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RESEARCH ARTICLE

EFFECT OF MANUAL VERSUS MECHANICAL LYMPHATIC DRAINAGE ON TOTAL LYMPHOCYTIC COUNT IN HEALTHY SUBJECTS

*¹Michel Fathy Fayek, ²Dr. Abeer Mahmoud Yousef and ³Dr. Mohamad Maher el Keblawy

¹Department of Basic science for Physical Therapy, Faculty of Physical Therapy, Cairo University, Egypt

²Lecturer in department of Basic Science for Physical Therapy, Faculty of Physical Therapy, Cairo University, Egypt

³Researcher in National Center of Research-Cairo University, Egypt

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*Corresponding author:

Michel Fathy Fayek

ABSTRACT

Background: lymphocytes are a main component of the immune system, reaching an optimum level of lymphocytic count may improve immunity in healthy subjects or fasten recovery from diseases; therefore manual lymphatic draining effects were compared to mechanical lymphatic draining. **Purpose:** This study was conducted to investigate manual lymphatic drainage versus mechanical lymphatic drainage effects on total lymphocytic count in healthy subjects. **Subjects:** Forty five healthy individuals of both genders were conducted to this study, their ages ranged from 20 to 40 years old Participants were randomly alphabetically chosen and divided into three equal groups each group included 15 subjects. **Methods:** this study was conducted in Nasser institute hospital outpatient physical therapy department Cairo Egypt; Group A (Experimental Group A): Fifteen participants received mechanical lymphatic drainage Course 30 minutes segmentally. Group B (experimental group B): Fifteen participants received segmental manual lymphatic drainage course. Group c (control group c): Fifteen participants did not receive any treatment approach. lymphocytic count were measured before and after every week through 5 consecutive weeks by medonic cell counter in lab. **Results:** lymphocytic counts increased gradually from the 0-Day to 1st week through the 2nd, 3rd, 4th and 5th week respectively in manual massage than mechanical massage and both than the control group. Conclusion: conducting manual lymphatic drainage increased lymphocytic count than that of mechanical drainage and both of experimental groups increased lymphocytic count than the control group of no drainage. Three sessions per week lymphatic draining for five consecutive weeks appeared to potentiate immunological improvements increasing circulating phenotypic lymphocytic markers. Manual lymphatic drainage technique may be an effective method for improving both patient and disease-oriented outcomes in relation to promoting immunity.

INTRODUCTION

The primary function of the lymph nodes is to filter and purify the lymph. Lymph nodes produce lymphocytes that destroy harmful substances within the body (Daniela and Andrea, 2011). Lymphatic drainage therapy has been proven to aid in the absorption of toxins, assist the body in deep cleansing, stimulate fluid circulation and the work of the immune system, absorb fat molecules, induce deep relaxation and activate antispasmodic actions (Shah *et al.*, 2011). Unfortunately, there is no method available to immediately evaluate efficacy of manual lymphatic drainage in a single treatment session (Chih *et al.*, 2011). When the mechanical lymphatic drainage optional (indication), for athletically active people, lymphatic drainage supports faster reduction of inclusion bodies from intermediary metabolism, regeneration of muscles and other tissues (for example: runners, hockey players, footballers etc...), (Shan *et al.*, 2011 and Iva Bílková, 2018). Lymph is like broth. When the broth cools off, it forms a hard, white, top layer (fat) and a gel underneath (protein). When lymph temperature drops below normal body temperature, the fats solidify and the proteins gel. This accounts for knots, stiffness and a large percentage of muscle injuries. It is the character-the

consistency of lymph that is affected by the use of hot and cold on the body (Ohhashi *et al.*, 2005). The lymphatic system plays a critical role in regulating tissue fluid balance by draining the interstitial space and preserving protein concentrations to maintain oncotic pressure (Daniela and Andrea, 2011). The lymphatic system is the most extensive fluid system in the body. It represents about 60 % of our fluid volume. By contrast, the blood system represents only about 33 % of our fluids. These are the body's two largest circulating systems (Shan *et al.*, 2011). Management of lymphatic disorders is extremely variable in the medical profession, ranging from total denial of diagnostic procedures and treatment to excessively aggressive treatments (Clemens *et al.*, 2010). Also, Managing edema after trauma or injury is a primary concern for health care professionals, as it is theorized that delaying the removal of edema will increase secondary injury and result in a longer recovery period. (Majewski-Schrage and Snyder, 2016). The inflammatory process generates a series of events, starting with bleeding and ultimately leading to fluid accumulation in intercellular spaces and the formation of edema. Once edema is formed, the lymphatic system plays a tremendous role in removing excess interstitial fluid and returning the fluid to the circulatory

