

A SYSTEMATIC REVIEW OF DEEP TISSUE OSCILLATION AND A STUDY PROPOSAL OF ITS
EFFECTS ON GERIATRIC BEDRIDDEN PATIENTS WITH LOWER EXTREMITY LYMPHEDEMA

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Abstract

Background: Deep Tissue Oscillation (DTO) is an emerging therapy that encourages the body to heal by decreasing swelling, and edema, and in turn, allowing the opportunity for increased range of motion, all of which may contribute to a shorter healing time for the patient. DTO uses a pulsed electrostatic field to lift and drop the connective tissue, creating a rhythmic motion that pumps out metabolic wastes, toxins and stagnant edema, similarly to the body's natural skeletal muscle contractions. This therapy could be particularly applicable to bedridden geriatrics, whose naturally detoxifying skeletal muscle contractions are hindered by their lack of mobility.

Purpose: To observe Deep Tissue Oscillation (DTO) therapy performed on bedridden geriatric patients with lower extremity lymphedema and measure change in their health-related quality of life. The proposed study will evaluate DTO's psychological effects from baseline and after exposure, as well as levels of functional health and well-being using the SF-36 health survey. This study will educate clinicians and the general population by promoting awareness of additional therapeutic options.

Methods (proposal): Participants will range from 65-80 years, bedridden with lower extremity lymphedema. Block randomization will be used to determine whether the participants will be placed in the treatment group (DTO and compression socks) or the

control group (manual drainage and compression socks). Treatment will be given for 30 minutes, twice a week for 6 weeks. Pre- and post-treatment circumference measurements will be taken at three specific locations from the ankle to the thigh.

Results: Due to lack of access to a DTO unit and time required to conduct a thorough study, this project will be conducted in the future. Therefore, no results are available at this time.

Conclusion: The findings of this study will determine whether physiological and psychological benefits exist, possibly make DTO a more readily available modality and a viable treatment option for clinicians and the geriatric population.

TABLE OF CONTENTS

CHAPTER	
INTRODUCTION.....	1
Intro paragraph.....	1
Purpose of the study.....	3
Background.....	4
Why it is important.....	6
Operational Definitions.....	7
Phases of Healing.....	8
Lymphatic System.....	11
Psychological Effects.....	13
Null Hypothesis.....	15
Significance of the Study.....	15
LITERARY REVIEW.....	17
Deep Tissue Oscillation.....	17
Johnson-Rahbeck Effect.....	19
Indications.....	20
Contraindications.....	21
PROPOSAL METHODS.....	22
Participants.....	22
Study Parameters.....	22
Treatment.....	23
SF-36.....	23

Results.....	24
CONCLUSION.....	24
DISCUSSION.....	24
References.....	26

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CHAPTER I

INTRODUCTION

Lymphedema is a chronic progressive disease without a cure. (1) Lymphedema is the accumulation of protein dense fluid that results in swelling, pain, loss of function and psychological distress as seen in **Figure 1**. (1, 2) When compared to normal edema with say, a sprained ankle, lymphedema is so much more dangerous due to its protein dense composition. (3) The proteins in the lymphedema that would normally be funneling out pathogens are now no longer circulating and begin to harden (**Figure 2**). (1, 4) The-” ...treatment goal is to remove stagnating lymph in order to avoid the onset of subcutaneous fibrosis, [or hardening], prevent complications such as..., severe functional impairment, cosmetic embarrassment and amputation of the limb.”(1)



Figure 1 Example of Lower Extremity Lymphedema

This disease may present either genetically or because of trauma to the lymph vessels.

(5) Lymphedema due to trauma is typically seen by cancer survivors that have undergone radiation therapy or surgery to remove the lymph vessels. (5)

As stated earlier, there is no cure for lymphedema, but symptoms can be managed.

