MOTILITY AND MOBILITY OF THE LUNGS AND THE CORRELATION WITH PNEUMONIA

Master Thesis for obtaining the academic degree

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STATUTORY DECLARATION

I, Kathrin Grimmer, born on December 17, 1980 in Scheibbs hereby declare,

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2. that I have not publicized my Master Thesis in my domestic or any foreign country in any form to this date and/or have not used it as an exam paper,

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ABSTRACT ENGLISH

OBJECTIVE: In osteopathic training the treatment of the lungs is a fundamental part. Aim of the study is to examine the connection between motility and mobility of patients with and without medically diagnosed pneumonia in the past.

METHODS: This study is an experimental basic trial in a parallel group design. Different persons (N=41), quasi/balanced randomized, are tested by two osteopaths and surveyed by a doctor of medicine with a quantitative research method. The osteopaths are blinded of the fact whether a tested person has had pneumonia or not and of each other's findings. The coefficients of correlation are tested by phi. To evaluate the differences between patients with and without pneumonia regarding their mobility and motility, the Chi squared test is used.

RESULTS: The significance value p=0.007 suggests that there is a correlation between motility and mobility of the lungs. Patients with (p=0.354) and without pneumonia (p=0.208) do not differ regarding the correlation between mobility and motility. However, the significance value p=0.041 shows that the two groups differ with regard to their mobility and with p=0.000 also to their motility (α=0.05).

CONCLUSIONS: There is a correlation between mobility and motility of the lungs. Patients with and without pneumonia do not differ regarding the correlation between mobility and motility, but the results of patients with pneumonia indicate that the condition represents a relevant context. Patients with and without pneumonia differ in their mobility and motility, in that patients with pneumonia have a higher risk to have a restricted mobility and motility.

Keywords**:** motility, mobility, lungs, pneumonia, correlation

ABSTRACT GERMAN

ZIEL: In der Ausbildung zum Osteopathen ist die Behandlung der Lunge grundlegend. Ziel dieser Studie ist die Ergründung der Verbindung von Motilität und Mobilität zwischen Patienten mit und ohne stattgefundener medizinisch diagnostizierte Pneumonie.

METHODE: Experimentelle Grundlagenforschung in einem Parallelgruppendesign. Verschiedene Personen (N=41), quasi/balanciert randomisiert, werden durch jeweils zwei Osteopathen getestet und durch einen Arzt mit Hilfe einer quantitativen Untersuchungsmethode befragt. Die Osteopathen sind bezüglich der Patienten und auch bezüglich ihrer Ergebnisse zueinander geblindet. Die Koeffizienten der Korrelation werden mittels Phi geprüft. Um die Unterschiede zwischen den Patienten mit und ohne Pneumonie bezüglich ihrer Mobilität und Motilität zu ermitteln, wird der Chi-Quadrat-Test benützt.

ERGEBNISSE: Der Signifikanzwert p=0,007 zeigt, dass die Motilität und Mobilität der Lungen korrelieren. Patienten mit (p=0,354) und ohne (p=0,208) Pneumonie unterscheiden sich nicht in Korrelation zwischen Mobilität und Motilität. Der Signifikanzwert p=0,041 zeigt, dass sich die zwei Gruppen bezüglich ihrer Mobilität und mit p=0,000 bezüglich ihrer Motilität unterscheiden (α=0,05).

KONKLUSION: Mobilität und Motilität der Lungen sind korreliert. Patienten mit und ohne Pneumonie unterscheiden sich nicht in ihrer Korrelation zwischen Mobilität und Motilität, wobei hier das Ergebnis der Patienten mit Pneumonie auf einen relevanten Kontext hinweist. Patienten mit und ohne Pneumonie unterscheiden sich in ihrer Mobilität und Motilität, so dass Patienten mit Pneumonie ein höheres Risiko einer eingeschränkten Mobilität und Motilität aufweisen.

Schlüsselwörter: Motilität, Mobilität, Lunge, Pneumonie, Korrelation

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1. Introduction

1.1. Status quo of science

In osteopathic training the treatment of the lungs is a fundamental part. There is a distinction between the motility -treatment and the mobility -treatment. “Motility” is a slow, nonvisible movement with low amplitude, “mobility” is a movement caused by the pressure of the diaphragmatic pump (Barral and Mercier 2005, p. 5, 9). While the mobility of the lungs is a known phenomenon in medicine, the motility of the lungs can only be noticed by a well-trained sense of touch (Barral and Mercier, 2005, p. 7). However both, motility and mobility are necessary for a good lung -function and the health of the body. Because of the fact that a poor lung -motility is the first clinical sign of a visceral lesion, its identification and subsequent treatment could probably prevent pleuropulmonal infections (Barral and Mercier, 2005, p. 66).