system. (Majewski-Schrage and Snyder, 2016). The improvements of lymphatic pathologies were much superior and the treatment was more cost effective. The results depend on the patients willingness to follow the compressive treatment for the rest of his/her life (ISL, 2003 and Torres Lacomba *et al.*, 2010). Therefore, rehabilitation specialists ought to use therapies that enhance the uptake of edema via the lymphatic system to manage edema; however, the modalities commonly used are ice, compression, and elevation. Modalities such as these may be effective at preventing swelling but present limited evidence to suggest that the function of the lymphatic system is enhanced. Manual lymphatic drainage (MLD) is a manual therapy technique that assists the lymphatic system function by promoting variations in interstitial pressures by applying light pressure using different hand movements (Majewski-Schrage and Snyder, 2016). Surgical techniques for the treatment of lymph edema aimed to reduce limb volume using a debulking resection approach. With the advent of microsurgery, use of multiple lymphatic-venous anastomoses has become the most common surgical treatment. Thus, most patients with lymph edema choose non-surgical treatments, such as the use of elastic stockings, especially in early stages of lymph edema (Tsai *et al.*, 2013).

Peripheral lymphoscintigraphy is a safe and relatively simple investigation that has been widely used to investigate edema in both the lower and upper extremities. Interpretation of peripheral lymphoscintigraphy can be difficult due to anatomical and physiological variations between individuals, pathological changes which may vary enormously depending on the chronicity of the disease process and technical factors relating to injection site, radiotracer and scanning technique (Masson *et al.*, 2014). A physical treatment program combining MLD, skin care, exercise, compression bandaging (figure-of-eight or spiral) and sleeve or stocking compression is recognized as providing optimal lymphatic lesion management (Tsai *et al.*, 2013). Manual lymphatic drainage is used in physiotherapy of limb lymph edema in combination with other physical techniques (Ebert *et al.*, 2013). Passive mechanical lymph drainage has provided a true revolution in the treatment of lymph edema of both legs with a concept of intense lymph edema treatment. Electromechanical devices can be used to produce passive flexion and stretching movements (Parsch *et al.*, 2011). Previous study have suggested that lymph drainage has an effect on absorption of toxins, assisting in deep body cleansing, stimulates the work of the immune system but there are little reviews on the effects of manual versus mechanical lymphatic draining on total lymphocytic count.

MATERIALS AND METHODS

Design of the Study: A pre and posttest study design was used in current study.

Subjects: Forty five normal individuals of both genders were selected for this study in Nasser institute hospital outpatient department. Their ages ranged from 20 to 40 years old (Oremus *et al.*, 2009). All subjects were healthy and free of any health disorder that may affect the results. Participants were randomly alphabetically chosen and divided into three equal groups; fifteen subjects for each group (Table, 1).

Group A (Experimental Group A): Fifteen participants received mechanical lymphatic drainage. course (Oremus *et al.*, 2009).

Group B (experimental group B): Fifteen participants received manual lymphatic drainage course (Godoy *et al.*, 2012).

Group c (control group c): Fifteen participants did not receive any treatment approach.

All three groups lymphocytic counts were measured before application of procedures and after study for 5 consecutive weeks using medonic (cell counter)

Inclusion Criteria: The selection of subjects was under the following criteria: Active normal subjects were included: Subject's age ranged between 20 and 40 years old, Subjects were selected from both genders and had sufficient cognition and educated enough to understand the requirements of the study.

Exclusion Criteria: Subjects with cardiovascular, neurological, musculoskeletal or lymphatic dysfunction or infection and Subjects with cardiac pacemakers or other electronic implants. Were excluded from this study.

Instrumentation

Evaluation and therapeutic equipments.

A. Evaluation Equipment

1 Medonic (Cell Counter)

A Medonic (cell counter) was used to assess complete lymphocytic count.

B. Therapeutic Equipment

1 Mechanical Lympha Press

The mechanical lympha press device have been used to apply mechanical lymphatic drainage to group A participants. (Power-q1000- plus model WHF-324, made in Korea). It consists of the motorized main unit (52X30x16 centimeters) and three extensions for arms legs and abdomen. The control panel will connected to external parts by special cables. The device will be supplied by 220 Volts.

