

# ANATOMY OF THE DEEP LYMPHATIC SYSTEM — KEY TO LYMPHATIC DRAINAGE

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## Abstract

This article describes the anatomy of the deep lymphatic system. Clinical experience indicates that the piezoelectric effect, generated by suitably sized quartz crystal tools when applied by hand over deep lymphatic trunks and nodal complexes, effectively stimulates them, significantly improving lymphatic function. Particular areas of congestion can be specifically targeted resulting in major benefits for clients.

## Reference

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**Keywords:** Lymphatic drainage; Lymphatic system; Lymphostasis; Piezoelectric effect.

## Introduction

There has been little, if any, direct focus on the deep lymphatic system. Most methods of stimulating lymphatic function predominantly affect the superficial system. Deep breathing, various exercises and movements aimed at increasing muscular activity, cannot effectively clear all congestion that can occur in the deeply seated lymph nodes and lymphatic vessels.

All body organs have deep lymphatic drainage<sup>(1)</sup>. Both deep and superficial channels are integral parts of the lymphatic system. The smaller superficial channels converge to form bigger vessels feeding into the deep lymphatic trunks, usually near the deep fascia, that drain to the thoracic duct or the right lymphatic duct.

Often, deep drainage pathways from different areas of the deep organs flow in different directions. They can drain to different parts of a particular node, to different nodes in the same chain or even to completely different chains. Regions of most of the organs lying on or near the midline, such as lungs, diaphragm and heart, follow different pathways either to the thoracic duct or to the trunks feeding into right lymphatic duct<sup>(1)</sup>.

The gut is an exception<sup>(1,2)</sup>. Lymph drains to nodes situated along its arteries, then to the pre-aortic nodes. Flow continues via the intestinal lymph trunk to the cisterna chyli, thence to the thoracic duct<sup>(2)</sup>. The pharynx and pharyngeal tissues drain to both sides of the body<sup>(1)</sup>.

Deep organs and the skin are divided by a series of drainage areas where lymph flows in different directions towards different groups of lymph nodes<sup>(4)</sup>. In the skin, these areas are termed lymphotomes<sup>(1,3)</sup>. The 'watershed', the area between them, contains an extensive network of collateral lymphatic capillaries and superficial collecting channels communicating with both regions<sup>(1,3)</sup>. These are connected to both superficial and deeper plexuses formed by collateral lymphatics. The deep trunks have collateral channels across the watersheds<sup>(1)</sup>.

In the trunk, the major vertical watershed runs vertically along the midline of the body<sup>(1,3)</sup>. There is also one over the nipple lines of the thorax. Horizontally they are situated at the level of the clavicles and the umbilicus<sup>(1,3)</sup>.

Lymph drains in different directions from these areas<sup>(1,3)</sup>. It flows to both cervical and axillary lymph nodes at clavicular level. At umbilical level, it drains to both the axillary and inguinal nodal complexes<sup>(3)</sup>.

## Deep Lymphostasis

Lymphostasis can occur anywhere in the deep system, leading to serious problems<sup>(1)</sup>. When the superficial vessels are overloaded, normal drainage pathways become congested, causing backflow to occur. The deep channels are affected<sup>(1)</sup>.

This system is so extensive, with deep lymphatic nodes and vessels situated so deeply in the body, that it is evident that exercises and outside pressure alone cannot clear all the congestion that often occurs at particular points or areas<sup>(4)</sup>.

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Deep breathing helps, inhalation decreases the pressure in the chest sucking lymph flow along. It is squeezed forward on exhalation<sup>(5)</sup>. Unfortunately it is not enough to clear all deep lymphostasis. There are instances when stimulation of the superficial system has to be relied upon, when the deep lymphatic system is blocked<sup>(1)</sup>.

Most techniques currently used predominantly access the superficial system. The skin and subcutaneous tissue are the areas that directly respond to complex physical therapy (CPT)<sup>(1)</sup>.

### **Piezoelectric Effect**

Clinical experience now indicates that these deep areas can be reached and effectively stimulated by utilising the piezoelectric effect of specifically sized quartz crystal tools. Simply defined 'piezoelectricity is the ability of crystals to generate a voltage in response to applied mechanical stress'<sup>(6)</sup>.

