

The Structure and Function of the Lymphatic System

The lymphatic system runs through the body and is made up of organs and lymphatic tissue, this includes organs like the spleen and thymus and also lymphatic tissue like lymphatic capillaries, vessels and nodes[5][figure 8]. These components help achieve the functions of the lymphatic system which are the draining of interstitial fluid, transportation of lipids and fighting infection (immune response)[1].

At the extremities of the lymphatic system are the lymphatic capillaries [figure1]. They are blind end tubes [3] and are bigger than blood capillaries [2], they also have a unique one-way structure that allows interstitial fluids [figure 1] in but not out [1] they are very permeable [2]. Lymphatic capillaries are not everywhere in the body, for example they are not found in nervous tissue, the brain or spinal cord [2], but can be found in vascular tissue. Their roll is to absorb interstitial fluid that has built up in the tissue, in the process they also pick up broken cells, bacteria and viruses [5]. Attached to the capillaries are anchoring filaments [figure 1] which extend out from the capillary attaching lymphatic endothelial cells [figure1] to the surrounding tissue [1]. So if there is an accumulation of fluid in an area, the resulting swelling will cause the anchoring filament to be pulled, opening up the cells of the lymphatic capillaries wider to enable them to absorb the excess fluid more rapidly.

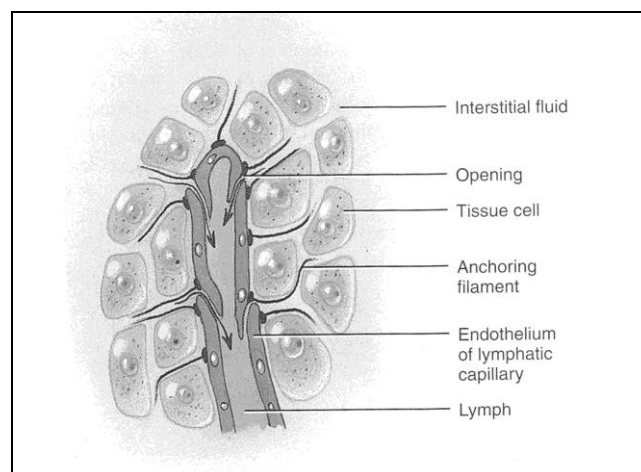


Figure 1 lymphatic capillary [1]

The capillaries then form lymphatic vessels [figure2], the lymphatic's [2] are larger than the capillaries and open out into lymphatic nodes [figure3][3]. The fluid, lymph (a usually clear fluid containing electrolytes, proteins and lymphocytes)[5] is helped along by

skeletal muscle contractions and also by respiratory movements, the lymphatic's have a one way valve to prevent backflow[2].

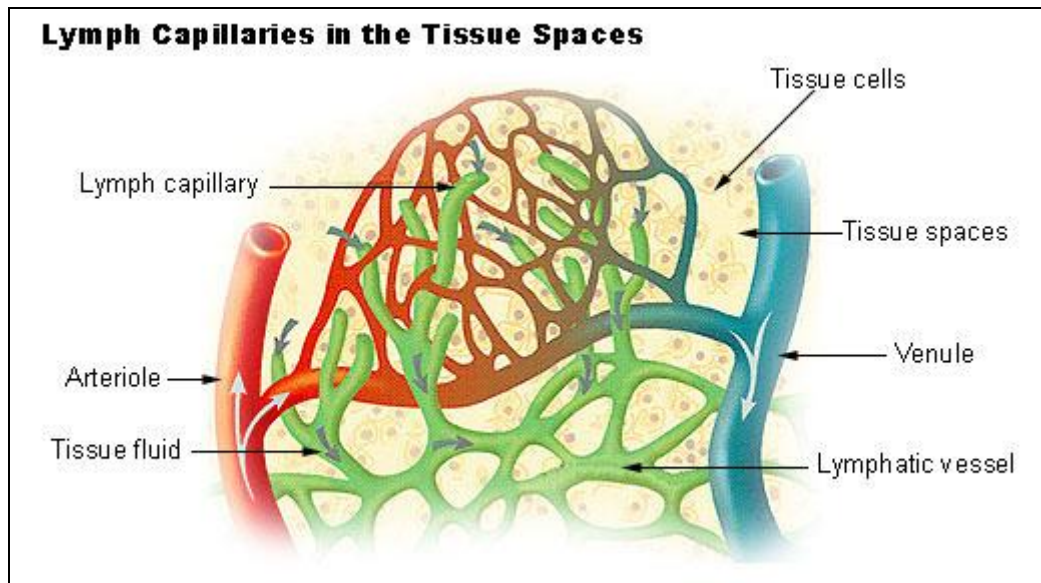


Figure 2 lymphatic vessels [6]

The lymph will always pass through at least one lymph node [figure3]. There are approximately 600 lymph nodes [1] in the body and are bean-shaped [figure 3] . They are between 1 -25mm long [1] and are found usually in groups [2]. They are named according to where they are, what they surround or the organ they receive lymph from [5].

