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To compare the efficacy of pneumatic compression therapy (PCT), lymphatic drainage exercises (LDE) and control group in patient with lower limb lymph edema

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Abstract

Introduction: Lymphedema is a symptom of morphologically or functionally insufficient lymph transport. There are several etiological factors damaging the lymphatic pathways. Infections and trauma of limb skin and deep tissues evoke reaction of peripheral lymphatics and lymph nodes ^[1].

Aim and Objective: To compare the “efficacy of pneumatic compression therapy (PCT), lymphatic drainage exercises and control group in patient with lower limb lymph edema.

Methodology: Subject randomly assigned into three groups viz group A, B and C. Group A patients given Pneumatic Compression Therapy (PCT) and Manual Lymphatic Drainage (MLD). Group B given Lymphatic Drainage Exercises (LDE) and Manual lymphatic drainage (MLD) and Group C given Manual lymphatic drainage (MLD) for lower limb lymph edema. All three groups were treated for four weeks.

Results: The age, weight and height of subjects in groups A, B and C were compared by using analysis of variance. There was no significant difference found in age, weight and height in all 3 groups ($P>0.05$). But significant difference found at 3 to 4 weeks in all 3 groups. ($P<0.05$).

Conclusion: The present study concluded that group A (Pneumatic Compression Therapy and Lymphatic Drainage Exercises) showed significant improvement as Group B (Manual lymphatic drainage (MLD) and control group (lymphatic drainage exercises) for lower limb in lymphoedema.

Keywords: Pneumatic compression therapy (PCT) and manual lymphatic drainage (MLD), lymphatic drainage exercises (LDE) and measure tape

Introduction

Lymphedema is a symptom of morphologically or functionally insufficient lymph transport. There are several etiological factors damaging the lymphatic pathways. Infections and trauma of limb skin and deep tissues evoke reaction of peripheral lymphatics and lymph nodes. Gradually, lymphatic structures become destroyed, tissue fluid transport toward and along lymphatics slows down, and edema of the dermis, subcutaneous tissue, as well as the muscular fascia and muscles gradually develops. Besides inflammation and trauma, the iatrogenic damaging factors for lymphatics are surgery and irradiation of lymph nodes in cancer therapy ^[1]. [Fig- 1]

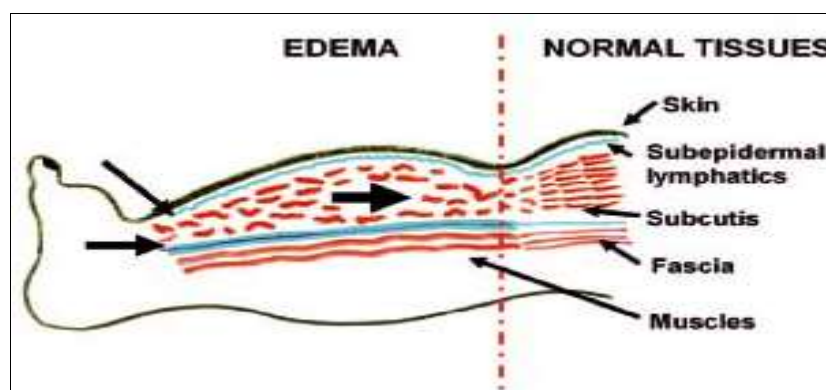


Fig 1: Lymphedema

Lymphatic drainage exercises, often referred to as pumping exercises, move fluids through lymphatic channels. Active, repetitive ROM exercises are performed throughout each session. The exercises follow a specific sequence to move away from congested areas. It is similar to the sequence of massage applied during manual lymph drainage [2].

Intermittent pneumatic compression (IPC) is a mechanical Therapeutic modality that include an air pump that intermittently inflates supportive sleeves, gloves or boots around an edematous part to improve venous and lymphatic circulation [3].

IPC delivers the dual hematological benefits of suppressing pro-coagulant activation and enhancing global fibrinolysis [4].

Manual lymphatic drainage (MLD) is a type of massage based on preliminary evidence which is hypothesized to encourage the natural drainage of the lymph, which carries waste products away from the tissues back toward the heart [5, 6].

Aims and Objectives

To compare the “efficacy of pneumatic compression therapy (PCT), lymphatic drainage exercises and control group in patient with lower limb lymph edema.

Hypothesis

Null Hypothesis

There is no significant difference between pneumatic compression therapy (PCT), lymphatic drainage exercises (LDE) and control group in patient with lower limb lymph edema.

Experimental Hypothesis

There is a significant difference between pneumatic compression therapy (PCT), lymphatic drainage exercises (LDE) and control group in patient with lower limb lymph edema.

Operational Definitions

Lymphoedema

Lymphoedema has been defined as one of the most significant survivorship issues after the surgical treatment of breast cancer, and in this population has been documented to have significant physical, functional, economic consequences, and impairment of quality of life [7].

Pneumatic Compression Therapy (PCT)

Intermittent pneumatic compression is a therapeutic technique used in medical devices that include an air pump and inflatable auxiliary sleeves, gloves or boots in a system designed to improve venous circulation in the limbs of patients who suffer edema or the risk of deep vein thrombosis (DVT) or pulmonary embolism (PE). When activated, the pump fills the air chambers of the jacket in order to pressurize the tissues in the limb, thereby forcing fluids, such as blood and lymph, out of the pressurized area. A short time later, the pressure is reduced, allowing increased blood flow back into the limb [7].

