The Oesophagus and the Stomach

Luc Peeters & Grégoire Lason
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Content

1. Introduction .................................................................................................................. 7
2. Anatomy ....................................................................................................................... 8
   2.1. Position and important anatomical Data ................................................................. 8
      2.1.1. The Oesophagus ......................................................................................... 8
      2.1.2. The Cardia ............................................................................................... 10
      2.1.3. The Stomach ............................................................................................. 11
   2.2. Physiological Fixations of the Stomach ................................................................. 13
   2.3. Blood Supply of the Stomach ............................................................................. 16
      2.3.1. Arterial ..................................................................................................... 16
      2.3.2. Venous ...................................................................................................... 17
3. Mobility ......................................................................................................................... 19
4. Innervation .................................................................................................................... 20
5. Physiology ..................................................................................................................... 23
   5.1. Functions of the Stomach ..................................................................................... 23
      5.1.1. General ...................................................................................................... 23
      5.1.2. Peristalsis ................................................................................................. 23
      5.1.3. Swallowing ............................................................................................... 24
   5.2. Histology ............................................................................................................... 27
   5.3. Stomach Absorption ......................................................................................... 29
      5.3.1. Absorption ............................................................................................... 29
      5.3.2. How long does Food stay in the Stomach? ................................................. 29
   5.4. Digestion of Milk in Children ........................................................................... 31
   5.5. Physiology of Vomiting (Emesis) ....................................................................... 31
6. Case History and physical Diagnosis ......................................................................... 33
   6.1. Achalasia ........................................................................................................... 33
   6.2. Barrett’s Oesophagus ....................................................................................... 34
   6.3. Oesophageal Cancer ......................................................................................... 35
   6.4. Varicose Veins ................................................................................................. 35
   6.5. Mallory-Weiss Syndrome ............................................................................... 36
   6.6. Zenkers’ Diverticulum ..................................................................................... 36
   6.7. Boerhave’s Syndrome ..................................................................................... 36
   6.8. Diffuse oesophageal Spasm ............................................................................ 37
   6.9. Oesophageal Hypomotility .............................................................................. 38
   6.10. Nutcracker Oesophagus ............................................................................... 38
   6.11. Candidiasis ...................................................................................................... 38
   6.12. Gastro-Oesophageal Reflux Disease ............................................................... 40
   6.13. Hiatus Hernia ................................................................................................. 40
   6.14. Stomach Ulcer ................................................................................................. 41
8.1.  General Techniques

8.1.1.  General Remark when Mobilising the Ribs

8.1.2.  Mobilisation of the ribs in the frontal Plane

8.1.3.  Mobilisation of the Ribs in the sagittal Plane

8.1.4.  Mobilisation of the Ribs in the horizontal Plane

8.1.5.  Re-enforcement of the Diaphragm

8.1.6.  Stretch of the intrathoracic Fascia

8.1.7.  Stretch of the left intrathoracic Fascia

8.1.8.  Recoil on the Thorax

8.1.9.  Recoil on the Diaphragm

8.1.10. Mobilisation of the intrathoracic Fascia

8.1.11. Doming Technique

8.1.12. Doming Technique with raised Ribs

8.2.  Specific Techniques

8.2.1.  Mobilisation of the Pylorus
8.2.2. Mobilisation of the Cardia – Sitting ................................................................. 71
8.2.3. Mobilisation of the Cardia – Standing ......................................................... 72
8.2.4. Inhibition of the suspension System of the Stomach ..................................... 72
8.2.5. Stretch of the lesser Omentum and the lesser Curvature ................................. 73
8.2.6. Lifting the Stomach ...................................................................................... 74
8.2.7. Stretching of the lesser Omentum and the lesser Curvature ............................. 74
8.2.8. Stretching of underlying Adhesions ............................................................ 75
8.2.9. Massage of the pyloric Region .................................................................... 75
8.2.10. Relaxation of the pyloric Region .................................................................. 76
8.2.11. Relaxation of the stomach Region .............................................................. 76

8.3. Osteopathic Techniques .................................................................................. 77
8.4. Neurolymphatic reflex Points ......................................................................... 77

9. Bibliography ....................................................................................................... 81

