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1. Introduction

It is well recognised by classic medicine that kidney problems can lead to musculoskeletal complaints. Renal colic most commonly begins with pain in the flank.

Functional problems of the kidneys are a frequent source of complaint, which is not always immediately associated with the kidney. The reason for this is that the kidney plays an important role in filtration and therefore purification of the blood and regulation of the blood pressure.

An osteopath can significantly influence the kidney function by improving mobility of the organ under influence of the diaphragmatic respiration, by providing optimal neurovegetative supply and by improving the venous and arterial blood supply.

Anatomically the adrenal glands are closely related to the kidney, with a predominant endocrine function. The medulla produces adrenaline while the cortex hormones are implicated in fat, sugar and mineral metabolism.

Osteopathic consideration of the kidney segment can therefore have different aims.

On one hand kidney and/or adrenal dysfunctions can lead to complaints in the related segments but on the other hand kidney and/or adrenal dysfunctions can also be involved in complaints, which are not directly related to the segment.

Blood pressure problems, oedema, stress management, fluid balances, pH balance problems, bone metabolism, fatigue, weight-loss, immune depletion and many other problems are often associated with the kidney and/or adrenal segment.

The first sign for the osteopath that would indicate that treatment of the kidney is required would be somatic dysfunction in the zone T10 to T12.

This e-book deals with both the kidney and adrenal organs even though they have completely different functions. The reason for this is that the adrenal gland cannot be mobilised specifically on its own. In other words the anatomical unity between kidney and adrenal means that the visceral tests and techniques cannot be differentiated for each organ.

The vertebral segments are also the same.

This e-book discusses the anatomy, neurology and physiology of the kidney and the adrenal but also provides instruction as to how the osteopath can examine and treat these organs.

The osteopath must be capable of recognising structural kidney and adrenal problems and refer the patient appropriately.

For readers who are unfamiliar with the osteopathic visceral approach, please refer to Chapter 11 at the end of this e-book.
2. Anatomy

2.1. Position
The kidneys are bean-shaped and are located in the retroperitoneal space in the superior lumbar region.

The right kidney is approx. 2cm lower than the left kidney due to the presence of the liver, which effectively pushes the right kidney downwards.

The lateral side is convex and the medial concave.

On the medial side of each kidney is the hilum: the aggregation of the arteries, veins, lymph vessels and nerves, which run to and from the kidney.

The pyelum is also medial; this is from where the ureters run towards the posterior/inferior side of the bladder.

The adrenals sit upon the kidneys (Figures 1 and 2) surrounded by a common fatty tissue layer and capsule. They are also retroperitoneal.

They are in contact with:

- Right: liver and inf. vena cava.
- Left: pancreas and stomach.
- Posterior: diaphragm.

Figure 1 - Position of the right adrenal in the frontal plane
Figure 2a - Position of the kidneys in the frontal plane
Figure 2b - Position of the kidneys in the frontal plane

The kidney is found lateral to the spine and retroperitoneal (Figure 3).

Figure 3 - Upper horizontal section of the kidney

The kidney is found lateral to the spine and retroperitoneal (Figure 4).
3. Physiology

3.1. Functions of the Kidney

3.1.1. Filter and Resorption Function
- Regulation of the blood volume and blood pressure.
- Regulation of the chemical composition of the blood: sodium (Na\(^+\)) and potassium (K\(^+\)) balance and pH balance.
- Transport of waste products such as nitrogen and sulphur-bonds which result from protein metabolism.

3.1.2. Endocrine Function
- Hormone production:
  - Erythropoetin, or EPO, stimulator of the bone marrow to produce red blood cells.
  - Renin as blood pressure regulator.

3.2. Regulation of the Blood Volume
Each influx of blood into the kidney leads to a certain volume of fluid being pressed into the renal tubuli via specialised capillaries (glomerular capillaries). These renal tubuli run along the peritubular capillaries. The majority of the water is reabsorbed through these renal tubuli into the blood vessels. The water, which remains in tubuli, is excreted.

