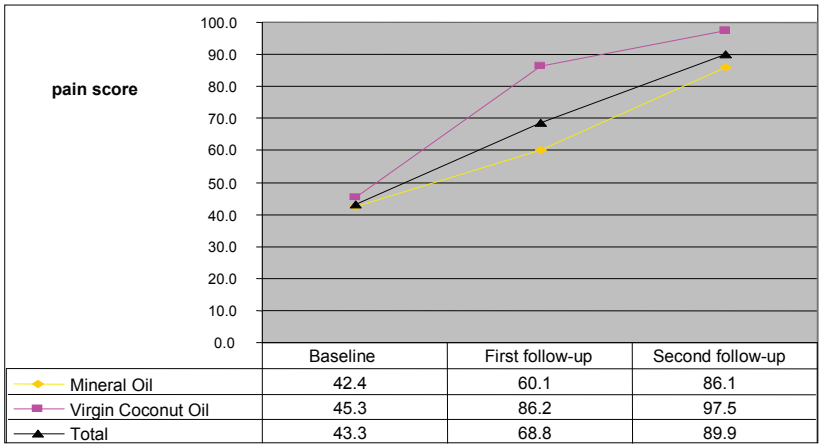
	Baseline	First follow-up	Second follow-up
Mineral Oil	7.23	4.68	2.73
Virgin Coconut Oil	7.06	4.29	1.82
Total	7.15	4.51	2.33

Figure 2. Pain scores by time period



	Baseline	First follow-up	Second follow-up
Mineral Oil	42.2	63.7	87.4
Virgin Coconut Oil	43.8	90.1	98.2
Total	42.8	74.0	91.6

Figure 3. Extension by time period among participants with limited motion



	Baseline	First follow-up	Second follow-up
Mineral Oil	42.4	60.1	86.1
Virgin Coconut Oil	45.3	86.2	97.5
Total	43.3	68.8	89.9

Figure 4. Flexion by time period among those with reduced motion

Conclusion

The therapeutic effects of virgin coconut oil on the human body and research on its use in the treatment of different illnesses are currently encouraged in the Philippines by the Department of Health. This study showed that virgin coconut oil is seemingly more effective in the alleviation of pain and improvement of range of motion compared with mineral oil.

As to safety and tolerability, the absence of major adverse events in this study shows that the topical use of virgin coconut oil is a relatively safe and well-tolerated coupling medium in ultrasound therapy.

Looking at the interaction between the VCO and MO groups and visits in the study, virgin coconut oil was shown to be seemingly more effective than mineral oil in terms of reduction of pain and improvement of flexion and extension ROM.

Limitations and Recommendations

The use of virgin coconut oil is a new and exciting development in the field of Movement Sciences and Rehabilitation Medicine especially in its use as a potential coupling medium during therapeutic ultrasound rehabilitation treatments and in the search for alternative and more affordable coupling medium for phonophoresis.

This study presented with several limitations. A larger sample size is recommended in future studies. There should be stricter inclusion criteria in terms of other interventions administered to the participants. Common conditions presenting with pain such as carpal tunnel syndrome and other nerve entrapment disorders, neuropathy, radiculopathy and arthritis, among others, should be ruled out. Other medications being taken by the participants especially pain medications, muscle relaxants, vitamin B complex and others should be controlled. A longer duration of study from 10 to 12 weeks with follow up every three to four weeks is recommended. Further research on the specific dosage of the agent is also recommended. The assessment of treatment efficacy should include more outcomes using appropriate global or specific functional scales and health-related quality of life.

A follow-up study on this potentially cost-effective and readily available therapeutic option in the rehabilitation medicine management of patients with musculotendinous injuries is highly considered.

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