Treatment to date consists of manual drainage (massage), compression socks, specific exercises guided by a therapist or in extreme cases surgery. (5) This research will

introduce a form of treatment called Deep Tissue Oscillation (DTO) that has been proven to be more effective at improving symptoms over time and at a faster rate, while simultaneously promoting relaxation. (1, 8)

Furthermore, the one on one patient care needed to perform the treatment fosters a connection between the patient and clinician. This is impactful, because lymphedema is not only causing physical disability but also psychological suffering. (6) Patients have reported feeling as if they “go unheard” by clinicians because a common ground of understanding is minimal, lack of treatment options causes frustration, and they “may have beaten cancer but now have a chronic disability”. (6) This research will provide a means to measure physical as well as psychological changes in lymphedema patients before and after Deep Tissue Oscillation therapy.

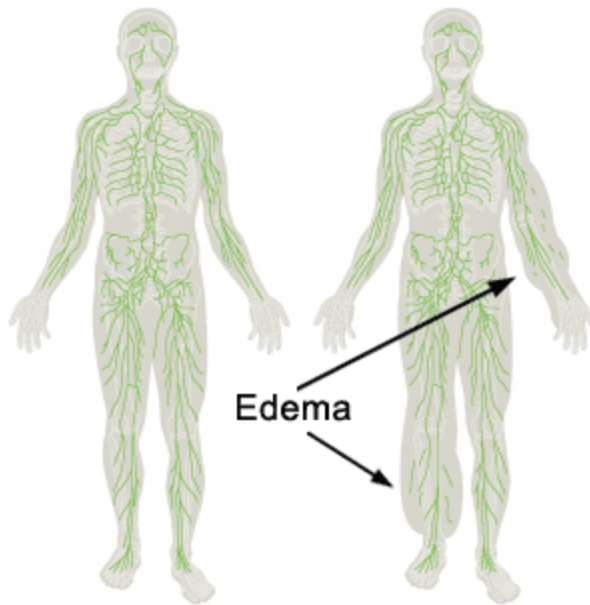


Figure 2 Lymphedema

PUPROSE

1. To observe Deep Tissue Oscillation (DTO) therapy performed on bedridden geriatric patients with lower extremity lymphedema and measure change in their health-related quality of life.
2. The proposed study will evaluate DTO's psychological effects from baseline and after exposure, as well as levels of functional health and well-being using the SF-36 health survey.
3. This study will educate clinicians and the general population by promoting awareness of alternative therapeutic options.

BACKGROUND

The idea behind Deep Tissue Oscillation originated in Germany in 1963. (7) Dr. Johannes Asdonk and his wife, Dr. Krystyna Barteczko, had served as military physicians during WWII and had since turned their attention to increased comfort and well-being for patients in peacetime. Dr. Asdonk was fascinated with the work of Dr. Emil Vodder on manual lymph drainage, and he worked with Dr. Barteczko to improve methodology. (7) Eventually, they theorized that lymphedema could be significantly improved by combining massage therapy with a pulsed electrostatic field: the basic theory behind DTO. (8)

The concept was refined in 1973 by Hans Seidl who is credited with the invention of the HIVAMAT unit, which was the first machine to capitalize on this therapeutic principle. (9) Histology Variable Manual Technique, or HIVAMAT, is currently the only recognized machine that produces the Deep Tissue Oscillation (DTO) effect. (9)

DTO has been marketed as a treatment for a wide range of illnesses and injuries, from open wounds to muscle strains. (8, 9) Unfortunately, only a portion of these claims are backed by credible research studies. The lack of homeland research could be due to DTO therapy stemming from overseas and the time it has taken to become acknowledged in the United States therapy circuit. According to the manual handbook for the HIVAMAT

unit, DTO is mostly seen at the collegiate and professional sports level in America, where it receives abundant anecdotal support from athletic populations. (11)

Research supports DTO as an effective treatment for the following pathologies/injuries:

- Primary and Secondary Lymphedema (1, 8)
- Osteoarthritis (8)
- Muscle tightness (12)
- Cellulite (13)
- Burns (14)
- Open Wounds (9)
- Amputations (9)
- Respiratory Inflammation (15)

Many more aesthetic conditions, and acute, and chronic injuries have been treated with DTO; the list above only includes those in which it has been shown to be effective in a research setting.