The quantity of water which is reabsorbed regulates the blood volume.

![Figure 18 - Reabsorption and secretion](image-url)
3.3. Regulation of the Chemical Constituents of the Blood

3.3.1. General
The kidney regulates the chemical composition of the internal environment by way of a combination of filtration, reabsorption and secretion (Figures 18, 19, 20 and 21). The filter process in the kidney is initially non-discriminatory. This means that anything small enough to be filtered will be filtered including products which the body does not wish to excrete (glucose, amino acids, vitamins etc.). These molecules are then reabsorbed via the renal tubuli into the bloodstream while other molecules are not reabsorbed (creatine, toxins). These are waste products.

It is important to realise that 20% of the plasma leaves the blood vessels and enters the renal tubuli meaning that waste products actually remain in the bloodstream. These waste products need to be secreted.

By the regulation of the reabsorption and the secretion the kidneys can determine Na⁺, K⁺, hydrogen and bicarbonates levels in the plasma. In this way the kidney regulates the chemical composition of the blood.

Figure 19 - Regulation of the chemical constituents of the blood
3.3.2. Filtration

80% of the plasma enters the glomerulus. Due to the high blood pressure in the afferent arterioles and the high permeability in the glomerular endothelium 20% of that plasma is filtered.

The remaining blood flows further into the efferent arterioles, which run along the renal tubule to the renal vein where the blood pressure is lower. These veins are also porous which allows easy reabsorption of the watery solution from the renal tubule.

Only plasma enters into the renal tubule; the blood cells and proteins larger than albumin do not pass. The filtrate in the renal tubule consists therefore of plasma without proteins larger than albumin.

Glucose, small cations Na\(^+\), K\(^+\), H\(^+\) and small anions Cl\(^-\), HCO\(_3\)^- do enter into the renal tubule.

The balance between the pressure in the afferent arterioles, the pressure in the glomerulus and the pressure in the peritubular capillaries decide how much filtrate is produced per unit of time.

99% of the plasma that enters the kidney re-enters the circulation.

1% of the volume is excreted.

The kidneys filter approx. 180 litres of fluid per day.
4. Mobility

(Schwartz et al 1994, Sörmsen the Koste 2006, Vasbinder 2002)

The kidney is a very mobile organ.

The motor of this mobility is the diaphragm and the respiration.

During inhalation the kidney descends; during exhalation it ascends (Figure 27).

Per day the bladder moves approx. 800 m due to respiration alone.

The amplitude between inhalation and exhalation is 4 to 5 cm in an adult.

During the descend and return (ascent) the kidney follows a curved trajectory which results from the length of the vascular pedicle.

The inferior pole of the kidney descends 1 cm more than the superior pole. This means that the kidney itself stretches under influence of the respiration, which leads to an even better blood flow.

The left and the right kidney are evenly mobile.

In boys up to the age of 15 it has been noted that the right kidney is more mobile. When body weight reaches 60 to 70 kg, left and right mobility becomes even and the gender difference disappears.

During apnoea the kidney ascends spontaneously by 0.5 cm.

During these motions of the kidney the renal artery will bend but also alter its angle with the kidney.

During inhalation the kidney also bends 1 to 2 cm forwards and rebounds backwards during the exhalation (Figure 28).

The adrenals follow the motions of the kidney.
Figure 27 - Mobility of the kidney

Figure 28 - Mobility of the kidney in the horizontal plane
5. Patient History and Physical Examination


5.1. Kidney Ptosis

The kidney can be found in ptosis (Figure 29).

Three grades of ptosis are described:

- Lateral descent of the kidney, following the lateral edge of the psoas m..
- Further descent of the kidney so that it rests upon the psoas m., and tilts inwards.
- Further descent into the pelvis and complete tilting.

When in ptosis the kidney loses normal mobility under influence of the diaphragm leading to decreased function.

Serious ptosis can lead to congestion due to kinking of the ureter and interruption to the peristalsis.