Procedures: Each participant received a full explanation of the procedures of the study then they were requested to sign a written informed consent as well they were divided randomly into three equal groups fifteen subject to each group.

Evaluation Procedures: Each participant was subjected to a detailed demographic data evaluation and a complete medical examination at the baseline of this study, The complete lymphocytic count was measured. The received data was tabulated at first at the baseline of the study then at the end of the study and then undergone statistical procedures.

Treatment procedures: Group A received mechanical lymphatic drainage, while group B received manual lymphatic drainage. Group c was a control group.

Mechanical Lymphatic drainage procedures (Group A): Each participant in Group A was subjected to mechanical lymphatic drainage technique. On the abdomen, thighs and arms. For thirty minutes each, segmentally. The lymph nodes were stimulated by lymphatic sequential pneumatic drainage. pressure was performed in the constant low mode of 40 to 60

mm hg. Finally, the proximal lymph nodes were stimulated then the distal ones and the procedure were ended. Participants received a total of 15 sessions (three sessions per week for 5 weeks) with the mechanical lymphatic drainage technique according to the study protocol (Oremus *et al.*, 2009).

Manual Lymphatic drainage procedures (Group B): Each participant in Group B was subjected to manual lymphatic drainage technique. This is a technique in which the lymphatic fluid is forced to flow freely by manipulating the lymphatic system manually. It shapes the adipose tissue, decreases the intercellular edema of the fat tissue, increases the lymphatic flow and accelerates the flow of the lymphatic fluid into lymphatic channels. It affects the sympathetic nervous system, relieves pain and provides a deep sense of comfort. It strengthens immunity. Manual lymphatic drainage supports the formation of collagen in the skin and therefore skin is tightened. (Godoy *et al.*, 2012). Manual lymph drainage was carried out according to the massage technique of vodder (Wittlinger *et al.*, 1987). In theory, manual lymph drainage massage mechanically stretches underlying lymph collectors (Mislin *et al.*, 1983) promotes greater frequency of lymphangion contractions (Olszewski *et al.*, 1980) and increase pressure in the lymph collectors thereby improving the lymph transport capacity (Foldi *et al.*, 1983).

Massage is applied with low pressure in a proximal direction starting at the trunk, slowly moving more distally, the rhythm of the thrust and relaxation must gradually so-called 1-sec. movement with five to seven repetitions in one place. The stationary circles consists of an active (pressure) and a passive relaxation) phase the skin is stretched maximally in the direction of drainage (Vodder *et al.*, 1966).

RESULTS

A-Demographic Characters: Results observed in table (2) cleared that, the age of the different groups ranged from 20 to 40 years. The mean of age value in mechanical massage group reached to 35 years with a median level of 34 years while in Manual massage group reached to 37.50 years with a median level of 37 years, control group mean age reached to 30 years with a median of 29 years.

B-Comparison between the different groups at different periods in level of lymphocytes: Comparison observed in Table (3) and Fig. (1) cleared that, lymphatic drainage and lymphocytic count increased with manual massage followed by mechanical massage and both of them increased the lymphocytic count than the control group. results also cleared that, the lymphocytic count increased gradually from the 1st week to the 2nd, 3rd, 4th and 5th week respectively in manual massage than mechanical massage.

Table 1. Groups

| group | Group A (Mechanical lymphatic drainage) | Group B (Manual lymphatic drainage) | Group C Control group |
|---------------------------------|--|--|--------------------------------|
| Site of application of drainage | Four limbs and abdomen | Four limbs and abdomen | No application of any modality |
| Methods | Mechanical pneumatic pressure 40 – 60 mm/Hg for ½ hrs segmentally Four limbs and abdomen 3 sessions per week for 5 weeks | Manual lymphatic draining Four limbs and abdomen 3 sessions per week for 5 weeks | |

Table 2. Demographic data among different groups

| | Group A (Mechanical lymphatic drainage) | Group B (Manual lymphatic drainage) | Group C Control group |
|-------------------|--|--|--------------------------|
| Number of patient | 15 | 15 | 15 |
| Age (Year) | 20 – 40 | 20 - 40 | 20 – 40 |
| Mean | 37.50 | 35 | 30 |
| Median | 37 | 34 | 29 |