Manual lymphatic drainage (MLD)

Manual lymphatic drainage is not the same as massage; it consists of intermittent, gentle pressure applied directly on the

skin to stretch the very small initial lymphatics, increasing lymphatic vessel contraction, and lymph drainage of the affected field. It has four essential hand strokes which must be circular or spiral in character and with a slow frequency. The central fields are treated first, and then the drainage continues peripherally [8].

Lymphatic Drainage Exercises

Lymphatic drainage exercises, often referred to as pumping exercises, move fluids through lymphatic channels. Active, repetitive ROM exercises are performed throughout each session. The exercises follow a specific sequence to move away from congested areas. It is similar to the sequence of massage applied during manual lymph drainage [8].

Measure Tape

A flexible, non-stretch, woven fabric tape measure was used to measure arm circumferences. It consists of a ribbon of cloth, plastic, fiber glass, or metal strip with linear-measurement marking. It is a common measuring tool. To assure consistent tension over soft tissue, muscle, and bony prominences registered nurses with previous training and extensive experience in circumferential arm measurement techniques completed the measurements the tape measure was calibrated in meter and inch (150 meter/60 inches) [2].

Pitting Edema

Observable swelling of body tissues due to fluid accumulation that may be demonstrated by applying pressure to the swollen area (such as by depressing the skin with a finger). If the pressing causes an indentation that persists for some time after the release of the pressure, the edema is referred to as pitting edema.

Degrees of Pitting Edema:-

- +1 pitting edema = trace = barely perceptible depression
- +2 pitting edema = mild = 0.6 cm depression with rebound in less than 15 seconds
- +3 pitting edema = moderate = 0.6 to 1.3 cm depression with rebound in 15 to 30 seconds
- +4 pitting edema = severe = 1.3 to 2.5 cm depression with rebound of greater than 30 seconds [9].

Review of Literature

Anatomy of Lymphatic System

Lymphatic system is essentially a drainage system which is accessory to the venous system. It is important to know that the larger particles (proteins and particulate matter) can be removed from the tissue fluid only by lymphatics. Therefore, the lymphatic system may regarded as ‘drainage system of coarse type’ and venous system as ‘drainage system of fine type’. The tissue fluid flowing in the lymphatics is called lymph. Components of Lymphatic System The lymphatic system comprises: (1) lymph vessels; (2) central lymphoid tissues; (3) peripheral lymphoid organs and circulating lymphocytes [10] (Fig. 2)