10. About the Authors ............................................................................................ 84

11. Acknowledgements ........................................................................................... 85

12. Visceral Osteopathy .......................................................................................... 86
12.1. Introduction ..................................................................................................... 86
12.2. Motion Physiology ......................................................................................... 87
12.3. Visceral Interactions .................................................................................... 88
12.3.1. General ...................................................................................................... 88
12.3.2. Relationships ............................................................................................ 89
12.3.2.1. Gliding Surfaces .................................................................................... 89
12.3.2.2. Ligamentous suspensory System ......................................................... 89
12.3.2.3. The Mesentery ..................................................................................... 89
12.3.2.4. The Omenta .......................................................................................... 90
12.3.2.5. The turgor Effect and the intracavitary Pressures ................................. 90
12.4. Mobility Loss ................................................................................................ 90
12.4.1. Diaphragm Dysfunction ........................................................................... 90
12.4.2. Adhesions .................................................................................................. 91
12.4.3. Retractions ................................................................................................ 91
12.4.4. Trophic Tissue Changes ........................................................................... 91
12.4.5. Congestion ................................................................................................ 92
12.4.6. Postural Disorders .................................................................................... 92
12.4.7. Visceral Mobility Loss ............................................................................. 92
12.5. Visceral Hypermobility ................................................................................ 93
12.6. Osteopathic visceral Examination ................................................................. 93
12.7. Bibliography visceral Osteopathy ................................................................. 94
1. Introduction

Many patients suffer from various stomach problems, such as stomach ulcers, chronic gastritis, or gastro-oesophageal reflux disease (GERD). All these problems decrease quality of life.

Stomach disorders can be present even without obvious stomach complaints. They can cause referred complaints in the musculoskeletal system. Cervical complaints, shoulder pain, headaches, and sleeping disorders can be present.

In this e-book we give the osteopathic view, on the anatomy, physiology and neurology of the stomach. It is a necessity for the osteopath to know all about the stomach’s structure and function to be able to examine and treat a patient adequately.

Beside the medical text, seen through the eyes of an osteopath, the osteopathic tests and techniques are discussed and presented with treatment strategies.

For readers not yet familiar with the osteopathic visceral concepts, chapter 12 included at the end of this e-book.
2. Anatomy

2.1. Position and important anatomical Data

2.1.1. The Oesophagus
The oesophagus (Figure 1) is the least complex part of the digestive system.

It is 25 cm long and 2 cm wide.

The oesophagus begins where the pharynx ends. This is at the level of C₆.

Till the level of T₄ the oesophagus runs behind the trachea. Beneath that level it deviates towards the left to pass the diaphragm at the level of T₁₀.

Between T₄ and T₁₀ the oesophagus is surrounded by the oesophageal plexus of the vagus nerve that regroups again below as anterior and posterior vagal trunks.

The oesophagus runs 2 cm further to the left below the diaphragm.

The tube conveys the bolus (food) from the pharynx to the stomach.

When empty, the oesophagus is in a physiological collapse.

Just like other parts of the digestive system, the oesophagus has 4 layers:

- **Muscular layer**: the muscular layer contains less smooth muscle than the rest of the digestive system but more striated muscle fibres. The muscular upper third consist completely of striated muscles, the middle part is a mix and the lower third has smooth muscles. The inner muscular layer is circular and the outer muscular layer is longitudinal.

- **The tunica externa or adventitia** (outer part) is not a real serosa but an adventitia because it is imbedded in the connective tissues of the thorax.

- **The tunica submucosa and mucosa**: the inner part here is stronger than the inner part of the rest of the digestive system because the oesophagus receives food that is only partially macerated and therefore has to be more resistant to trauma. It contains stratified, squamous epithelia.

No absorption takes place in the oesophagus.

The oesophagus contains glands that secrete mucus for the bolus to slide more easily.
The oesophagus has two sphincters one above and one below:

- The upper sphincter is a muscle, which is associated with the larynx. In swallowing, the muscle relaxes. It helps to bring the food into the oesophagus and not into the larynx by pulling the larynx anteriorly.
- The lower sphincter lies where the oesophagus passes through the diaphragm.