Who is affected by restricted motility and mobility of the lungs? Due to the fact that the lungs are not sensitive to pain, patients consult an osteopath rather because of conditions that occur as a consequence of a restricted lung -motility and –mobility. The author of the study observed in her osteopathic practice that mainly patients who suffered from pneumonia, a common infectious disease, had a restricted lung -motility and –mobility. Often they did not come to see me for that reason but because of other problems they experienced.

Thus the interest of looking at the correlation between pneumonia and the restriction of lung -motility and –mobility was born.

A thorough research of the available literature showed that it is important to deal with pneumonia within the scope of an osteopathic practice. Alexander (2015) states that pneumonia is a substantial healthcare concern, ranking among the most common reasons for emergency and outpatient visits, hospitalizations and death among both adults and children.

In 2013, 739 persons died in Austria because of pneumonia, i.e. an average of 1.53 – 3.19 persons per month (Statistik Austria, 2014).

According to Stone (1996) the state of the smooth muscles has an influence on the function of organs. An improvement of the muscle tone can improve the movement of organs.

The authors of the book “Lehrbuch der visceralen Osteopathie Band 1” Jean-Pierre Barral and Pierre Mercier (2005) suspect a correlation between the disturbed motility of the lungs and pleuropulmonary infections. Alexander (2015) mentions that a history of childhood pneumonia has also been associated with an increased risk of developing pneumonia later on.

Despite the fact that there are studies regarding pneumonia and osteopathic treatment, there seems to be a lack of information concerning basic research studies that look at the visceral treatment of the lungs, especially in the context of pneumonia.

Therefore the presented study could be considered as “trailblazer” for basic research studies concerning the correlation of pneumonia, mobility and motility in osteopathic medicine.

1.2. Literature review

What is the incidence of pneumonia in Austria and worldwide? According to a statistical study of 9 departments of internal medicine in Austria in 2011, 598 persons aged of <65 years and 1,358 persons ≥65 years developed pneumonia. These 1,956 persons incurred additional costs of ~3,716 € / person because of longer hospitalization. In 2011 among a population of 8,420,900 there was an incidence of 3.65 cases of pneumonia per 1,000 persons (Wenisch, 2014).
Pneumonia accounts for 15% of all deaths of children under 5 years, killing an estimated 922.000 children in 2015 worldwide (WHO, 2015).
Thus it is quite an issue both in Austria and worldwide, in particular also because of the additional costs caused by longer hospitalization when a person has developed pneumonia. It would therefore be interesting for the medical world to decrease the incidence of pneumonia, not only through the common prescription of antibiotics but possibly also through other therapeutic interventions. Hodge, Creasy, Carter, Orlowsky, Schander, King (2012) also mention this consideration and state that the common medical treatment for pneumonia is the prescription of antibiotics, which are generally effective for the treatment of infections. However, the continued emergence of strains of bacteria resistant to antibiotics threatens the effectiveness of treatment (Hodge et al. 2012).
To answer the question whether it is or would be interesting for osteopathic medicine to take care of patients with pneumonia the author of the present study did a web search from May to October 2015 to look for studies which investigate visceral techniques with regard to the lungs or even pneumonia.
With the terms “pneumonia” and “osteopathic medicine” the search engine google schoolar found 1,740 results in October 2015. The studies of Noll, Degenhardt, Morley, Blais, Hortos, Hensel, Stoll (2010), Hodge et al. (2012), Yao, Hassani, Gagne, George, Gilliar (2014), Creasy, Schander, Orlowski, Hodge (2013) and Mueller (2013) looked at osteopathic techniques and pneumonia, in particular osteopathic manipulative techniques and lymph techniques were used or described.
With MeSh (Medical Subject Headings) terms “osteopathic treatment” AND “lung” the web search engine “Pubmed” found 71 results in May 2015. Only one of these studies involved a visceral technique (Hodge et al. 2012), but 10 studies looked at osteopathic manipulative techniques.
With the terms mentioned above the web search engine “Pedro” found 4 files in August 2015. All the studies investigated manual techniques with regard to the lungs.
With the term “visceral techniques” the web search engine “Osteopathic Research Web” produced 10 results in September 2015. None of them covered the context of the lungs. With the term “lung” this web search engine found 35 results in September 2015, but none of them in the context of pneumonia. However, two exclusively discussed visceral techniques in the region of the lungs.
With the term “Pneumonie” the search engine “Medpilot” produced 1,923 results in September 2015, but none of them looked at them looked at the context of visceral osteopathy.