While DTO is generally considered effective on its own, it can achieve better outcomes when coupled with other treatments. (8, 14, 12) For example, the original method of lymphedema reduction in patients is manual drainage or massage, (7) where the therapist is physically pumping and pushing the edema out of the affected area with their hands. In the past, physicians have had the problem of edema returning quickly, leading to more frequent visits from the patient as well as interruptions in their daily life, not to mention the possible strain on the clinician. (1, 8) When manual drainage and

DTO have been used simultaneously, the edema has been reduced much faster and remains lessened over a prolonged period of time. (8)

Although research has been minimal in supporting this new modality, the published studies have credible evidence to substantiate the rise in DTOs usage. DTO is only beginning to be recognized as a modality in the United States. It is likely that more studies will be published in the future as exploration of this promising therapy continues.

WHY IT IS IMPORTANT

Patients and clinicians need to be aware of different forms of therapy because not every individual can receive the same treatment for the same pathology or injury. As stated earlier, the range of success with this modality is vast. This therapy is suitable for many more populations than the one represented in this project.

In time, natural degeneration will take its toll on everyone and possibly lead to a bedridden state because aging is inevitable. This modality has shown an effective and faster recovery while simultaneously promoting relaxation. (1, 8) Knowledge of therapeutic options will allow productive preparation for the individual therapeutic journey.

This study is also intended for clinicians, to remind them of the importance of patient centered care and fostering a connection with the patient to treat not only the physical

pathology but also address the psychosocial distress associated with this chronic illness. Ultimately, this modality will aid clinicians as they seek to utilize a new viable treatment option.

OPERATIONAL DEFINITIONS

Chemical Mediators – Chemicals that mobilize the body's resources after injury to neutralize the cause of the injury and to begin removing the cellular debris so that repair can take place. Chemical mediation is one of eight events in the inflammatory response.

(16)

Contraindication - Situations in which a specific modality should not be used - that is, situations in which it may do more harm than good. (16)

Edema - The accumulation of fluid in the interstitial space. (3)

Fascia - Fibrous membrane that covers, supports, and separates muscles. (17)

Frequency - 1 The rate of passage of crests on a waveform, expressed in cycles per second or hertz (Hz). 2 The rate of vibration of a force or wave, usually measured relative to local time. (16)

Indication - Situations in which a specific modality should be used; conditions that would benefit from application of a certain modality. (16)

Modality - A device or application that delivers a physical agent to the body for therapeutic purposes. (16)

Health Related Quality Of Life – a multi-dimensional concept that includes domains related to physical, mental, emotional and social functioning. It goes beyond direct measured of population health, life expectancy, and causes of death, and focuses on the impact health status has on quality of life. (26)

Swelling - An increase in tissue volume owing to extra fluid and cellular material in the tissue. (16)

White Blood Cells (WBC) - Cells that have the special function of recognizing and reacting with antigens in the body. (19)

PHASES OF HEALING

DTO is a modality, as are ice, ultrasound, electrical stimulation, and heat; in that, a modality does not heal an injury but instead creates the optimum environment for healing by limiting swelling, promoting wound healing, pain relief and increasing range of motion. (16, 17) After injury, the body goes through natural processes to heal on its own. Ice serves to relieve pain, limit inflammation, and consequently, increase range of motion or function. (16, 17) The faster the limb can return to previous range of motion, the sooner rehabilitative exercises can be utilized. (16) Modalities facilitate the body's natural healing processes. Basic knowledge of the phases of healing will allow for

understanding of when and where DTO comes in to aid in the body's recovery time. For the sake of these examples, ice will be the modality discussed, since it is more widely used and understood by the general population.