Under normal circumstances both sphincters are closed so nothing can leave the stomach or oesophagus.

When the lower sphincter doesn’t function as it should, reflux occurs. This is called “Gastro Oesophageal Reflux Disease (GERD)”. The lower sphincter stays open and stomach acid is allowed into the oesophagus.

The oesophagus has 3 narrow parts (*Figure 1)*:

These three locations of narrowing are the places where the oesophagus can be irritated more easily. That is why these locations deserve our special attention. We will examine and eventually treat the corresponding musculoskeletal areas.

In the subdiaphragmatic area, the oesophagus is connected with the left crus of the diaphragm.

*Figure 1* - The oesophagus and its 3 narrow parts
2.1.2. The Cardia

The cardia (Figure 2 and 3) lies 2 cm left of the midline of the body and at the level of T_{10-11}.

**Figure 2 - The cardia**

**Figure 3 - The cardia – sagittal view**
3. Mobility

The mobility of the stomach works under the influence of respiration and the diaphragm.

In the frontal plane:

The central tendon of the diaphragm descends during inhalation, more on the right than on the left side.

The fundus of the stomach therefore descends caudally and inwards.

The most caudal part of the stomach ascends and turns to the right.

The stomach does a sidebend towards the left. The structures especially involved in this movement are the fundus and the greater curvature of the stomach. The movement happens around a transversal axis that runs through the caudal part of the lesser curvature.

In the sagittal plane:

The stomach rolls in ventral direction. This means that the fundus moves ventrally and the caudal part of the stomach moves dorsally. The axis of movement is laterolateral but not through the middle of the stomach. The axis of mobility lies close to the pylorus so the fundus moves more than the caudal part of the stomach.

In the horizontal plane:

A right rotation is seen around a craniocaudal axis through the oesophagus.

Figure 15 - Mobility of the stomach during inhalation. With exhalation the opposite movement is seen.
4. Innervation


The digestive tract, from the oesophagus to the middle part of the transverse colon is innervated by the vagus nerve.

The vagus nerve is 80 to 90% afferent nerve fibres. It transports messages coming from the stretch receptors and from the osmoreceptors.

The vagus nerve also has a small efferent function. The nerve synapses with the ganglionic cells of the intrinsic plexus of the stomach (Auerbach in the muscular layer and Meissner in the submucous layer).

The vagus nerve organises the contractions of the stomach, relaxes the pylorus and stimulates the mucous, HCL and pepsin production.

The sympathetic innervation of the stomach comes from the segments T₆-₉.

Through this segmental relationship, musculoskeletal complaints of gastric origin can occur.

The sympathetic nervous system inhibits the stomach contractions, narrows the gastric arteries, reduces the stomach secretions and contracts the pylorus.

During physical activity, the motility of the digestive tract diminishes because of the raised sympathetic tone. The contractions are inhibited and the sphincters raise their tone. Also the circulation towards the digestive system diminishes.

We know that the autonomic system plays a role in the contractility of the muscular layers but we also know that this is not the only regulatory system of peristalsis. Hormonal secretions play an equal role. This is why osteopaths don’t only treat the segmental relationship through the spine by correcting somatic dysfunctions but also the mobility of the organ itself. Improving local visceral mobility improves circulation and the function of the intrinsic system. Nutrition also plays an important role.

Visceral pain

Visceral pain is a common reason for medical consultation.

Somatic and visceral pain work via different mechanisms.

We get little sensory input from the visceral system. Only pain and discomfort are registered. A feeling of fullness will easily be associated with pain.

All forms of visceral pain can also give pain in distant structures. This is called referred hyperalgia. Sometimes only this referred hyperalgia is noticed (Cervero 1995, Cervero & Laird 2009, Hobson & Aziz 2003, Mayer & Gebhart 1994).
The above is one of the main reasons why osteopaths examine and treat organs.

The eventual visceral disease is not the one treated osteopathically, but the irritating factors such as ischemia, spasm and retraction. These irritating factors tend to worsen the disease and inhibit the healing process.

The representation of the visceral system in the central nervous system is poor. However visceral nociception exists for some (mostly hollow) organs. Most of these receptors stay inactive and become active in:

- A real trauma.
- An inflammation.
- An ischemia.
- A muscle spasm.
- An irritating traction.
- A stretch of a hollow organ.