With the term “Pneumonie” and “Osteopathie” the web search engine “DIMDI” found two results in September 2015. One of the studies was about the manipulative treatment of patients with pneumonia, but visceral treatment was not mentioned. With the terms “pneumonia” AND “osteopathy” DIMDI found 79 results in September 2015. The search result provided some studies about pneumonia or lungs and manual osteopathic techniques but none about pneumonia and visceral mobilisation.

Despite the fact that some studies described osteopathic techniques with regard to patients with pneumonia, the author of the present study was not able to find studies dealing with the testing of motility or mobility in the context of pneumonia. Considering that both are essential elements in osteopathic treatment, would it not be necessary to know more about the relationship between motility and mobility regarding patients with and without pneumonia? In particular since pneumonia plays quite an important role in the medical world of which osteopathy is a part.

1.3. Aim of the study

Barral and Mercier (2005) led me to look at the possibility of a correlation between pneumonia and the restriction of lung -motility and –mobility (cf. 1.1., p.3). Alexander (2015) and Stone (1996) note that there could be a correlation of the movement of an organ and a disease like pneumonia. But if persons with and without pneumonia are compared, will there be differences regarding the movement of their lungs or more precisely regarding the mobility and motility of their lungs? Are pulmonary mobility and motility present to the same extent? The research question of this paper (cf. 3., p.23) comprises these two questions.

The aim of the study is to answer these questions as contribution to basic research in the field of osteopathy. Since this basic research effort is done privately and is not sponsored, it has to be done in a manageable form. Since no comparable basic research project has been implemented to this date, the outcome would probably be of interest.

Basic research is important for every profession that intends to be based on a scientific background. There is not enough basic research available regarding the visceral treatment of the lungs (cf. 1.2., p.4,5) especially in the context of a common disease like pneumonia. More information about the connection between a common disease like pneumonia and restricted visceral mobility and motility could prove useful for the scientific background of osteopathic medicine. Additional information could also be useful regarding osteopathic treatment of pneumonia and subsequently also help to better prevent pleuropulmonal infections, as suggested by Barral and Mercier (2005). An additional aim of this study is to contribute to basic research relating to osteopathic medicine.

2. Theory

2.1. Definitions

Since the terms “motility”, “mobility” and “pneumonia” are mentioned quite often in this paper, an overview of how these terms are defined in the available literature should be provided. In the context of motility and mobility also the terms “disturbance” and “restrictions” are explained, as well as the term “inflammation” in context of pneumonia.

2.1.1. Definition of Motility

Regarding motility Pschyrembel (1998, p. 1042) states, for example, that it means the ability to move, more precisely referring to organs which move as a reflex or under autonomic control (e.g. peristalsis).
In Stedman´s Medical Dictionary Hensyl (1990) explains motility as: “the power of spontaneous movement” (p. 983).
Collin (2000) describes motility (of cells or microbes) in The Dictionary of Medicine: “being able to move about” (p.287).
According to Eric (2011) motility is defined as the intrinsic movement of the organs with slow frequency and small amplitude. It can be detected by the hand of a well-trained practitioner and it is the kinetic expression of movements in the organ tissues. During embryonic development, the evolving organs carry out growth movements and position shifts that remain stored in each organ cell as a kind of memory. Motility is a rhythmic repetition of these embryonic migration movements to the organ´s place of origin and back to the final, postnatal position. Likewise, it is impossible to rule out a connection to the craniosacral rhythm, in spite of the fact that motility shows a different rhythm. An expiration phase - that is the movement toward the midline - should be distinguished from the inspiration phase - a movement in the opposite direction away from the midline. Changes in the axes of movement or amplitudes lead to deviation from the physiologic mobility and motility. Such changes lead to local pathologies first without and later with symptoms, recurring local pathologies and pathologies in visceral and parietal regions of the body that are linked through topographic, vascular, nervous or fascial osteopathic changes. The frequency is 7-8 cycles/min, one cycle comprising one expiration and one in inspiration (Eric, 2011, p.14).
Barral and Mercier (2005) define visceral motility as palpable movements which reflect the embryological development. Liem, Dobler and Puylaert (2014) define visceral motility as the ability of an organ or tissue to change its form or morphology. This ability is an intrinsic attribute of the organ or tissue and not caused by outside influences, comparable to the primary respiratory mechanism. Liem et al. (2014) refer to the work of Nordenström (1983), who examined the electrochemical properties of tumours with electric potential measurement in tissues and found that the electric potential of normal tissue fluctuates. In addition, Nordenström (1983) found that