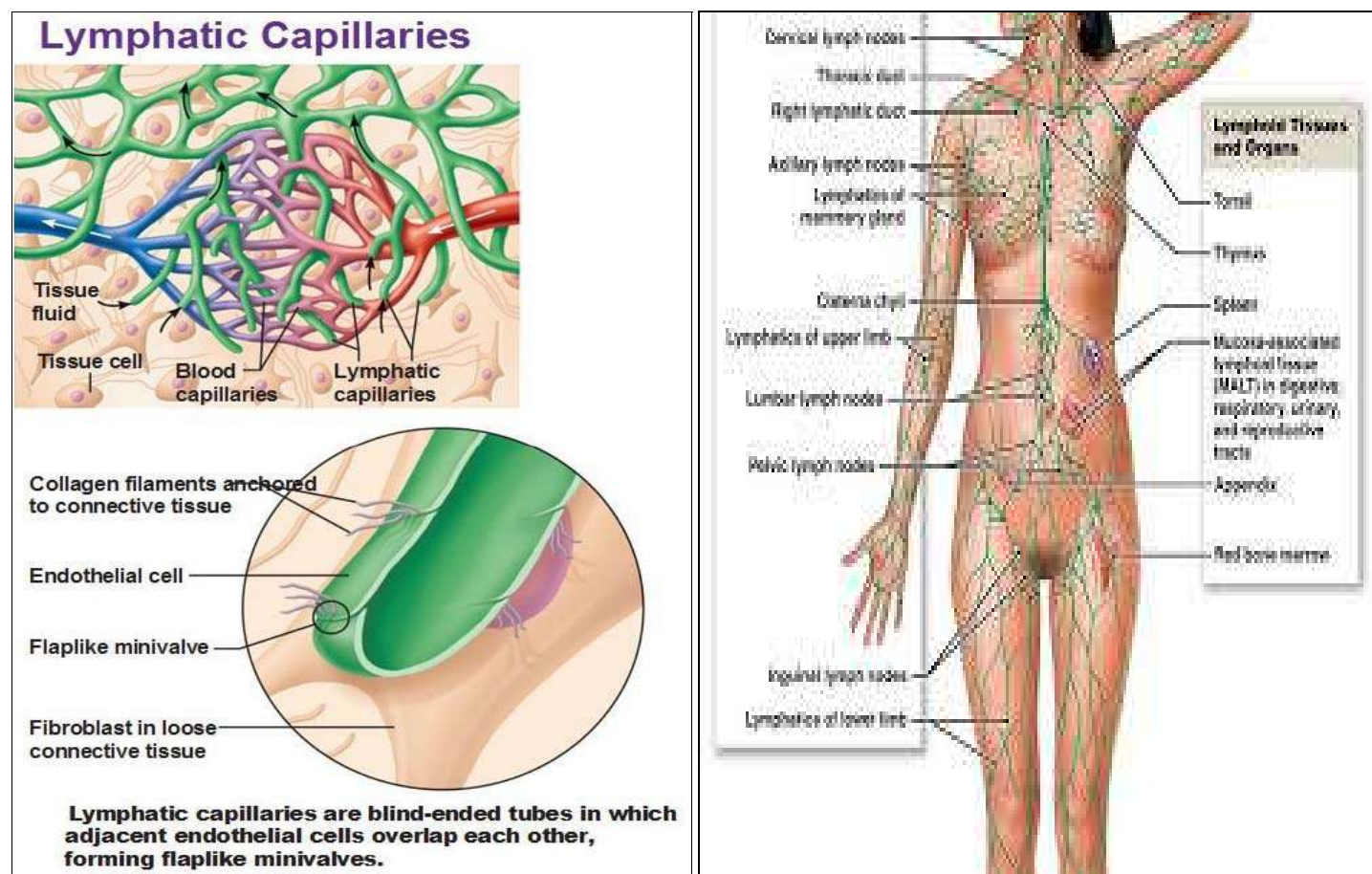


Fig 2: Lymphatic System

Lymphatic Vessels

The lymphatic vessels of the lower limb can be divided into two major groups; superficial vessels and deep vessels. Their distribution is similar to the veins of the lower limb.

Superficial Lymphatic Vessels

The superficial vessels can be divided into two major subsets; (i) medial vessels, which closely follow the course of the great saphenous vein and; (ii) lateral vessels which are more closely associated with the small saphenous vein.

Deep Lymphatic Vessels

These are far fewer in number than their superficial counterparts and accompany the deep arteries of the lower leg. They are found in 3 main groups: anterior tibial, posterior tibial and peroneal following the corresponding artery respectively, and entering the popliteal lymph nodes^[11].

Inguinal Nodes

The inguinal nodes are found in the upper aspect of the femoral triangle and are 1—20 in number. They are subdivided into 2

groupings determined by their position relative to a horizontal line drawn at the level of termination of the great saphenous vein. Those below this line are the sub-inguinal nodes (consisting of a deep and superficial set) and those above are the superficial inguinal nodes.

Superficial Inguinal Nodes

These form a line directly below the inguinal ligament and receive lymph from the penis, scrotum, perineum, buttock and abdominal wall.

Superficial Sub-Inguinal Nodes

These are located on each side of the proximal section of the great saphenous vein. They receive afferent input primarily from the superficial lymphatic vessels of the lower leg.

Deep Sub-Inguinal Nodes

These are often found in one to three in number and are most commonly found on the medial aspect of the femoral vein. The afferent supply to these nodes is from the deep lymphatic trunks of the thigh which accompany the femoral vessels^[11]. (Fig. 3):

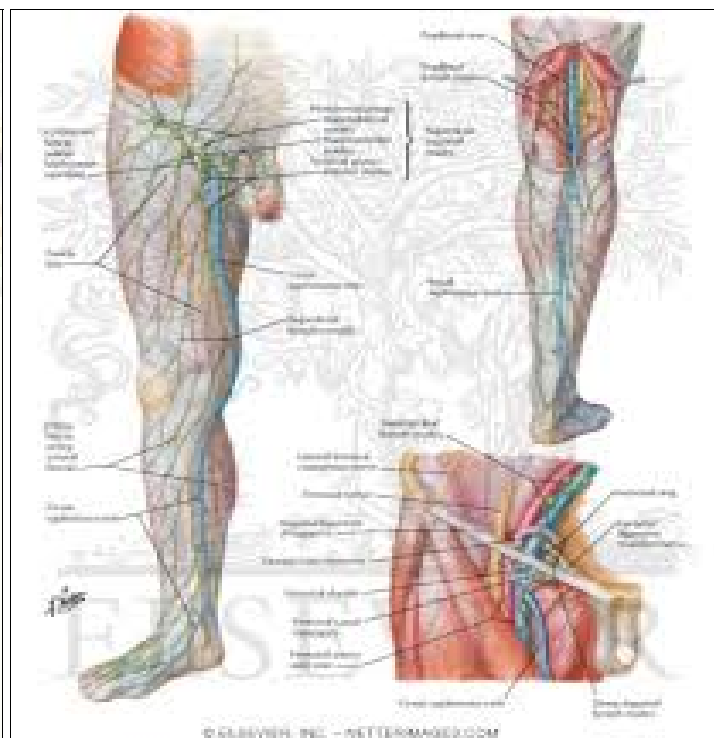
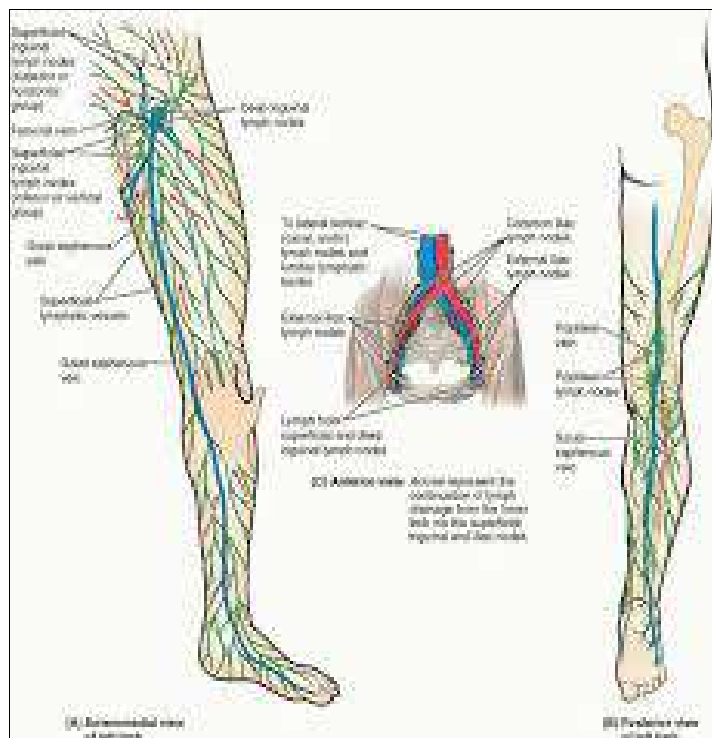