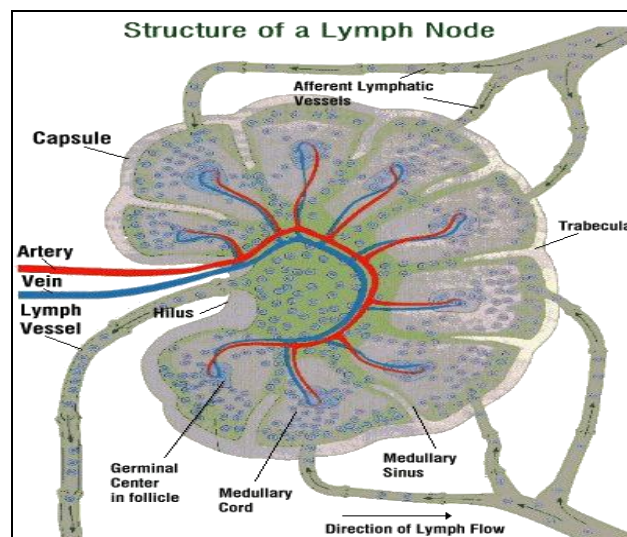


Figure 3 structure of a lymph node [4]

There are main groups of nodes such as axillary nodes[figure 8], inguinal nodes[figure 8] and cervical[figure 8] nodes[5]. The nodes are surrounded by an external capsule made of collagen[2][figure 3]. Projecting in from the external capsule are trabecula[figure3] also called septa[2].

The trabeculae divide the node, provide support and also allow blood vessels a route into the interior node[1]. On one side is a depression called hilus[2][figure3], this is also where blood vessels leave and enter and also where efferent lymphatic vessels emerge[figure 4][1].

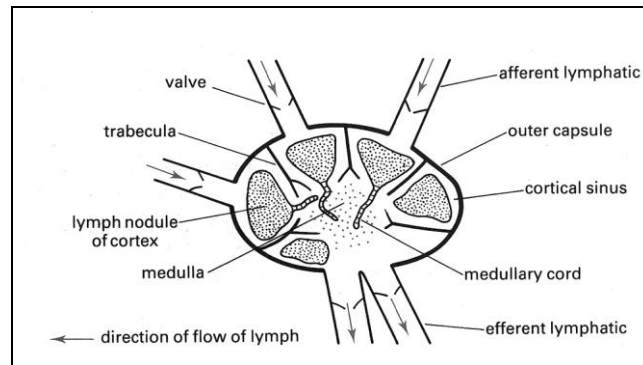


Figure 4 lymph node [2]

The lymph node is like a filtration system. Lymph enters the node by the afferent lymphatic's[figure 3], into the cortical sinuses[figure4] and then into the medullary sinuses[figure 3][2]. The sinuses are lined with macrophages which destroy substances like damaged cells, unwanted protein and bacteria by ingesting[2]. This process is called phagocytosis[1]. Lymphocytes then destroy other substances by immune response[1] through the production of antibodies[2].

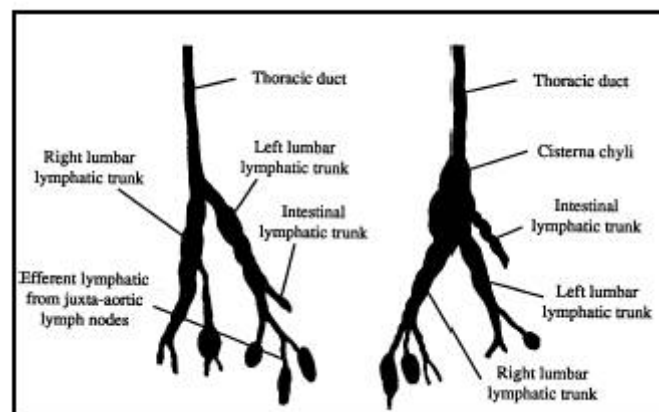


Figure 5 lymph trunk [7]

Lymphocytes will also become detached and leave the node in the lymph entering the blood stream where they can then deal with infection in the tissues[2]. The lymph, once it has been cleaned then leaves the node via the efferent lymphatics[figure 4]. The efferent lymphatics at this point then join to form lymph trunks[figure 5] which then empty into two main ducts, the thoracic duct[figure 6] and the right lymph duct[figure 6][2]. The lymph from specific areas is drained into one or the other, so lymph from left side of the head, neck and thorax, left arm, whole of the abdomen, both legs and ileum all drain into the thoracic duct [figure 7][2] this is the main duct and is about 38-45cm[1] long

and begin as a dilation called cistern chyli^{[1][figure3]} That leaves the right side of head, neck and thorax and also the right arm to drain into the right lymph duct^[figure 7] which as about 1.2cm long^[1]. From here the lymph finally enters the blood stream via the subclavian veins^[figure 8].