Table 3. Lymphocytes level among different groups

| | Group A (Mechanical massage) | Group B (Manual massage) | Group C Control group |
|--|--|--|--|
| Number of patient | 15 | 15 | 15 |
| Lymphatic drainage | | | |
| 0-Day (At beginning of the experiment) | Af 1.20 X 10 ³ ±0.40 X 10 ³ | Af 1.15 X 10 ³ ±0.4X 10 ³ | Af 1.10 X 10 ³ ±0.22 X 10 ³ |
| 1 st week | Be 1.40 X 10 ³ ±0.40 X 10 ³ | Ae 1.50 X 10 ³ ±0.5 X 10 ³ | Ce 1.10 X 10 ³ ±0.22 X 10 ³ |
| 2 nd Week | Bd 1.50 X 10 ³ ±0.33 X 10 ³ | Ad 1.65 X 10 ³ ±0.30 X 10 ³ | Cd 1.21 X 10 ³ ±0.22 X 10 ³ |
| 3 rd Week | Bc 2.00 X 10 ³ ±0.53 X 10 ³ | Ac 2.55 X 10 ³ ±0.56 X 10 ³ | Cc 1.33 X 10 ³ ±0.23 X 10 ³ |
| 4 th Week | Bb 3.40 X 10 ³ ±0.53 X 10 ³ | Ab 3.39 X 10 ³ ±0.55 X 10 ³ | Cb 1.44 X 10 ³ ±0.55 X 10 ³ |
| 5 th Week | Ba 3.50 X 10 ³ ±0.43 X 10 ³ | Aa 4.80 X 10 ³ ±0.44 X 10 ³ | Ca 1.50 X 10 ³ ±0.54 X 10 ³ |

Means within the same row of different litters are significantly different at (P < 0.01)

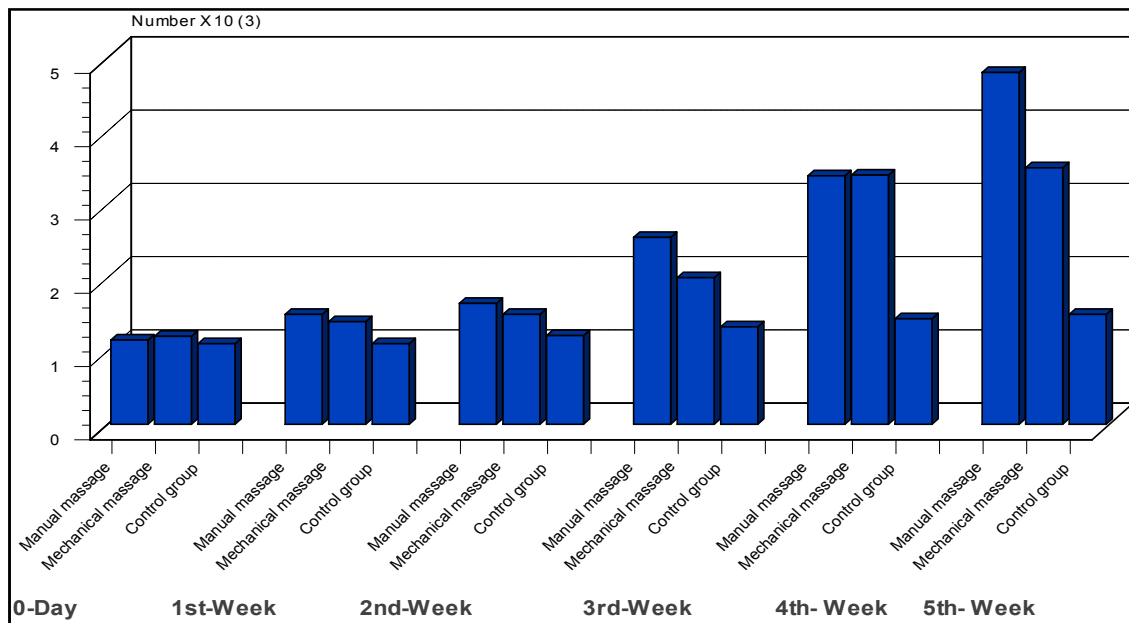


Fig. 1. Comparison between different groups among different periods in lymphocytic counts