Fig 3: Lymph Nodes of Lower Limb

Popliteal Lymph Nodes

The popliteal lymph nodes are relatively small in size. They are embedded in the popliteal fat. One lies just deep to the popliteal fascia and drains the saphenous vein territory e.g. the superficial regions of the lateral leg and the sole of the foot. A second node lies near the popliteal artery. This receives lymphatic vessels from the knee joint. The remaining nodes lie at the sides of the popliteal vessels, and receive the lymph from the posterior and anterior tibial vessels ^[12]. (Fig. 4):

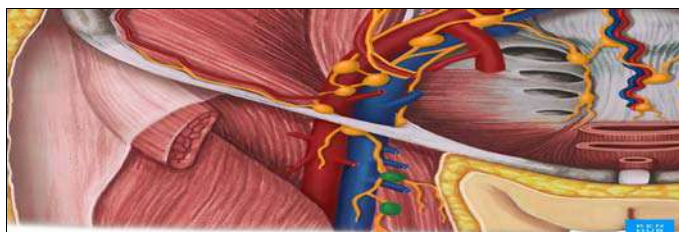


Fig 4: Popliteal Lymph Nodes

Functions of lymph nodes

Lymph nodes serve as filters which filter bacteria and toxic substances from the lymph.

Functions of the lymph nodes are:

1. When lymph passes through the lymph nodes, it is filtered that is the water and electrolytes are removed. But the proteins and lipids are retained in the lymph.
2. Bacteria and other toxic substances are destroyed by macrophages of lymph nodes. Because of this, lymph nodes are called defense barriers ^[13].

Author's study description

Waldemar Lolszewski *et al* Foot, calf, and thigh skin and subcutaneous tissue of stages IIIV lymphedematous lower limbs contained similar calculated volumes of tissue fluid reaching on average 50% of the total tissue volume.

Freire de Oliveira MM, *et al.* A study “Manual lymphatic drainage and active exercise effects on lymphatic function do

not translate into morbidities in women who underwent breast cancer surgery.” MLD and active exercise effects are equivalent with regard to morbidity. Minor changes in lymphatic function associated with either MLD or active exercises were not related to patients' symptoms or signs.

Kirstin Lane, *et al.* A study on “Exercise and the lymphatic system implications for breast-cancer survivors” Both resistance and upper body exercises have not been shown to lead to significant changes in arm volume; however further research is needed using lymphoscintigraphy to better understand the effect of short and long term exercises on lymphatic function.

Ana Carolina Pereira de Godoy One of the ways of treating posttraumatic lymphedema is lymph drainage, and in recent years, new techniques of manual and mechanical lymph drainage have been developed Lymph Drainage of Posttraumatic Edema of Lower Limbs 2018 [21].

Niraj kumar *et al* (2018) study we have discussed about significant reduction of upper extremity lymph edema. The group A (Pneumatic Compression Therapy and Lymphatic Drainage Exercises) showed more improvement than group B (Manual lymphatic drainage (MLD) and lymphatic drainage exercises) ^[11].

Methodology

Sample

It is an experimental study design. A convenience sample of 45 subjects with lymphoedema was solicited from the OPD physiotherapy department and surgery ward of Shri Guru Ram Rai Institute of medical & Health Sciences / Shri Mahant Indresh Hospital Patel Nagar Dehradun. 15 subjects each in three groups were selected according to inclusion and exclusion criteria. Inclusion criteria Inclusion Criteria- Patient with lymph edema, Age Group - 25-50 years. and Weight -50to 80 kg. post traumatic complication, post-surgical complication, lower limb lymph edema due to chemotherapy Exclusion Criteria- Subjects with a history of severe acute traumas, Congenital disorder, Patient with neurological deficit, Spondylolsthesis, Pott's spine, Rheumatoid Arthritis Disorder, Ankylosing Spondylosis.

Vertebro-Basilar Insufficiency, Cardiac Problem. Instrumentation for Data Collection -Measure tape and Pitting Edema:

Procedure

The 45 subjects were randomly taken and assigned into group A, B and C. Prior to participation all subjects were informed about the study and an informed consent was taken. Group A patients given Pneumatic Compression Therapy (PCT) and Manual Lymphatic Drainage (MLD). Group B given Lymphatic Drainage Exercises (LDE) and Manual lymphatic drainage (MLD) and Group C given Manual lymphatic drainage (MLD) for lower limb lymph edema. All three groups were treated for four weeks.

Intermittent Pneumatic Compression Therapy (IPCT)

Treatment Protocol

Intermittent pneumatic compression is a therapeutic technique used in lower limb that include an air pump and inflatable auxiliary sleeves, gloves or boots in a system designed to

improve venous circulation patients with lower limb Lymphoedema. When activated, the pump fills the air chambers of the jacket in order to pressurize the tissues in the limb, thereby forcing fluids, such as blood and lymph, out of the pressurized area.