After the body has been injured, the respective tissue goes through three identifiable phases of healing: 1) inflammation 2) proliferation and 3) maturation. (16, 18)

The most notable signs of inflammation are redness, heat, swelling, pain, and loss of function and are termed the cardinal signs of inflammation. (16, 17, 18, 19) These signs are the cues/results of the "eight sequential, interrelated and overlapping events...; [they] occur simultaneously at different places within the injured tissue, because they progress at different rates in different parts of the tissue". (16) These steps all happen at once to cue each other into action and when to cease action.

Inflammation is made of 8 actions that are all triggered by a primary injury. For example, an individual steps off a stair and sprains their ankle. By either stretching the ligaments or tearing them partially or entirely, they have immediate damage to the tissue.

As soon as the individual stretched the ligaments in their ankle, chemical mediators were sent out with different goals to alert the body that something is wrong. Chemical mediators are why the individual will have swelling and bruising from a rush of blood and fluids to the area to get white blood cells (WBC's) to clean up the damage, also, making the individual compensate with their other leg and respond to pain. These chemical mediators trigger the cardinal signs of inflammation. (16)

In addition, damage is occurring on a cellular level. When repairing the tissue, oxygen serves as a primary source of energy for the cells surrounding the damage. (16)

Unfortunately, there is not enough oxygen for all of the cells suddenly needing all of the attention, creating a deficit, which in turn damages more cells because they take oxygen from adjoining cells. (16) At this time, clinicians utilize ice to limit the cells' need for oxygen. WBC's engulf the dead or dying cells and in this case, serve as a clean-up crew.

(16) If left unchecked and without ice, the return to normal function could be extended to compensate for the cleaning and removal of cellular damage, or phagocytosis. (16)

The proliferation phase will begin shortly after inflammation, with parts overlapping. It will focus on repairing the tissue by creating new blood vessels to expedite the travel of nutrients and WBC's and laying down a fibrous protein called collagen. (16) This material is the "...primary substance of ligaments, tendons and scar tissue". (16) Once the collagen is laid down the tissue will begin to regain its shape and basic function, which is essentially the maturation phase. During this phase, the tissue is regaining normal function and integrity. This process could last up to a year or longer depending on the severity, treatment, and healing of the patient. (16)

DTO encourages the body to heal by decreasing swelling, and edema, while in turn allowing increased range of motion, all of which may contribute to an expedited healing rate for the patient. (8, 14, 10) In research, the wounds that reach the maturation phase have shown to not only heal days faster but also have minimal scarring. (9) For the

phases of healing to run properly, the body has to have a working lymphatic system to aid in the extraction of cellular debris.

LYMPHATIC SYSTEM

The Lymphatic system is a network of vessels that runs throughout the length of the body to filter out pathogens and toxins that enter the body from the environment and the cellular debris produced as shown in **Figure 3.** (3, 25)