This phenomenon produces various effects. One is that when pressure is applied to quartz crystal, an electric charge at a particular frequency of energy emission is produced<sup>(7,8,9,10)</sup>. Minute, pulsing energy waves are created by the natural intrinsic movement of the body<sup>(11)</sup>. This field is amplified through the therapist's fingers and specific movements. It can be directed in a coherent, orderly and highly concentrated form to the target area, by analogy, similar to a laser beam<sup>(7,8)</sup>. This energy flow, though minute, is highly effective.

In most cases deep lymphatic vessels lie close to deep veins. However the deep lymphatic trunks draining all intestinal areas are adjacent to arteries, following them back up to where they branch out from the front of the abdominal aorta<sup>(9)</sup>. They carry lipids (long chain fatty acids — more than 12 carbon atoms), partially processed from food to chylomicrons, upwards via the thoracic duct, thence to be transported per the systemic venous circulation<sup>(12)</sup>. The bronchomediastinal trunk is different in that it is unaccompanied by blood vessels<sup>(3)</sup>.

### **Thoracic Duct and Supra-Claviculars**

The thoracic duct receives drainage from the abdominal cavities, and lies superior to the azygos vein, close to the thoracic aorta<sup>(4)</sup>. It has a beaded appearance due to its valves and thin walls and receives drainage from the major mediastinal lymph nodes lying adjacent to the aorta<sup>(3)</sup>. In some people, the bronchomediastinal trunk flows into it from the right at about the level of the third rib. It then continues up under the left brachiocephalic vein, feeding into the venous circulation at or near the junction of the internal jugular and left subclavian veins at the base of the neck<sup>(4)</sup>. Some people have a smaller thoracic duct draining up on the right side of the chest cavity<sup>(5)</sup>.

Three major trunks, the right subclavian, draining the right arm, the right jugular, draining right side of head and the right bronchomediastinal, draining the right side of the thorax, heart and part of the liver, drain into the right lymphatic duct, which is about 1.25 cm long. Lymph then flows into the venous circulation via the right subclavian vein<sup>(12)</sup>. This is

variable as sometimes the right lymphatic duct is absent, and these major trunks enter the venous system at different locations<sup>(3)</sup>.

A photographic study of the lymphatic vessels of the posterior body wall shows deep drainage from the right flowing via the right bronchomediastinal trunk into the thoracic duct. There is a clearly visible vessel linking the right medial cervical and jugulo-omohyoid lymphatic vessels and lymph nodes, lying deep to the internal jugular vein, to the bronchomediastinal trunk draining in from the right<sup>(4)</sup>. Thus, in some instances, there is deep lymph drainage from the right side of the thorax and head flowing via this tract directly to the thoracic duct.

It is thought that drainage of the thoracic paravertebral space may occur via local lymph nodes and thence to thoracic duct tributaries. Unwanted detritus outside the pleural cavity is drained by intercostal lymphatics<sup>(13)</sup>. The pathway followed by lymphatic vessels draining the skin above the sternum and part of the breast goes directly via tributaries of the internal thoracic vein to the deep nodes situated alongside the sternum (parasternal nodes)<sup>(3)</sup>. In the chest there are numerous lympho-venous connections between the azygos veins and the thoracic duct<sup>(3)</sup>. At deep level, lymphatic flow from both sides of the chest is taken up by the thoracic duct

Major cardiac collecting trunks, formed at the subepicardial level from the subendocardial and myocardial plexuses drain to the thoracic duct. Any increase of pressure in these trunks will prevent clearance of the coronary arteries. Increased hydrostatic pressure in these vessels has been shown to cause decreased cardiac output and small vessel occlusion. It is likely that stagnation of normal lymph flow is a major factor in the development of atherosclerosis. A high percentage of high density lipoproteins, the 'good' lipoproteins that 'carry' cholesterol to the liver to be metabolised into bile acids is transported by the lymphatics<sup>(14)</sup>.

### **Mucosa Associated Lymphoid Tissue (MALT)**

These important and extensive tissues, known as mucosa associated lymphoid tissue (MALT), are a major part of the lymphatic system. They contain at least 50% of the body's immune cells and consist of oval shaped lymphatic nodules, without a capsule, lining the urinary, reproductive, respiratory and gastrointestinal systems. They are situated in the lamina propria, the middle part of the mucous membrane lining these areas, between the epithelium and the muscularis mucosa. They are strategically placed to protect them from unwanted substances and organisms. In the gastrointestinal tract, these nodules are concentrated in the tonsils and small and large intestines<sup>(12)</sup>.