DISCUSSION

The most underrated circulatory system in the human body is our lymphatic system. And, most health practitioners never consider the critical role lymph plays in preventing sickness or the critical role it plays in keeping us healthy (Majewski-Schrage and Snyder, 2016). The lymph system is a vital circulatory system and the body's primary immune defense and waste eliminator system, it is critical to managing the elimination of toxins from our body. It contains over 600 'collection' sites called 'lymph nodes' and has a network or collecting vessels, making it even more extensive than the venous system. Our lymphatic system is primarily responsible for carrying disease-fighting material to cells attacked by germs, transporting the dead germs away, and supplying protein-rich plasma fluid back to the heart. When this system is blocked, we become defenseless against attacks by viruses, fungi, bacterium, and cancer. (Daniela and Andrea, 2011). Medical research explains the lymphatic system as the primary system used by all immunological support elements (such as macrophages, T-Cells, B-Cells, lymphocytes, etc.) to fight the cancer, virus, fungus, and bacteria attacking our body. It is also composed of over 50% plasma protein and is the major system carrying nutritionrich plasma protein back into our blood. When the lymph system is blocked, infection-fighting material is prevented from destroying germs and cell-nourishing elements are prevented from reaching our blood. As a result, germs grow, our blood loses needed protein, the immune system falters and infectious diseases march in. (Torres Lacomba *et al.*, 2010). Most chronic disease problems occur at the junction of lymph vessels called 'lymph nodes'. One can feel lymph nodes by pressing under the arms just below the collarbone or in the crease between the thigh and pelvic area. When touching these areas, many people will feel small bumps and sometimes pain. The bumps and pain are symptomatic of blocked lymph nodes. Blocked lymph nodes indicate a breakdown in the 'mechanical' functioning of the lymphatic system. (Tsai *et al.*, 2013). In men, the inguinal nodes, located in the area (crease) of the groin between the genitals and the thigh, are the primary channels for letting accumulated lymph (protein and fluid) release from the prostate.

In women, the axillary nodes, located in the armpit and extending from the armpit down towards the breast, and the primary channel for releasing accumulated lymph (protein and fluid) from the breast. In many prostate, breast and other cancer situations, these lymph nodes are well involved and enlarged, resulting in reduced ability to eliminate lymphatic fluid. (Modaghegh and Soltani, 2010). The issue of lymphatic flow has been studied for many years with in-depth clinical research resulting in very efficient manual methods for restoring the lymph system. Using manual lymph drainage techniques in conjunction with non-invasive technology called the Light Beam Generator (LBG) effects a swift, safe and natural method of eliminating excess lymphatic fluid. The LBG assists the body to achieve a free-flow of proteins within the lymph system and to release bonded protein blockages in the interstitium of the connective tissue. The LBG is a non-invasive technology and uses extremely low current and negatively charged light photons providing compatible frequencies to the blocked area resulting in cells correcting their out-of-balance condition and disassociating themselves from the binding agent responsible for the swelling and blockage. Rapid movement of waste material within the cell then occurs, greatly increasing the delivery of the waste material to the organs responsible for body waste disposal. Hands-on therapy is increased as free-flow of proteins speeds the healing process. With waste material moving within the body, day to day factors like eating habits, body structure, nutrition, medication and mental health can be addressed to provide a successful formula for restoring health. (Partsch *et al.*, 2011). Findings of the current study revealed that, the lymphocytic count increased with manual message than mechanical message and both of them increased the lymphocytic count than the control group. This results agreed with those of (Rapaport *et al.*, 2012) where they found that, the mean levels of total lymphocytes and all four lymphocyte cell types increased substantially with weekly massage but decreased substantially with weekly touch, resulting in large treatment-effect sizes for total lymphocytes (1.27), CD4+ cells (1.10), CD8+ cells (1.15), CD25+ cells (0.77), and CD56+ cells (1.09). This results attributed to the manual Lymph Drainage (MLD) is a gentle, light-touch, advanced bodywork technique designed to stimulate the lymphatic system, drain