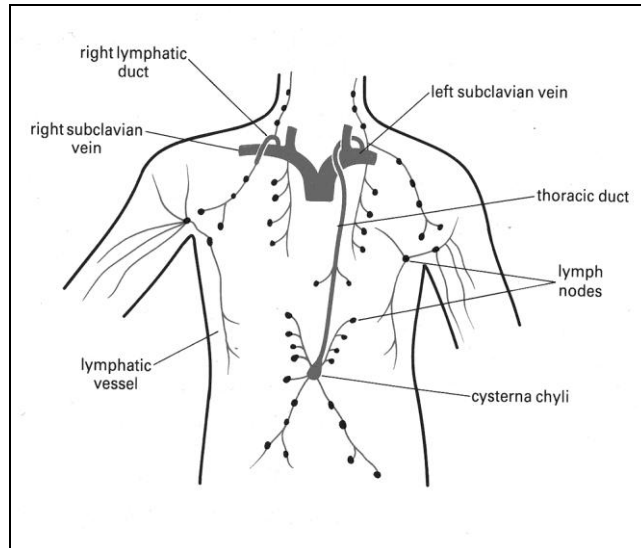


Figure 6 lymphatic ducts [2]

As well as the lymph system there are several other components that make up the complete lymphatic system. These include the thymus^[figure 8], red bone marrow^[figure 8] found in flat bones and epiphyses of long bones in adults^[1], the spleen^[figure 8] and lymphatic nodules (tonsils and peyer's patch)^[figure 8].

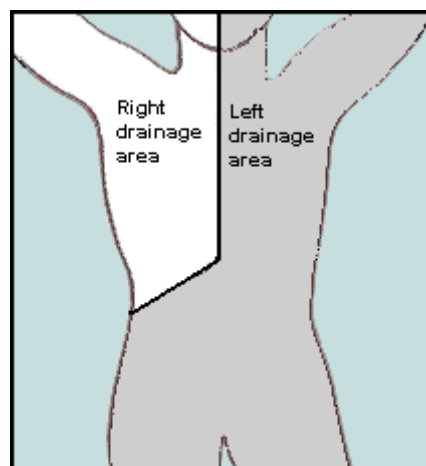


Figure 7 lymph drainage pattern [8]

The spleen is a dark red highly vascular organ about 12 cm long and is similar in construction to a lymph node having a capsule, hilum and trabeculae^[2]. the spleen is the largest single mass of lymphatic tissue in the body^[1]. It is filled with white and red pulp. The white pulp is lymphoid tissue^[5] and the red is filled with blood and cords of

phagocytic cells[2]. The function of the spleen in the case of the lymph system is to destroy bacteria, worn out red blood cells and platelets by phagocytosis which is completed in the white pulp.

The thymus is a gland and is made up of lymphoid tissue, which is larger in children than adults as the lymphoid tissue is replaced by connective tissue and fat[2]. Special lymphocytes are produced here which attack and destroy antigens[2].

Red bone marrow creates B cells which are mature, immunocompetent and T cells which migrate to the thymus where they become mature[1].

Lymphatic nodules are masses of lymphatic tissue, they can be small and solitary or they can become a group in specific areas of the body like the tonsils[1].