### **Deep Abdominal Drainage**

The deep drainage of the organs of the abdominal cavity is important<sup>(1)</sup>. There are many large lymph nodes and vessels deep within the peritoneal cavity. It contains serous fluid and can become grossly engorged in some disease states<sup>(12)</sup>.

The visceral peritoneum supports the abdominal organs and binds them to the posterior and anterior abdominal cavity walls. The mesentery and mesocolon hold the small and

large intestines loosely in place; the falciform supports the liver to the anterior abdominal wall and diaphragm; the lesser omentum suspends the duodenum and stomach from the liver. The greater omentum, containing adipose tissue, hangs loosely over the front of the transverse colon and intestines<sup>(12)</sup>.

### Lymph Nodes

Large groups of lymph nodes are found within the mesentery of the intestine, posterior to the greater omentum<sup>(4)</sup>. There are some lymph nodes in the lesser omentum and many in the greater omentum<sup>(12)</sup>. Lymph from the intestinal and lumbar trunks, the kidney and gut, drains up to the cisterna chyli<sup>(4)</sup>. This small sac like structure is positioned next to the aortic opening of the diaphragm. It is absent in some people, when there is simply a conglomerate of vessels feeding directly or indirectly into this area<sup>(3)</sup>. These include the intestinal and lumbar trunks, large 'pools' of lumbar lymph nodes and common iliac lymph nodes, the sacral nodes, external iliac lymph nodes and inguinal nodes<sup>(4)</sup>.

The deep sacral and common iliac nodes receive vessels from the rectum, uterus, vagina and bladder. The uterus, vagina and bladder also drain to the external iliacs, as do the seminal vesicle and vas deferens<sup>(1)</sup>. It is interesting to note that lymphatic vessels draining from the skin of the glans penis and clitoris follow the tributaries of the external pudendal vein directly to the deep inguinal nodes situated on the femoral vein<sup>(3)</sup>.

The large groups of lymph nodes located in the inguinal region are involved in both superficial and the major underlying deep drainage. Some afferent lymphatic vessels drain to the deep inguinal nodes from the external iliac lymph glands<sup>(1)</sup>, others feed back up into the lower abdominal tracts<sup>(12)</sup>. They are very important structures involved in both leg and abdominal drainage. If these major lower abdominal areas are congested, drainage in all other parts of the body will be affected<sup>(1)</sup>. The popliteal nodes just below and behind the knee drain deeply, as do cubital nodes those just below the elbow crease<sup>(2)</sup>.

### Axillary Nodes

Large groups of lymph nodes are situated in the axillae, where major trunks drain in from the arm. There are nodes of the anterior, posterior, inferior and superior subchains along the axillary vein; the external mammary nodes draining channels from the breast; the inferior scapular nodes with channels feeding in from the lateral chest wall and the superior thoracic nodes. The deltoid-pectoral chain, draining up from external bicipital, delto-bicipital, delto-pectoral nodes of the arm drains to the clavi-pectoral nodes, in the clavi-pectoral triangle below the clavicle, thence linking in with the transverse cervical chain of nodes<sup>(1)</sup>.

There is a system of lymphatic vessels draining under the armpit up to the acromio-clavicular joint, both at the front of the shoulder and behind it, discernible by stimulation with a quartz crystal tool. Clients state they can feel various areas in the head (sinus areas, temple, nose, eyes and ears) beneficially affected as these points are stimulated.

The powerful deep axillary nodes underlie the superficial drainage<sup>(4)</sup>. When correctly stimulated these nodes and vessels can effectively take over the drainage from superficial nodes that have had to be surgically removed, channelling the lymph flow from these areas to the thoracic duct.

### Head Lymphatics

The head has its own complex system of both deep and superficial drainage. Fluid from the brain must travel many centimetres before it finally enters the adventitia, the outermost covering of the internal carotid and vertebral arteries outside the skull<sup>(1)</sup>.

There are lymphatic vessels in the retro-bulbar region and the front of the eye, excluding the cornea. Drainage also occurs through the arachnoid villi in the sub-arachnoid space, flowing via blood and lymph into the lymphatics of the cranial nerves, the spinal nerves, inner ear and the cribriform plate of the ethmoid bone (forms the roof of the nasal cavity)<sup>(1)</sup>.

There are large groups of nodes deep to the mandible and the sterno-cleidomastoid muscle. Deep cervical nodes (jugulo-digastric and jugulo-omohyoid) lie adjacent to the internal jugular vein draining into the thoracic duct via the jugular trunks<sup>(4)</sup>.