Multichamber sleeve is used to provide sequential compression, the distal segment inflates first to the maximum pressure and then, as it deflates, the more proximal segments inflates sequentially, generally to slightly lower levels of pressure. For lower limb Lymphoedema inflation pressure is between 40 and 80 mm Hg. Total treatment time recommended vary 2-3 hours per treatment, with treatment frequency should be 6 times per week is recommended. The frequency and duration of treatment should be the minimum necessary to maintain good Lymphoedema control or satisfactory progress towards the goals of treatment. (48) [Fig-5].

Recommended parameters for the application of Intermittent Pneumatic Compression Therapy (IPCT)



Fig 5: Lower Limb Lymphoedema Treated with Pneumatic Compression Therapy

Problem	Inflation/Deflat in time in seconds (ratio)	Inflation pressure (mm Hg)	Treatment time (Hour)
Lymph Edema	80-100/25-35 (3:1)	40-80 lower Limb	2-3 Hours
Residual limb Reduction	40-60/10-15 (4:1)	40-80 lower Limb	2-3 Hours

Lymphatic drainage exercises for lower extremities

Total body relaxation

Have the patient assume a comfortable supine position and begin deep breathing. Then, isometrically contract and relax the muscles of the lower trunk (abdominals and erector spinae) followed by the hips, lower legs, feet, and toes.

Lower Extremity Exercises

We have started doing exercise before lower limb lymphatic drainage exercises. All these exercise given 15 repetitions for two sets.

- Alternate knee to chest exercises
- Bilateral knees to chest
- Gluteal setting and posterior pelvic tilts.
- Single knee to chest with the involved lower extremity.
- External rotation of the hips while lying supine with both legs elevated and resting on a wedge or wall.
- Active knee flexion of the involved lower extremity while lying supine.
- Active plantarflexion and dorsiflexion and circumduction of the ankles while lying supine with lower extremities elevated.
- Active hip and knee flexion with legs externally rotated and elevated against a wall.
- Active cycling and scissoring movements with legs

elevated.

- Bilateral knee to chest exercises, followed by partial curl-ups
- Rest with lower extremities elevated.

Lymphatic Drainage Exercises for Lower Extremities

The selection and sequences of exercises described in this section are designed to assist in the drainage of lower limb lymphedema. Many of the individual exercises suggested in Lymphoedema protocols, such as ROM of the ankle joint and some of the hip joint or lower extremity exercises are not exclusively used for lymph drainage. They also are used to improve mobility and strength [30].

1. Posterior pelvic tilt: Perform these exercises with hips and knees flexed, in the supine position. Start by lying on your back on a matted surface, your feet flat on the floor with your hips and knees bent to approximately 45 degrees.

- Fold arms in front of the chest, and relax the back.
- Exhale as you pull your belly button back toward your spine, lifting your buttocks and pressing your lower back firmly against the floor.
- Hold this position for 3 seconds.
- Inhale as you return to the start position. [31] [Fig. 6]

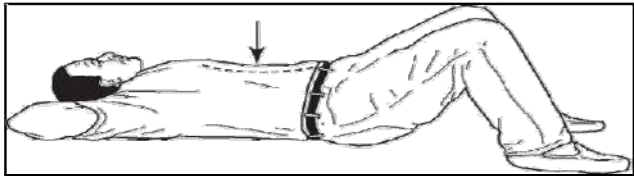


Fig 6: Posterior pelvic tilt

2. Partial curl-ups: Perform these exercises with hips and knees flexed, in the supine position. To start, lie on your back with your knees bent and feet flat on the floor. Don't press your neck or lower back to the floor. Breathe deeply. You should feel comfortable and relaxed in this position:

- Cross your arms loosely.
- Tighten your abdomen and curl halfway up, keeping your head in line with your shoulders.
- Hold for 5 seconds. Uncurl to lie down ^[31]. (Fig:- 7)

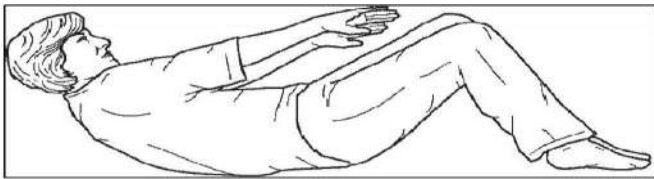


Fig 7: Partial curl- ups

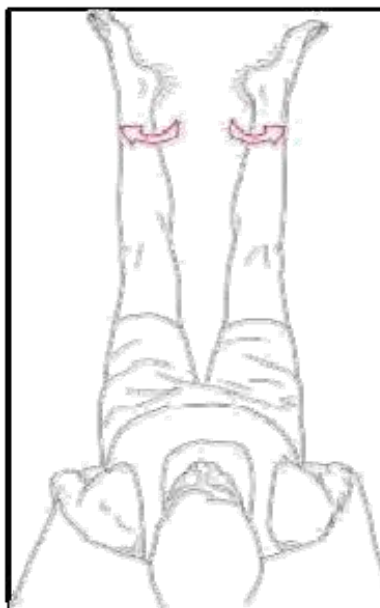


Fig 8: External rotation of hips

7. Knee flexion to clear the popliteal area

While lying in the supine position and keeping the uninvolved lower extremity extended, flex the involved hip and knee enough to clear the foot from the mat table. Actively flex the knee as far as possible by quickly moving the heel to the buttocks. Repeat approximately 15 times.