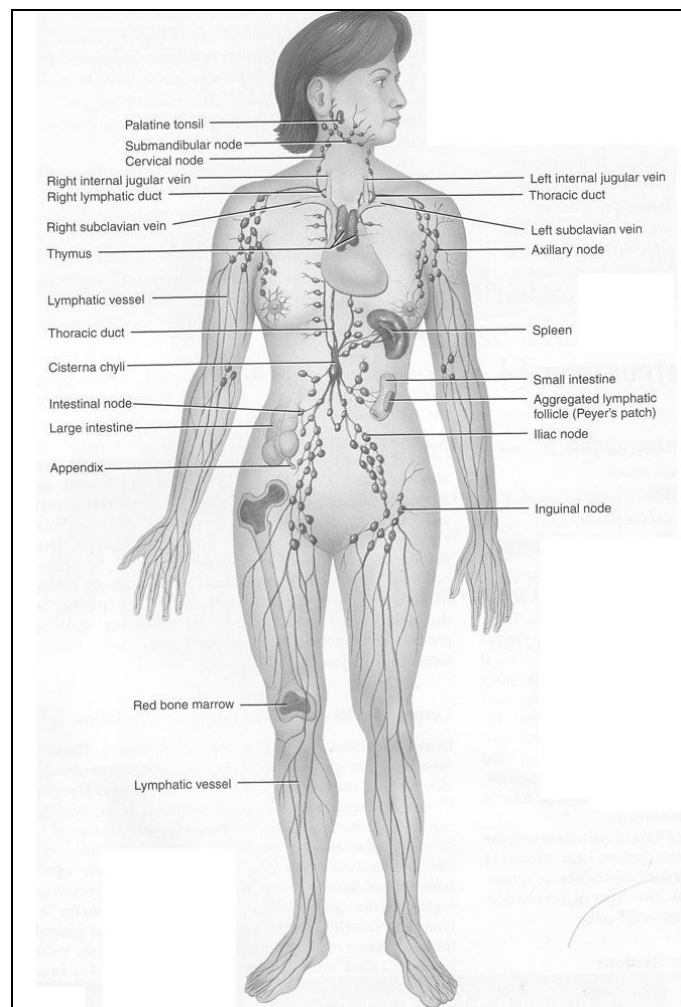


Figure 8 lymphatic system [1]

There are 3 functions of the lymphatic system:

1. The draining of interstitial fluid - this starts at the very extremities of the lymphatic system the capillaries are designed to absorb the fluids in the tissues which they then carry through the lymphatic system moving from the capillaries to the lymphatics (lymph vessels) and then into the lymph nodes. The lymph is filtered through the nodes and out the efferent lymphatics. From there the lymph passes into the lymphatic trunks and eventually into the lymphatic ducts. At this point the lymph is passed back into the blood supply where its journey starts again.

2. Fighting infection - while the capillaries of the lymph collect interstitial fluids they also pick up other things such as viruses and bacteria, these are carried along in the lymph until they reach the lymph node which sets to work destroying them using various methods. Firstly the macrophages cells ingest bacteria, this is known as phagocytosis. Secondly lymphocytes cells produce antibodies, this is known as immune response. These processes will hopefully deal with all infections that travel through the lymph but the lymphatic system does not leave it there. Some of the Lymphocyte cells will leave the node by travelling in the lymph and entering the blood when the lymph rejoins it, this allows it to deal with infections in other tissues.

This isn't the only area where the fight takes place, the spleen also filters the blood in a similar fashion as a node would filter lymph, B and T cells that have migrated from the red bone marrow and have matured in the spleen (there are 3 types of T cell one is amazing it is a memory T cell and can recognise pathogens that have entered the body before and deal with them much quicker, the other T cells are called helper and cytotoxic) carry out immune functions while the spleen's macrophages cells destroy blood borne pathogens by phagocytosis^[1].

There are lymphatic nodules such as the tonsils guarding against bacterial infection using lymphocytes cells.

The thymus gland matures cells produced in the red bone marrow these mature cells then migrate to lymphatic tissues such as the tonsils where they colonise the area and set about fighting off infection^[1]. Red bone marrow produces B and T cells which migrate to other areas of the lymph system to help in the immune response.

3. Transporting lipids - The network of capillaries and vessels also transport lipids and lipid soluble vitamins A, D, E and K^[1] to the blood, causing the lymph to turn a creamy colour. The lipids and vitamins are absorbed in the gastrointestinal tract^[1] from foods and are collected by the lymph as it travels through taking it to the blood.

Without a lymphatic system we would be in trouble very quickly, having problems with a lot of illnesses and before very long death. The tissues of the body would very quickly

become bogged down with fluid and debris making us very swollen. We would also miss out on vitamins required. From a massage therapist point of view it is good to understand how the system works and the fact we could have some benefit on it by helping to encourage the flow, and knowing which way the flow travels and where the main lymph node sites are to drain to.

List of references

1. Principles of Anatomy and physiology. By Gerard J. Tortora and Bryan Derrickson. Published by John Wiley and son Inc. Published 2006 11th edition.
2. The Science of Beauty Therapy by Ruth Bennett. Published by Hodder and Stoughton. First published 1990.
3. The Principles and Techniques for the Beauty Specialist by Ann Gallant. Published by Stanley Thornes (Publishers) Ltd. First printed 1975 republished second edition 1980.
4. http://www.acm.uiuc.edu/sigbio/project/updated-lymphatic/lymph_node.gif
5. The atlas of the human body by Professor Peter Abrahams. Published by Silverdale books in 2002.
6. http://www.web-books.com/eLibrary/Medicine/Physiology/Lymphatic/lymph_capillary.jpg
7. <http://www.nanomedicine.com/NMI/Figures/8.10.jpg>
8. <http://www.hls-herbs.com/FCKFiles/Image/Lymph%20Drainage%20Area.gif>