stagnant fluids, detoxify, regenerate tissues, and maintain a healthy immune system. Therapeutic applications assist the body's detoxification as part of general health maintenance. In can assist with post-surgical recovery, edema reduction, pain control, infection prevention, hematoma reduction/resolution, constipation relief, relaxation, stress reduction, and improved sleep. (Diego *et al.*, 2009). This results agreed with those of (Mark *et al.*, 2011) where they reported that, compared to the touch control condition, weekly Swedish massage stimulated a sustained pattern of increased circulating phenotypic lymphocyte markers and decreased mitogen-stimulated cytokine production, similar to what was previously reported for a single massage session, while having minimal effect on hypothalamic-pituitary-adrenal function. Twice-weekly massage produced a different response pattern with increased OT levels, decreased AVP, and decreased CORT but little effect on circulating lymphocyte phenotypic markers and a slight increase in mitogen-stimulated interferon- γ , tumor necrosis factor- α , interleukin (IL)-1b and IL-2 levels, suggesting increased production of pro-inflammatory cytokines. Also, results cleared that, the lymphocytic count increased gradually from the 1st week to the 2nd, 3rd, 4th and 5th week respectively in manual massage than mechanical massage. This results agreed with those of (Rapaport *et al.*, 2010) where they attempting to discern the mechanisms of action of massage. Also, (Diego *et al.*, 2009) reported that, When biologic data are reported, the purported biomarkers frequently are laboratory tests that evaluate a particular pathological state rather than measures selected to elucidate the underlying mechanism of action of massage.

There is one publication investigating the mechanism of action of a single session of massage in healthy individuals. (Toro-Velasco *et al.*, 2009). This is important to study because several investigators have reported that the therapeutic effects of massage are evanescent; (Kutner *et al.*, 2008) thus, repeated massage may have different biologic and psychological effects than a single session. An added challenge in studying cumulative effects of massage is that they may vary with "dosage" (i.e., the frequency or interval of time between sessions). One may expect that cumulative changes associated with once-weekly massage would increase with more frequent treatments; however, this has not yet been determined. These results explain what OVER 8% OF ADULT AMERICANS had at least one massage session in 2007. Massage is purported to have a wide array of benefits, ranging from being pleasurable to alleviating symptoms of depression, anxiety, back pain, asthma, cancer, and human immunodeficiency virus. (Hernandez-Reif *et al.*, 2004). Despite the popularity and high level of acceptance of massage, meta-analyses report significant reservations about the quality of the majority of studies published in the literature. (Jane *et al.*, 2008). Also, (Hillier *et al.*, 2010) concluded that, massage may reduce pain, stress, depression, anxiety, and cortisol, and enhance some immune parameters, but that more well-controlled studies are needed. Current study concluded that, the lymphatic drainage of either manual or mechanical increased the lymphocytic counts than the control groups of no drainage. The Manual lymphatic drainage technique may be an effective method for improving both patient- and disease-oriented outcomes in relation to optimizing immunity. That may help in treating diseases or infections. Three sessions per week lymph draining, increased circulating phenotypic lymphocytic markers production and appears to potentiate neuroendocrine differences. These findings suggest that further investigation of

"dosage," as well as length of treatment and reconstructing the lymphatic draining technique on specified diseases, needs more research efforts.