8. Active ankle movements

With both legs elevated and propped against a wall, or just the involved leg propped against a door frame and the uninvolved

3. Unilateral knee-to-chest movements

In the supine position, repeat this exercise for another 15 repetitions. If lymphedema is present in only one lower extremity, perform repeated knee to chest movements with the uninvolved leg first and then the involved leg.

4. Bilateral knees to chest

In the supine position, flex both hips and knees, grasp both thighs, and gently pull them to the abdomen and chest. Repeat 10 to 15 times.

5. Gluteal setting

- In supine lying and leg extended.
- Instruct the patient to contract the muscles of buttocks.
- Encouraged the patient to hold the contraction for 5 to 10 sec.
- Let the patient relax.

6. External rotation of the hips

Lie in the supine position with the legs elevated and resting against a wall or on a wedge. Externally rotate the hips, pressing the buttocks together, and holding the outwardly rotated position. Repeat several times. (Fig-8).

leg resting on the floor, actively plantarflex the ankle and curl the toes; then dorsiflex the ankle and extend the toes as far as possible for multiple repetitions. Finally, actively circumduct the foot clockwise and counter clockwise for several repetitions.

9. Wall slides in external rotation

With the feet propped up against the wall, legs externally rotated, and heels touching, slide both feet down the wall as far as possible and then back up the wall for several repetitions. [Fig-9]

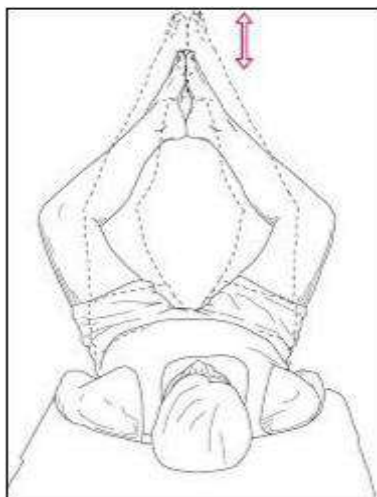


Fig 9: wall slides in external rotation

10. Leg movements in the air

With both hips flexed and the back flat on the floor and both feet

pointed to the ceiling, alternately move the legs, simulating cycling, walking, and scissoring motions. [Fig- 10].



Fig 10: Leg movements in the air

11. Hip adduction across the mid line

Lie in the supine position with the uninvolved leg extended. Flex the hip and knee of the involved leg. Grasp the lateral aspect of the knee with the contralateral hand; pull the involved knee

repeatedly across the midline in a rocking motion. [Fig-11]
(NOTE: If lymphedema is bilateral, repeat this exercise with the other lower extremity.)



Fig 11: Hip adduction across the mid line

Rest

With feet elevated and legs propped up against the wall, rest in this position for several minutes after completing exercises. Then rest the legs partially elevated on a wedge, and remain in this position for another 30 minutes ^[24].

Guidelines to the patient

Guidelines for Lymphatic Drainage Exercises

The patient should follow these guidelines when performing a sequence of lymphatic drainage exercises. These guidelines apply to management of lower extremity lymphedema and reflect the combined opinions of several authors and experts in the field.

Preparation for Lymphatic Drainage exercises

- Set aside approximately 20 to 30 minutes for each exercise session.
- Perform exercises twice daily every day.
- Have needed equipment at foot, such as a foam roll, wedge, or exercise wand.

During Lymphatic Drainage Exercises

- Wear compression bandages or a customized compression garment.
- Precede lymphatic drainage exercises with total body relaxation activities. Follow a specified order of exercises.
- Perform active, repetitive movements slowly, about 1 to 2 seconds per repetition.
- Elevate the involved limb above the heart during distal pumping exercises.
- Combine deep breathing exercises with active movements of the head, neck, trunk, and limbs. Initially, perform a low number of repetitions.
- Increase repetitions gradually to avoid excessive fatigue.
- Do not exercise to the point where the edematous limb aches.
- Incorporate self-massage into the exercise sequence to further enhance lymph drainage.
- Maintain good posture during exercises.

When strengthening exercises are added to the lymph drainage sequence, use light resistance and avoid excessive muscle fatigue.

After Lymphatic Drainage Exercises

- If possible, rest with the involved extremity elevated for 30 minutes.
- Set aside time several times per week for low-intensity aerobic exercise activities, such as walking or bicycling for

30 minutes

- Carefully check for signs of redness or increased swelling in the edematous limb, either of which could indicate that the level of exercise was excessive ^[28].

Data Analysis

IMB SPSS software 25.0 version used for data analysis. Variable i.e. age weight and height of group A, B and C were analyzed by using one way ANOVA. One way ANOVA was used to analyze the variable i.e measure tape at 0,1,2,3 and 4 week. Post hoc analysis using Tukey HSD was used for pair wise comparison of measure tape at 0,1,2,3 and 4 weeks. The significant level of this study was 0.05.

Results

The age, weight and height of subjects in groups A, B and C were compared by using analysis of variance. There was no significant difference found in age, weight and height in all 3 groups ($P>0.05$) (Table 1).