Grade 3 ptosis (Figure 29) position cannot be corrected by the osteopath. However, mobilisation is still important to help drain some of the congestion and aid the good function of the ureter.

A light grade of ptosis is not necessarily pathological. More serious ptosis can lead to dysfunction (Barber & Thompson 2004, Boccardo et al 1994, Clorius et al 1987).

70% of kidney ptosis occurs on the right side.

Kidney ptosis will significantly decrease the blood supply to the organ.
5.2. Trauma  
(\textit{Smith et al 2007})

The kidneys are found between the 12\textsuperscript{th} rib and the 3\textsuperscript{rd} lumbar vertebra. The upper part is quite well protected by the lower ribs but are otherwise relatively exposed, especially the right kidney as it sits lower.

The kidneys are often actually lower than described topographically meaning that the musculoskeletal system provides less protection than implied. Both kidneys are therefore vulnerable to trauma and this is also more so for the right than the left.

Classic medicine describes motor vehicle accidents as the most notable cause of kidney trauma but even an ‘innocent’ fall can lead to problems in the region.

Classically 95\% of kidney traumas are expected to present with haematuria; this is not really the case especially if the injury is to the renal pedicle. Furthermore, the patient does not always notice haematuria.

Measuring the blood pressure after trauma is therefore indicated.
6. Clinical Examination

6.1. Provocation Tests

6.1.1. Provocation Test for Pyelonephritis

The osteopath places the flat hand over the Grynfelt zone. This is lateral to the paravertebral muscles and under the 12th rib. In this region the muscular layer is at its thinnest.

Using the fist of the other hand several percussions are given to ventral with increasing intensity.

If a dull pain occurs which continues to ache after the percussion has stopped, this is a sign of pyelonephritis. Of course, this finding must be found along with other clinical signs from the patient history and with ventral palpation pain.

Video 1 - Provocation test for pyelonephritis
7. Osteopathic Techniques

7.1. Relaxation of the Kidney Zone and Fascial Techniques

7.1.1. Relaxation of the Posterior Side

The patient is placed in the “lumbar roll” position with the lumbar spine in light lordosis.

The osteopath places the thumb in the Grynfelt zone, pointing into the angle between the paravertebral muscles and the 12th rib.

A progressive pressure is given with the thumb to ventral/medial, in the direction of the kidney.

During this progressive pressure the lumbar roll position is used to help find the position of maximum relaxation of the region where the thumb is placed.

The technique is an example of a more advanced mobilisation technique of the kidney most notably because the kidney moves ventrally during inhalation and any posterior adhesions can limit this motion.

This means that the pressure to ventral should be held while several deep abdominal inhalations are done. During these inhalations the kidney moves ventrally.

At the beginning of this technique this region will feel hard but the combination of the progressive thumb pressure and the relaxation via the lumbar roll position will result in slow relaxation of the region.

The technique is deemed successful if less resistance is felt in this zone afterwards.

It is not fully understood how the technique works but the effect is very clear by way of the palpable relaxation of the region. It is possible that posterior adhesions are stretched; possibly the over-stimulated sympathetic tone of the tissue in this posterior region is inhibited.

It is a good preparation for further mobilisation of the kidney.
7.1.2. Relaxation of the Posterior Parietal Peritoneum

The patient is supine with both legs bent.

The osteopath stands opposite to the side to be mobilised.

The fingers of both hands are placed in the Grynfelt space and this zone is lifted ventrally and medially.

A progressive pressure is given against the resistance and then held for a certain time.

The technique is successful if a more relaxed region is felt after 30 seconds to a minute.

It is not fully understood how the technique works but the effect is very clear by way of the palpable relaxation of the region. It is possible that posterior adhesions are stretched; possibly the over-stimulated sympathetic tone of the tissue in this posterior region is inhibited.

It is an essential preparation for further mobilisation of the kidney most importantly because the kidney moves ventrally during inhalation and any posterior adhesions can limit this motion.

The ventral lift can even be held and - during a deep inhalation - suddenly released so as to stretch posterior adhesions.
9. 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), 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.
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