REFERENCES

- Chih, T., Erik, AM., John, CR., Milton, VM., Kristen, EA., Caroline, EF., Latisha, AS., Wenyaw, C. and Eva, MS. 2011. Assessment of lymphatic contractile function following manual lymphatic drainage using near-infrared fluorescence imaging. *Arch Phys Med Rehabil.*, 92(5):756-764.
- Daniela, N. and Andrea, M. 2011. Lymphatic anatomy and biomechanics. *J Physiol.*, 589(12):2927-2934.
- Diego, MA. And Field T. 2009. Moderate pressure massage elicits a parasympathetic nervous system response. *Int J Neurosci.*, 119:630-638.
- Ebert, JR., Joss, B., Jardine, B. and Wood, DJ. 2013. Randomized trial investigating the efficacy of manual lymphatic drainage to improve early outcome after total knee arthroplasty. *Arch Phys Med Rehabil.*, 2013;94:2103-2111.
- Foldi, M. 1983. Lymphoedema. in: lymphangiology. foldi, m, jr casley-smith schattauer, Stuttgart-new york
- Hernandez-Reif, M., Ironson, G., Field, T., *et al.*, 2004. Breast cancer patients have improved immune and neuroendocrine functions following massage therapy. *J Psychosom Res.*, 57:45-52.
- Hillier, SL., Louw, Q., Morris L, *et al.*, 2010. Massage therapy for people with HIV/Aids. *Cochrane Database Syst Rev.*, CD007502.
- International Society of Lymphology (ISL), 2003. The diagnosis and treatment of peripheral lymphedema. Consensus document of the International Society of Lymphology. *Lymphol.*, 36:84-91.
- Jane, SW., Wilkie, DJ., Gallucci, BB. And Beaton, RD. 2008. Systematic review of massage intervention for adult patients with cancer: A methodological perspective. *Cancer Nurs.*, 31:E24-E35.
- Kutner, JS., Smith, MC., Corbin, L., *et al.*, 2008. Massage therapy versus simple touch to improve pain and mood in patients with advanced cancer: A randomized trial. *Ann Intern Med.*, 149:369-379.
- Majewski-Schrage, T. and Snyder, K. 2016. The Effectiveness of Manual Lymphatic Drainage in Patients With Orthopedic Injuries. *Journal of Sport Rehabilitation*, 2016, 25, 91 -97.
- Masson, IFB., Oliveira, BDA., Machado, AFP., Farcic, TS., Junior, IE. and Schiavinato, C. 2014. Manual lymphatic drainage and therapeutic ultrasound in liposuction and lipoabdominoplasty post-operative period. *Indian J Plast Surg.*, 47(1):70-76.
- Mislin, H. 1983. Lymphangion. in: Lymphangiology. Foldi, M, Jrcasley-Smith (EDS). Schattauer, Stuttgart-new York.
- Modaghegh, MH. and Soltani, E. 2010. A newly designed SIPC device for management of lymphoedema. *Indian J Surg.*, 72:32-36.
- Ohhashi, T., Mizuno, R., Ikomi, F. and Kawai, Y. 2005. Current topics of physiology and pharmacology in the lymphatic system. *Pharmacol Ther.*, 105:165-188.
- Olszewski, Wl. 1980. Angese: Intrinsic contractility of prenatal lymph vessels and lymph flow in human leg *AM.j.physiol.*, 239.
- Oremus, M., Walker, K., Dayes, I. and Raina, P. 2009. Diagnosis and treatment of secondary lymphedema.

- Technology assessment report. Baltimore (MD): Medicare Evidence Development & Coverage Advisory Committee meeting. *Cen Med Medicaid Ser.*, 18: 0908.
- Partsch, H., Damstra, R.J. and Mosti, G. 2011. Dose finding for an optimal compression pressure to reduce chronic edema of the extremities. *Int Angiol.*, 30(6):527-533.
- Rapaport, M.H., Schettler, P.J. And Bresee, C. 2010. A preliminary study of the effects of a single session of Swedish massage on hypothalamic–pituitary–adrenal and immune function in normal individuals. *J Altern Complement Med.*, 16:1079–1088.
- Shan, L., Gang, C., David, A.C., Yuhui, H., Raju, S.K., Lance, L.M., Nancy, H.R., Rakesh, K.J., Dai, F. and Timothy, P. 2011. Impaired lymphatic contraction associated with immunosuppression. *Proc Natl Acad Sci USA*; 108(46): 18784-18789.
- Toro-Velasco, C., Arroyo-Morales, M., Fernandez-de-Las-Penas, C., *et al.*, 2009. Short-term effects of manual therapy on heart rate variability, mood state, and pressure pain sensitivity in patients with chronic tension-type headache: A pilot study. *J Manip Physiol Ther.*, 32:527–535.
- Torres Lacomba, M., Yuste Sánchez, M.J., ZapicoGoñi, A., Prieto Merino, D., Mayoral del Moral, O., CerezoTéllez, E. and Minayo Mogollón, E. 2010. Effectiveness of early physiotherapy to prevent lymphoedema after surgery for breast cancer: randomised, single blinded, clinical trial. *BMJ.*, 340:b5396.
- Tsai, W.H., Sung, H.T., Chia, C.L., Chyi, H.B., Ching, S.C., Chin, S.H., Chih, H.W. and Ka, W.T. 2013. Effects of manual lymphatic drainage on breast cancer-related lymphedema: a systematic review and meta-analysis of randomized controlled trials. *World J Surg Oncol.*, 11:15.
- Vodder, E. 1966. Die manuelle Lymphdrainage und ihre medizinischen Anwendungsbeite. *Erfahrungsheilkunder.* 16:7.
- Wittlinger, H.G. 1987. Wittlinger: Einfurung in die Manuelle Lymphdrainage Nach dr vodder haug verlag, Heidelberg.