Comparison of measure tape between groups was done by using ANOVA. No significant difference was found from 0 to 1 week ($P>0.05$). But significant difference found at 2 to 4 weeks in all 3 groups. ($P<0.05$) (Table 2)

Comparison of pitting edema between groups was done by using ANOVA. There was no significant difference found at 0 and 1 weeks ($P<0.05$). But significant difference was found at 2 to 4 weeks in all 3 groups. ($P<0.05$) (Table 2)

Comparison of measure tape between the 3 groups i. e. groups A,B and C was done by Post Hoc test using Tukey HSD at 0 to 1st week. There was insignificant difference between the groups. Also there was no significant difference was found at 2 and 4 weeks between A & B and B & C ($P>0.05$) but significant difference was found between A & C at 2 to 4 weeks ($P<0.05$) (Table 3).

Comparison of pitting edema between the 3 groups i.e groups A, B and C was done by using Post Hoc test (Tukey HSD) at 0 to 1 week. No significant difference was found between the groups ($P>0.05$). Also no significant difference was found at 2 to 4 week between A & B and B & C. ($P>0.05$) But significant difference was found between A & c at 2 to 4 weeks. ($P<0.05$) (Table 4).

Table 1: Demographic data

Variable	f- value	p-value
Age	1.776	0.491
Weight	1.165	0.322
Height	2.687	0.080

Table 2: Comparison of Measure Tape and Pitting Edema between groups 0 to 4 weeks.

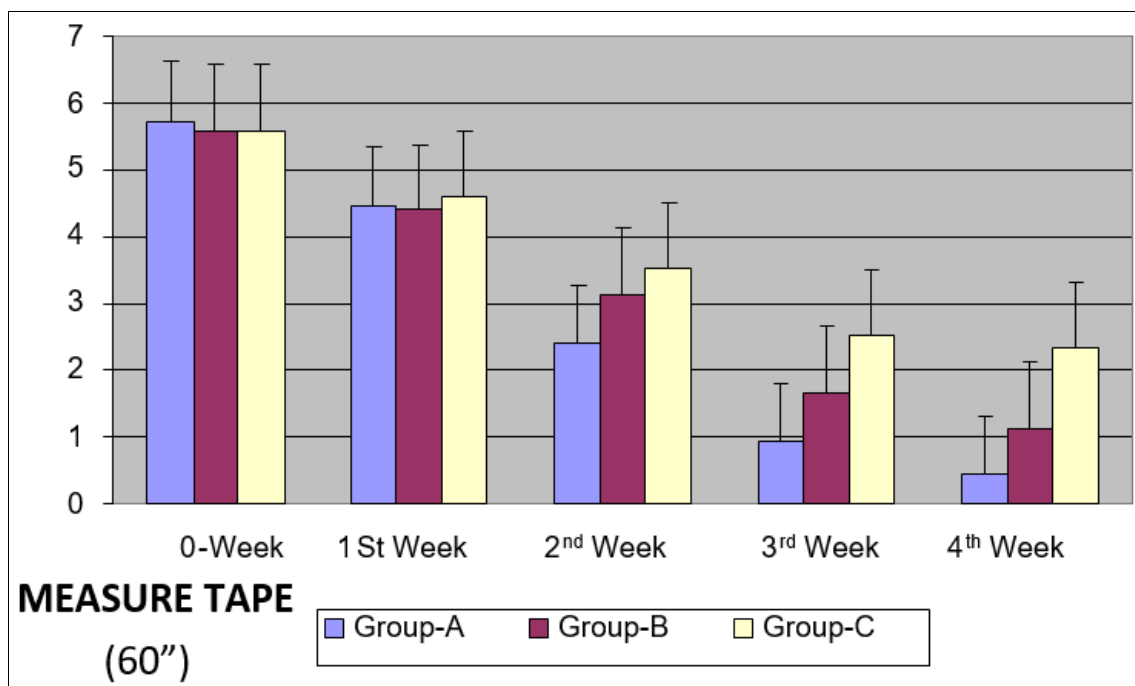
Variable	Week	f- value	p-value
Measure Tape	0	0.024	0.976
	1	0.160	0.853
	2	5.615	0.007
	3	10.635	0.000
	4	12.860	0.000
Pitting Edema	0	0.209	0.812
	1	0.929	0.403
	2	9.086	0.001
	3	13.899	0.000
	4	12.293	0.000

Table 3: Post Hoc Tests for measure tape between groups A, B and C from 0 to 4 weeks.

Variable	Group (i)	Group (j)	Mean Difference (i-j)	Std. Error	Signification (p-value)
Measure Tape 0 Week	1	2	0.06667	0.34975	0.980
	1	3	0.06667	0.34975	0.980
	2	3	-0.06667	0.34975	0.980
Measure Tape 1 Week	1	2	0.06667	0.36048	0.981
	1	3	-0.13333	0.36048	0.927
	2	3	-0.06667	0.36048	0.981
Measure Tape 2 Week	1	2	-0.73333	0.34303	0.094
	1	3	-0.13333	0.34303	0.005
	2	3	0.73333	0.34303	0.094
Measure Tape 3 Week	1	2	-0.73333	0.34733	0.100
	1	3	-1.60000	0.34733	0.000
	2	3	0.73333	0.34733	0.100
Measure Tape 4 Week	1	2	-0.73333	0.38490	0.150
	1	3	-1.93333	0.38490	0.000
	2	3	0.73333	0.38490	0.15

Table 4: Post Hoc Tests for Pitting Edema between groups A, B and C from 0 to 4 weeks.