The number of these nociceptors is small but once the impulses reach the spinal cord it triggers several secondary neurons, which diverge in the central nervous system.

This divergent input can activate several systems: sensory, motor and autonomous. This explains the reaction to visceral pain: diffuse, referred and with sustained autonomous activity.

Chronic, sustained pain is often of visceral origin while acute pain more often has a somatic cause. Somatic pain can of course also find its origin in the parietal peritoneum.

The osteopath must be aware of the fact that the location of the pain is not always the region that has to be examined and treated.

Chemical segmental blocks also work via this pain mechanism but osteopaths use manual techniques on the somatic segments to influence visceral pain.
Oesophageal pain:

The neurophysiological basis of oesophageal pain and discomfort is not clear. Non-cardiac chest and thorax pain is often associated with hypersensitivity of the oesophagus (primary afferent).

The oesophagus is innervated by spinal nerves as well as sympathetic and parasympathetic (vagus) nerves. The afferent neurons come from the serosa, the muscles (longitudinal and circular) and from the mucous wall.

They are sensitive to anything touching the mucous membrane and to acidity and chemicals.

The spinal afferent neurons run from C\textsubscript{1} to L\textsubscript{2}, and the sympathetic nerves between T\textsubscript{6-9}.

Radiating pain is mostly seen in the ipsilateral side over the thorax and the arm.

The dorsal horn reacts to these stimuli by either inhibiting or stimulating oesophageal distension.
5. Physiology
(Guyton & Hall 2005, Klinke & Pape 2005)

5.1. Functions of the Stomach

5.1.1. General
The functions of the stomach are:

- To receive swallowed food.
- To mechanically and chemically prepare food for digestion.
- To deliver chyme (food with chemical components) to the duodenum.
- To digest proteins through the enzyme pepsin.
- To produce the intrinsic factor necessary for the absorption of vitamin B.

5.1.2. Peristalsis
Peristalsis is a specific pattern of contractions of smooth muscles to transport the food through the digestive tract.

Bayliss and Starling first described this as motility. It means contraction behind the bolus and relaxation in front of the bolus.

The peristalsis is mostly controlled by the intrinsic nervous system.

The intrinsic system is stimulated by the bolus itself through stretch and mechanical mucous stimulation.

There are two reactions:

- A group of interneurons activates stimulating motor neurons above the bolus (acetylcholine and substance P stimulate the contractions above the bolus).
- Another group of interneurons activate inhibiting motor neurons that relax the smooth muscles in front of the bolus. Nitrate oxide, vasoactive intestinal peptide and ATP are the responsible neurotransmitters.
5.1.3. Swallowing

Swallowing is a voluntary action:

- Oropharyngeal phase: the bolus is brought into the pharynx.

Autonomic reaction:

- Relaxation of the upper sphincter.
- Peristalsis.
- Relaxation of the lower sphincter.

Between swallowing:

- The upper sphincter is closed and sees to it that no air comes into the oesophagus during respiration. The closed sphincter also avoids oesophageal content to return.
- The lower sphincter is closed to avoid gastro oesophageal reflux.
- Secondary peristalsis occurs when necessary (through stretch of the oesophagus caused by the bolus).
• Unspecific contractions can also occur. They are called tertiary contractions, which aren't real peristalsis, but just contractions. They occur in elderly people and are induced by stress and reflux.

• Retrograde peristalsis is seen in vomiting and retching.

Contractions of the stomach have two basic functions:

• Knead food, provide mucous and mix it with the food to form chyme.
• Emptying the stomach: transport of chyme to the duodenum

The fundus and the upper part of the stomach show low frequent and sustained contractions to maintain a basic pressure in the stomach. These low frequent contractions also generate a pressure component towards the duodenum. Eating fast great amounts of food stretches the stomach and inhibits these contractions of the fundus and upper part of the stomach. This way the stomach swells without the necessary pressure gradient.

The lower part of the stomach and the antrum show a strong peristaltic wave that increases in force when approaching the pylorus. This peristaltic wave occurs 3 times per minute.