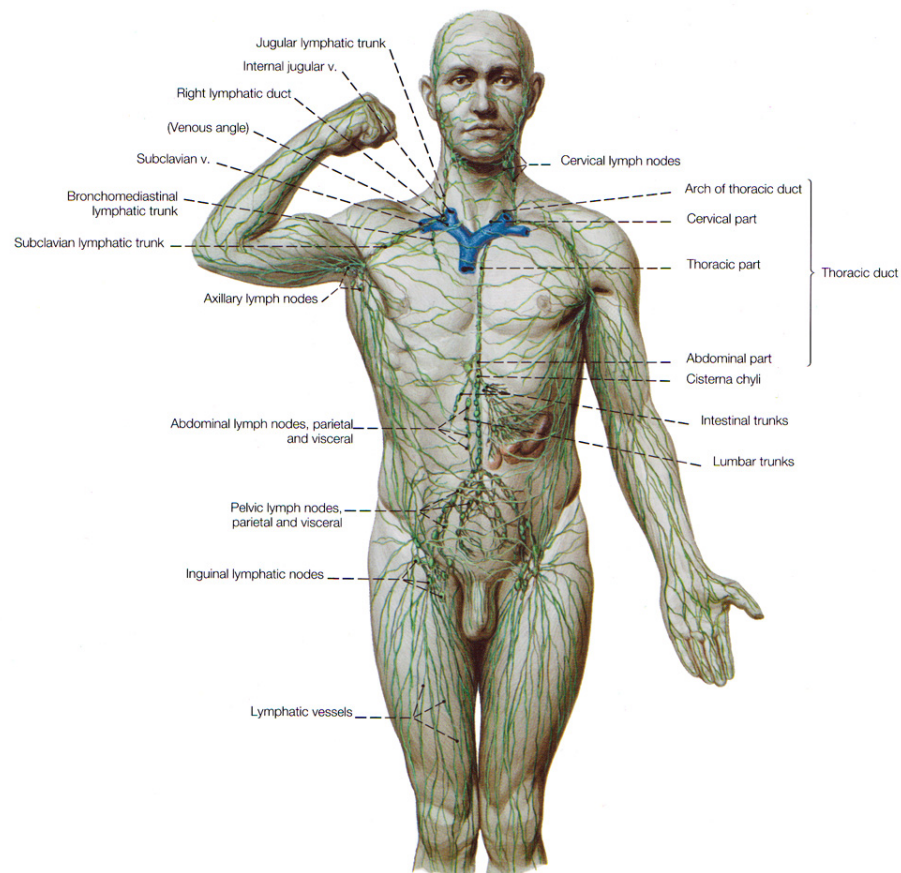


Figure 3 Lymphatic System

Because "...the lymphatic system has no single pump like the heart [in the cardiovascular system]. Lymph flow depends on waves of contraction of smooth muscle in the walls of the larger lymph vessels... and by external compression created by skeletal muscles". (3) The body excretes the lymph through the urinary system. (3) For this reason, when using DTO a side effect may be frequent urination. (8)

The lymph vessels are interwoven throughout the skeletal muscle, therefore through voluntary contraction, like exercise or repetitive motion; the muscles are pumping and pushing the lymph throughout the body as seen in **Figure 4**. (3) The "external compression" is often called a muscle pump system. Similar methods to drain edema include massage or manual drainage, compression socks, or specific exercises like ankle pumps.



Figure 4 Skeletal Muscle Pump

When lymph has been filtered but cannot be reabsorbed at a rate similar to the rate of fluid deposition, then a build-up of interstitial fluid, or lymphedema, occurs. (3)

PSYCHOLOGICAL EFFECTS

Although lymphedema creates significant physical changes in the patient, the psychological effects can be just as debilitating. Patients are upset because they are not reaching a level of understanding with their clinicians. (6) A lack of empathy and compassion for the embarrassment these patients have to experience each day is frustrating. The deficit of research in lymphedema treatments also contributes to the distress.

Whether the individual is suffering from an injury or disease, both have an effect on how that person conducts their daily lives. **Figure 5** "...illustrates the recursive nature of the disablement process: the effects of the disablement components acts as ripples that overlap and move back upon each other". (20) To apply this model, imagine someone recently diagnosed with Lymphedema. They now have a swollen lower leg. The swelling decreases the range of motion for the patient. In turn, daily activities like walking through the store to get groceries becomes difficult. Then they feel as if their role as a parent or guardian is now compromised. The stress of not being able to do the activities

they could do in the past begins to take its toll, and they become psychologically overwhelmed.