Variable	Group (i)	Group (j)	Mean Difference (i-j)	Std. Error	Signification (p-value)
Pitting Edema 0 week	1	2	-1.73333	2.80461	0.811
	1	3	-1.33333	2.80461	0.883
	2	3	1.73333	2.80461	0.811
Pitting Edema 1 week	1	2	-0.86667	2.59197	0.940
	1	3	-3.40000	2.59197	0.379
	2	3	0.86667	2.59197	0.940
Pitting Edema 2 week	1	2	-4.66667	3.14052	0.308
	1	3	-13.20000	3.14052	0.000
	2	3	4.66667	3.14052	0.308
Pitting Edema 3 week	1	2	-5.66667	2.94104	0.144
	1	3	-15.33333	2.94104	0.000
	2	3	5.66667	2.94104	0.144
Pitting Edema 4 week	1	2	-4.73333	3.12254	0.294
	1	3	-15.13333	3.12254	0.000
	2	3	4.73333	3.12254	0.294

**Fig 12:** Mean and standard deviation of Measure Tape between groups A, B and C

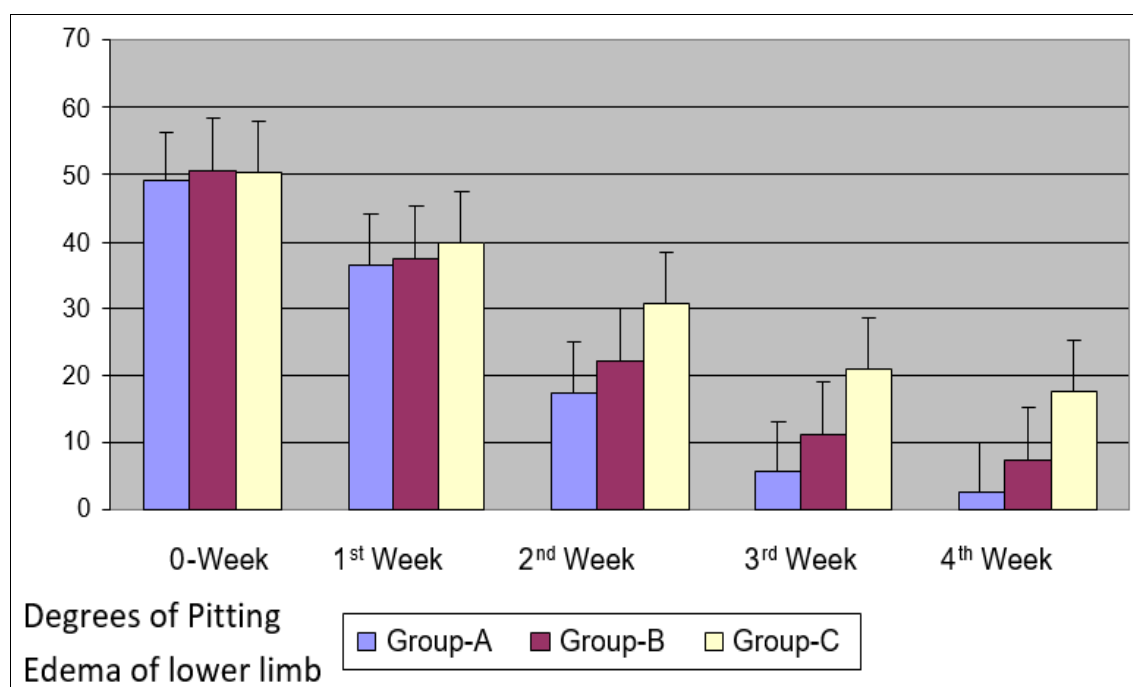


Fig 13: Mean and standard deviation of Pitting Edema between groups A, B and C

Discussion

Havas *et al.* (2000) finding those 2 hour of steady exercise increase lymph clearance rate five folds in the first 15 minutes while the rest of time it was increases 2-3 folds.

Lane *et al.* (2005) which demonstrated increase lymphatic clearance in the hand of healthy women who performed arm crank ergometry for five minutes^[15].

Morris, R. J. Woodcock, J. P. (2004). Studies indicated that CDT program is effective in reducing Lymphoedema volume and pain in women with moderate post breast surgery lymphoedema^[11].

Neeraj *et al.* (2016) The McKenzie treatment is effective on both low back pain and neck pain. Several studies have been done to prove the individual effect of McKenzie, Hot Pack and Strengthening exercise in both low back pain and neck pain. But none of study has been done to prove which one is more effective so the need arises to see the comparative effect of McKenzie, Strengthening Exercise and Hot Pack^[38].

Nishu Sharma *et al* (2018) The study concluded that hand functions improved by Intermittent Pneumatic Compression and Mirror Therapy in subacute stroke subjects and interventions should be emphasize to restore motor and sensory function^[40].

In present study we have discussed about anatomy and physiology of lymphatic system, therapeutic effects of exercises and their indication, contraindication, principles, guidelines to the patient and specific sequences of exercise protocol for lower limb.

In present study we have discussed about significant reduction of lower limb lymph edema ($P>0.05$). The group A (Pneumatic Compression Therapy and Lymphatic Drainage Exercises) showed more improvement than group B (Manual lymphatic drainage (MLD) and lymphatic drainage exercises).

Conclusion

The present study concluded that group A (Pneumatic Compression Therapy and Lymphatic Drainage Exercises) showed significant improvement as Group B (Manual lymphatic drainage (MLD) and control group (lymphatic drainage exercises) for lower limb in lymphoedema.

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