Stretch of the stomach increases this peristaltic wave and this stimulates the emptying of the stomach.

The pylorus is a functional sphincter of the lower part of the stomach and releases the chyme in parts to the duodenum.

Liquids pass easily through the pylorus but solid food is each time pushed against the pylorus until reduced to a diameter of 1 to 2 millimetres.

After every peristaltic wave towards the pylorus, there is a reflux upwards.
6. Case History and physical Diagnosis


In this chapter we discuss the most important pathologies of the oesophagus and the stomach that have to be recognised by the osteopath.

6.1. Achalasia

Achalasia is a failure of smooth muscle fibres to relax. This condition is also called ectasia or cardio spasm.

If this occurs at the level of the cardia, dilatation of the oesophagus is seen.

There is a real obstruction with unknown cause. Dysfunction of the dorsal nuclei of the vagus nerve could cause this condition.

The condition is seen in young adults (20-40 years) and is influenced strongly by stress. Drinking cold fluids increases the symptoms. In 2 to 5% of the cases it is seen in children.

In this condition there is reduced peristalsis and the lower sphincter doesn’t open easily.

If the condition persists for a longer time, local neuroanatomical changes will develop. There is a loss of myenteric ganglion cells.

Distal oesophageal diverticula can even occur with fistulas against the trachea.

The major complaint will be difficulty swallowing of solid food. Liquids are easier to swallow.

In 60 to 90% of the cases regurgitation occurs and in 50 to 75% of the cases there is thorax pain. Reflux and loss of weight are also possible consequences.

In 4 to 14% of the cases there is hiatus hernia.

The condition is seen in 8 out of 100,000 people.

Osteopathically the segments OAA (vagus nerve) draw our attention. Especially in the early phase of the condition, an osteopathic intervention is useful.
6.2. Barrett’s Oesophagus

*(Cohen & Postma 2003)*

In this condition there are trophic cell changes (mucous epithelium is replaced by columnar epithelium) in the lower oesophageal part.

It is mostly seen in white males of a somewhat higher social status and it is associated with rich food intake.

It is mostly seen following reoccurring stomach inflammation and chronic inflammation of the lower oesophageal region.

The condition is seen in 22.6 out of 100,000 people.

The condition often leads to carcinoma.

The typical complaints are dysphagia and acid reflux.

The risk factors are alcohol consumption, smoking, vitamin and mineral deficiency, genetic factors and primary throat cancer.
6.3. Oesophageal Cancer
The five-year survival rate for oesophageal cancer is only 6 to 9%.

6.4. Varicose Veins
Varicose veins are often seen in the cardia region. This is due to the presence of portocavale anastomosis.

60% of the patients with portal hypertension will develop varicose veins at the level of the cardia.

25 to 30% of the varicose veins will bleed.

The osteopathic treatment of this condition is:

- Mobilise the upper thoracic region to obtain an optimal heart function.
- Correct diaphragm lesions (especially a high diaphragm) with decongestion of the region.
- Drain the liver.
- Stretch of the lesser omentum to obtain a correct angle of the portal vein entering the liver.
- Stretch the lesser curvature of the stomach.
- Stretch of the cardia in caudal direction to stretch and drain the veins.
7. Clinical Diagnosis

7.1. Palpation

7.1.1. Palpation of the Cardia

The patient is sitting and the osteopath stands behind the patient.

He palpates the cardia, deep and posterior on the left side of the midline and as high as possible (in cranial direction), while the patient exhales.

Note the following when palpating:

- The cardia is palpable as a tube, which is 2 cm in length and lying obliquely towards the left. This is a normal finding.
- The cardia is not palpable and the region is painful. There are 3 possibilities:
  - Inflammation (cardio oesophagitis). In the case history we hear associated complaints such as reflux and a burning retrosternal pain after a meal.
  - Spasm of the cardia. The tone of the upper part of the stomach and the cardia is too high. In the case history there is the feeling of fullness immediately after the start of a meal. We also find reflux and inflammation. Treating the sympathetic and parasympathetic segments as well as the region of the medulla oblongata (OAA) is necessary.
  - Spasm of the diaphragm. The provoked pain will be associated with apnoea. The treatment will be directed towards the segment C3-5 and towards possible local adhesions of the diaphragm.
- The cardia can’t be palpated and the whole region is unpleasant for the patient with normal palpation pressure. The pain is often accompanied with nausea. This finding is often caused by a congestion of the whole upper digestive tract. Liver, gallbladder, pancreas, spleen and pylorus will also be congested. If there is congestion of the upper digestive tract, there is often venous congestion in the cardia region because of the presence of portocaval anastomosis. In the presence of venous congestion of the cardia, there is probably portal hypertension too. A general treatment for portal hypertension and congestion of the upper digestive tract will be necessary.
- The region is sensitive, accompanied with a kyphotic thoracic spine, which is difficult to correct. This suggests a structural, functional or combined hiatus hernia.
7.1.2. Palpation of the Diaphragm

The patient is supine with the hips and knees in flexion.

The osteopath palpates the posterior side of the lower ribcage with both thumbs.

The test ascertains pain and elasticity.

Pain can be caused by a local spasm of the diaphragm.

If the palpation shows a loss of elasticity, this can be caused by trophic changes of the diaphragm or its attachments.
7.1.3. Palpation of the suspensory Ligament of the Stomach

The patient is sitting and the osteopath stands behind the patient.

He palpates in the direction of the suspensory ligament, sub-diaphragmatically on the left and ventrally under the ribcage.

The direction of the palpation is cranially.

Pain in this region suggest a diaphragmatic irritation by abnormal traction of the stomach, for instance in the case of stomach ptosis.

*Video 3 - Palpation of the suspensory ligament*
8. Osteopathic Techniques

8.1. General Techniques

8.1.1. General Remark when Mobilising the Ribs
A thorax lacking elasticity will decrease the cardiac outflow. Not only in rest but also during exertion. The heart volume decreases and the lungs demonstrate decreased vital capacity. During exertion the heart rhythm increases but this is not sufficient to compensate for the decreased heart volume. The blood pressure quickly rises. The gastric pressure also increases significantly (Miller et al 2002).

Therefore good mobility of the thorax is essential for an optimal condition of the heart and general circulation, especially of the upper digestive tract.

Loss of elasticity in the thorax will also reduce the effect of the pumping function of the diaphragm.

Through good mobility of the inferior ribs there is a mechanical effect on the segments T₆-₉.

8.1.2. Mobilisation of the ribs in the frontal Plane
The patient is sitting with his back straight.

Using both hands the osteopath contacts the inferior ribs laterally and lifts them into cranial direction while the patient inhales and follows into caudal direction during exhalation. While inhaling, the thoracic spine is helped into extension and while exhaling into flexion.

The restrictive components are mobilised.

Mobilisation to cranially is most effective during inhalation and mobilisation to caudally is most effective during exhalation.

Video 20 - Mobilisation of the ribs in the frontal plane
8.1.3. Mobilisation of the Ribs in the Sagittal Plane

The patient is lying on the side and the osteopath places one hand posterior and one hand anterior upon the inferior ribs. The ribs are mobilised superiorly (inhalation) and inferiorly (exhalation).

Care must be taken that the patient lies in the sagittal plane with the upper thorax in neutral (no rotation).

Mobilisation into cranial direction is most effective during inhalation and mobilisation into caudal direction is most effective during exhalation.

*Video 21 - Mobilisation of the ribs in the sagittal plane*
10. About the Authors

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Both authors are holders of university degrees, namely the Master of Science in Osteopathy – University of Applied Sciences, and are very active with the promotion and academic structuring of osteopathy in Europe. In 1987 they began The International Academy of Osteopathy (IAO) and are, to this day, the joint-principals of this academy. The IAO is since several years the largest teaching institute for osteopathy in Europe. Both osteopaths are members of diverse professional organisations, including the American Academy of Osteopathy (AAO), the International Osteopathic Alliance (IOA) and the World Osteopathic Health Organisation (WOHO), as part of their mission to improve osteopathic development.

This osteopathic encyclopaedia aims to demonstrate the concept that a proper osteopathic examination and treatment is based upon the integration of three systems: the musculoskeletal, visceral and craniosacral systems.
This e-book is a product of Osteo 2000 bvba.

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