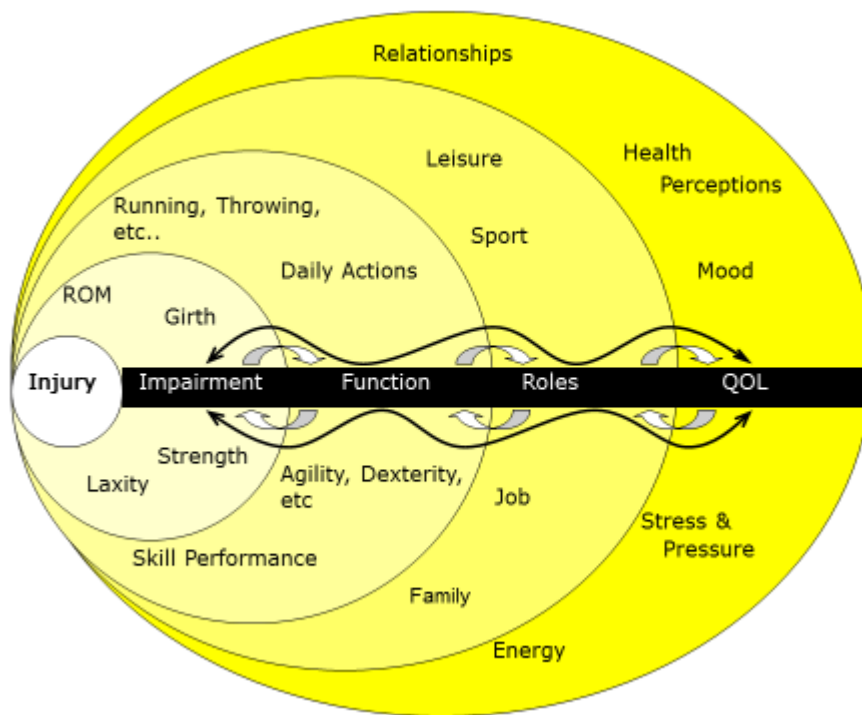


Figure 5. Disablement model and themes

The one-on-one physician-to-patient care that would be utilized in DTO treatment would provide the hands on approach to healing a population that has had their

independence taken away from them. By forming, a connection with the patient and showing compassion towards their individual journey the patient feels more at ease.

NULL HYPOTHESIS

It is hypothesized that...

1. Deep Tissue Oscillation will have no effect on lower extremity lymphedema in bedridden geriatrics.
2. Participants will report no differences in functional health or psychological well-being.

SIGNIFICANCE OF THE STUDY

This modality is relatively new to the medical world and has the potential to be implemented in more therapeutic programs. (8) When compared to other modalities in the treatment of a wide range of injuries, DTO shows resounding success coupled with

fewer contraindications. (8, 12) This could make it a more prominent choice of treatment. For instance, some modalities, like electrical stimulation and ultrasound, cannot be used over a fracture site; whereas, DTO can.

This study seeks to correct a major gap in DTO research: namely, its effectiveness for the geriatric bedridden population. Instead, this therapy is mostly used on athletes at the college and professional level. There have been noted positive psychological effects of DTO, though so far, no study has gathered scientific evidence to support their claims. (8, 21)

These findings could improve the health-related quality of life for an entire population, impacting them not only physiologically but also psychologically. The one-on-one, physician-to-patient experience that DTO utilizes will supplement the patient-centered care ideology.

CHAPTER II

LITERARY REVIEW

DEEP TISSUE OSCILLATION

Deep Tissue Oscillation (DTO) is an emerging modality that uses a pulsed electrostatic field to pick up and drop the respective tissue undergoing treatment. (1, 8, 10, 14) This can be thought of similar to a balloon being rubbed onto your shirt and then used to attract your hair to the balloon as when you move the balloon away from your head, and the hair attracts toward the balloon until it drops back to normal position.

The patient holds a metal grounding bar and the physician has an electrode placed on their body. Both the grounding bar and electrode are connected to the DTO machine. The physician's vinyl gloved hands, which hold the charge, are then placed on the affected tissue, completing a closed circuit with the patient as seen in **Figure 6**. (22)

While the clinician is in contact with the affected limb, the patient feels a soft vibration emanating from treatment area. To that effect, the vibrations promote relaxation and are even utilized in some spas.