### Fluid Return

It is thought that 90% of fluid return is via the lymphatic system and 90% of that return may occur in the lymph nodes. This could be due to the action of aquaporin 1, a transmembrane protein that acts as a water channel that is always open, enabling fluid exchange between its intricate network of lymphatics and adjoining blood vessels<sup>(2,15)</sup>.

A tiny arterial branch supplies blood to each node, there is a small vein as well as an efferent lymphatic leaving the hilum<sup>(2)</sup>. There is 100 times more resistance to the passage of lymph through nodes compared to the flow of the thoracic duct<sup>(1)</sup>.

### Lymph Nodes

Lymph, from whatever area of the body, must pass through at least one group of lymph nodes before entering the venous circulation. Superficial lymph nodes drain to deep nodal complexes. The first lymph nodes receiving drainage from a particular organ or area are termed sentinel lymph nodes. The node, situated next to the thoracic duct before its entrance into the venous system (Virchow's or 'signal' node) is of particular importance as it is the last site of defence and filtration of unwanted matter before lymph enters the blood stream.

In cancer patients, enlargement of this node (left supraclavicular area) may indicate spread of cancer situated in the area drained by the thoracic duct. In smokers, lungs have blackish appearance. This is due to the presence of inhaled carbon particles that have been filtered by the lymph nodes<sup>(3)</sup>.

An overload of bacteria or toxins for whatever reason (post severe infection, exposure to toxins) can make lymph nodes inflamed and oedematous, causing them to feel painful and

enlarged. Excess fibrosis can completely block them<sup>(1)</sup>. The use of a quartz crystal tool is important when this happens. The particular frequency (electromagnetic charge) generated by its piezoelectric effect and delivered per the coherent energy field radiating from it, can be directly focused on the specific area concerned, be it superficial or deep.

### Benefits of Deep Lymphatic Therapy

The major benefits of using a quartz crystal tool to stimulate deep lymphatics include:

- People breathe easier and more deeply.
- Symptoms mimicking a heart attack (checked by a doctor) disappeared in a patient.
- Severe generalised fluid retention due to congestive cardiac failure, including large fluid folds overhanging both ankles, was successfully alleviated and quality of life restored in a patient. Treatment of clients with this problem is contraindicated in most methods of lymphatic drainage<sup>(16)</sup>.
- Significant reductions have occurred in swelling/lymphoedema of arms and legs, in most cases without the use of compression garments.
- Clients with generalised fluid retention affecting both limbs and gut have reduced one to three dress sizes. Breasts became less swollen and more comfortable. Usually, both urine and bowel flow improve.
- Energy levels increase; symptom relief is often experienced over an extended period.

Thus, clinical experience indicates that deep lymphostasis, blockages in lymph nodes and nodal complexes, can be effectively relieved in a cost effective manner. Research is needed to further explain why this happens.

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# \$5 MILLION FOR RESEARCH INTO COMPLEMENTARY MEDICINES

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In November 2006, the Department of Health and Ageing National Health and Medical Research Council (NHMRC) hosted a two day capacity building workshop in Sydney to provide practical advice to complementary medicine researchers on how to apply for NHMRC funding.

The workshop was convened by the NHMRC as well as the NSW Office of Science and Medical Research and the Centre for Complementary Medicine Research at the University of Western Sydney. The workshop was attended by researchers, policy makers and industry to survey the research, regulations and industry activity in both Australia and the USA.

As a consequence of the workshop, on 23 November 2006 the Minister for Health and Ageing, the Hon Tony Abbott, announced that the Commonwealth Government will provide \$5 million in funding through the NHMRC to investi-

gate the use and effectiveness of complementary medicines. The \$5 million will be over a three year period.

The aim of the research is to contribute to the body of evidence relating to the use of complementary medicines in Australia. The objectives of the research funding are to enhance the evidence base regarding the best use of community resources to meet the current and future health needs of Australia. Specifically, the funding seeks to assist in the use of complementary medicines consistent with national health policies and guidelines.

The allocation of \$5 million over a three year period is not much money for a large scale project with a meaningful outcome. However it is a positive start which may be the precursor for yearly research funding. Further information about the funding grant can be obtained from the NHMRC website at [www.nhmrc.gov.au](http://www.nhmrc.gov.au). ❖

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