Figure 6 Deep Tissue Oscillation Treatment

Instead of the clinician's hands closing the circuit and connecting to the patient, in **Figure 7**, there is also a probe that can have the same effect. (23)The probe is especially useful in the smaller hand held versions that patients can take home for self-care.

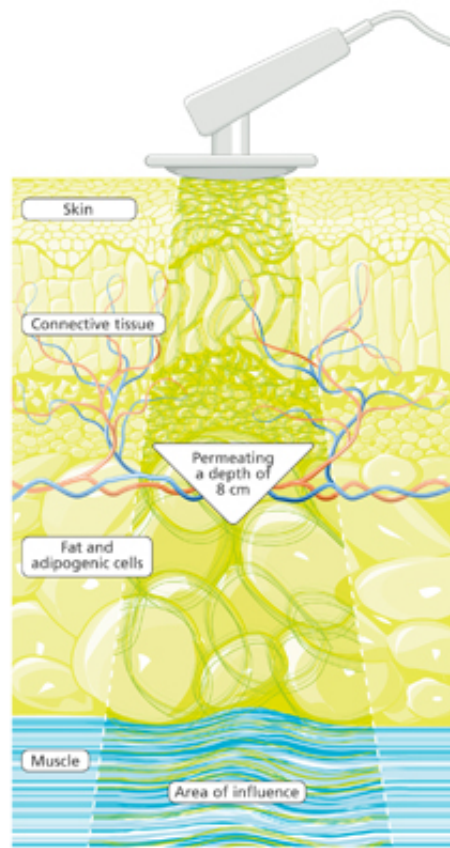


Figure 7 Penetration of Tissue Depth

JOHNSON-RAHBECK EFFECT

This modality can effectively penetrate the body up to 8 centimeters (3.14 inches) deep to attract and then drop the target tissue in the area known as the “sphere of activity”.

(14) This area receiving the static field is lifting and dropping based on a physics theory known as the Johnson-Rahback Effect. (8)

The Johnson-Rahback Effect states: “if a barrier layer is put between two electrodes, a high magnetic force is caused in the space between”. (8) The attraction and subsequent release of the tissue will run along the length of the muscle and has also been described

as “rhythmical tissue deformation”. (8) The body naturally uses skeletal muscular contractions to move lymph; otherwise known as a muscle pump system. The pumping action along a muscle will increase the individual fibers’ mobility and flexibility while also releasing trapped wastes and mobilizing lymph. (8) DTO acts as the muscle pump system with the “rhythmical tissue deformation” that is lacking in bedridden geriatrics due to loss of mobility. (3, 8)

INDICATIONS

According to published research studies, the following is a list of conditions and signs that would make the patient eligible for DTO therapy:

Pain (8, 9, 14, 15, 17)

Inflammation (8, 14, 15)

Edema (1, 6, 10, 15, 17)

Open wound healing (8, 14)

Scarring (8, 17)

Improve circulation (8)

Fracture (8)

Sprain, Strain, contusion (8)

Arthritis (8)

Respiratory Diseases (8, 9, 15)

CONTRAINDICATIONS

The following is a list of conditions and signs that would make the patient ineligible for DTO therapy. These stipulations are in place to prevent further trauma and to err on the side of caution with certain populations that may be negatively impacted by the treatment. Though DTO has contraindications, it should be noted that it has fewer when compared to other modalities. (1) For example, you cannot use ultrasound therapy if a fracture is suspected or an open wound is present. (8) Thermal ultrasound produces heat in the tissue and is contraindicated for many acute injuries. (8) DTO can be used on a fracture site and has been proven to effectively promote wound healing. (8, 9, 15) DTO does not heat up or promote any change in tissue temperature and is therefore more ideal in earlier treatment and post-operative rehabilitation. (5)

Contraindications for DTO:

Magnetic implants (8, 9)

Acute infection (8)

Thrombolytic vessels (8, 9)

Must be cautious around pacemakers (8, 9)

Untreated malignant diseases (8)

Unbalanced heart diseases (8)

Pregnancy (8)

Sensitivity to electric fields (8)

CHAPTER III

PROPOSAL METHODS

PARTICIPANTS

Inclusion criteria: age range 65 to 80 years of age, bedridden, with lower extremity lymphedema. Exclusion criteria: Deep Tissue Oscillation treatment 3 months preceding the study, acute infection, untreated malignant diseases, unbalanced heart disease, pregnancy, during menstruation avoiding the abdominal area, patient sensitivity to electric fields, if the patient is under pharmacological treatment, caution must be taken around pacemakers. Block randomization will be used to determine whether the participants will be placed in the treatment group (DTO and compression socks) or the control group (compression socks and manual drainage).

STUDY PARAMETERS

The diagnosis of lower limb lymphedema will be established via bilateral palpation by the same examiner throughout the study. Circumference measurements will be taken during every appointment at the same locations: above the ankle, upper 1/3 of the calf, and upper 1/3 of the thigh, before the therapy session begins and after the session is completed. Patients will be revisited 4 weeks and then 8 weeks post-treatment to assess the long-term effects of DTO.

TREATMENT

Treatment for the experiment group will be administered 30 minutes, twice a week for 6 weeks and delivered in two phases. Fifteen minutes of initial high frequency, (80-200 Hz) aimed “at softening the [hardened] tissue and stimulating the transportation of liquids”. (1) The final fifteen minutes’ medium frequency (25-80 Hz) will act as “a strong pumping effect which [will] allow effective interstitial drainage”. (1) Post treatment will consist of the compression sock reinstalled on the patient’s affected limb(s).

Treatment for the control group will consist of manual drainage 30 minutes, twice a week for 6 weeks. After treatment, compression socks will be placed back on the affected limb(s).

SF-36

The short-form health survey or SF-36 will be measuring the patient’s functional health and well-being before treatments begin and after each week for both the control and experimental group. The questionnaire is 36 questions long and “...proven useful in surveys of general and specific populations, comparing the relative burden of diseases, and in differentiating the health benefits produced by a wide range of different treatments”. (24) This tool will be utilized to focus on how the patient feels physically and emotionally. (24)

RESULTS

Due to lack of access to a DTO unit and time required to conduct a thorough study, this project is currently written as a proposal and will be conducted in the future. Therefore, no results are available at this time.

CONCLUSION

The findings of this study will determine whether physiological and psychological benefits exist and possibly make DTO a more readily available modality to the geriatric population and clinical settings. Ideally, the circumference of the affected limb(s) in the experimental group will decrease and maintain a decreased circumference longer when compared to the control group. In addition, the SF-36 survey would ideally show increases in functional health and well-being over the course of the treatment.

DISCUSSION

The purpose of this research was to reintroduce the skeletal muscle pump to a population that no longer had the mobility to produce the pumping action, gather more data about the psychological effects of DTO and to educate clinicians and the general population about this useful modality.

In conducting this research, questions have surfaced that would benefit from further research:

If the current passes through the clinician during treatment, does the clinician receive any harm or benefits or notice any physiological changes over the course of performing the therapy?

A side effect of DTO is frequent urination after treatment. This effect is the body's way of expelling the lymph drainage. Should a nephrologist be present with certain populations with chronic kidney failure? If so, should long-term dialysis patients be excluded from treatment?

More research is needed to fully understand the possible physical and psychological benefits from DTO in the bedridden geriatric population with lymphedema. This is the first study to look at DTO with this particular population. Ultimately, Deep Tissue Oscillation is a useful modality that has proven effective on a variety of injuries and pathologies, but lacks the acknowledgement. With further research, this modality could become available to various populations and not just kept in athletic programs.

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