in anesthetized dogs, the liver, pancreas, kidneys and stomach serosa fluctuate at the rate of three to five cycles per minute and with an amplitude of 1MV. These fluctuations are independent of the peristaltic and heart- or lung activity. The reasons for this phenomenon could not be fully explained, but Nordenström (1983) suspected a neural control of these fluctuations. Regarding motility, Hebgen (2008) says that it is an intrinsic movement of organs with a slow frequency and low amplitude. A well-trained hand is able to perceive the motility and motility which is a kinetic expression of organic tissue. In the embryonic development the organs make motions of growth or positional displacement. Those are filed as a memory in each cell of the organ. The motility is a rhythmic repetition of the embryonic movement to the origin and back to the postnatal end position. A connection to the craniosacral rhythm cannot be excluded, although the motility has a different frequency. There is a distinction made between an expiration phase, that is the movement towards the midline, and an inspiration phase, an opposing movement away from the midline. The frequency is 7 – 8 cycles per minute. One cycle consists of an expiration- and an inspiration phase (Hebgen 2008, p. 14). According to Liem et al. (2014) the visceral motility is barely explored and used in diagnosis and treatment predominantly on an empiric basis. Visceral motility is probably an embryological and biological phenomenon, which has an unexplained origin and is simply used empirically in practice (Liem et al. 2014, p.11). Regarding visceral motility Barral and Mercier (2005) note that it consists of two phases, one is “Exspir”, which approaches the organ to the midline axis of the body, the other is “Inspir”, which leads the organ away from the midline axis. Physiologically all organs move synchronously, which means all are in Inspir or Exspir at the same time.

2.1.2. Motility disturbance

According to Hebgen (2008) the motility can be disturbed in its amplitude. The extent of movement can be reduced in one or in both directions. Also the rhythm of the movement changes with the disturbance: the dormancy between inspiration and expiration can be extended. Reasons for the reduction in frequency and the arhythmical movement can be the loss of vitality of the organ, which is a sign of pathology, an articular restriction, a ptosis or a spasm of the viscera.
Barral and Mercier (2005) note that infectious processes, post- infectious residuals or other parenchymatous processes reduce the range of movement of an organ and fix the organ in Exspir. Examples for this are pneumonia, hepatitis, cirrhosis and nephritis.

2.1.3. Definition of Mobility

Regarding mobility Pschyrembel (1998) states the following: “mobility; arbitrary control of movements” (p. 1034). O'Toole and Miller – Keane (2005) explain mobility as: “the ability to move in one´s environment with ease and without restriction” (p. 928).

Hebgen (2008) explains mobility in the context of visceral osteopathy as the movement between two organs or the movement between an organ and the chest wall, the diaphragm or another structure of the musculoskeletal system. The motor of this movement could be the “motricity” or a different “automatism”. An automatism is an involuntary movement of striated or smooth muscles. Two kinds of automatisms are distinguished: continuously or periodically downward movements. Automatisms are e.g.: the diaphragmatic movement of respiration, the action of heart and the peristalsis of the visceral hollow organs. Hebgen (2008) states about the diaphragmatic movement of respiration that the diaphragm contracts twenty-thousand times per day with twelve to fourteen breaths per minute. During inspiration the diaphragm moves caudally, the volume of the thorax increases and the abdominal organs are being pushed down. Due to the smooth muscular abdominal wall the abdominal organs can shift ventrally, so the volume of the abdomen hardly changes. Hebgen (2008) states about heart action that the heart contracts a hundred-thousand times per day with a frequency of seventy heartbeats per minute. These actions have a vibrational effect on the mediastinal organs and through the diaphragm also on the abdomen (Hebgen, 2008, p.14). Regarding visceral mobility Davies, Hill, Holmes, Halliwell and Jackson (1994) mention that NMR- studies and PET- scans showed a movement of about one to three centimetre of the lungs, liver and kidneys during quiet breathing.

According to Liem et al. (2014) the visceral mobility depends on the membranes (peritoneal, pleural or pericardial), which contain the organs, line the body cavities and provide give joint-like connections. An altered elasticity of the peritoneal structures, which connect the viscera with the walls of the body cavity, can decrease the movement of the organs. An increased tension of the peritoneal structures can reduce the function of the organ.

Eric (2011) states that in visceral manipulation, mobility refers to the movement either between two organs or between an organ and the wall of the torso, the diaphragm, or another structure in the musculoskeletal system. The engine for this movement can be motricity or various automatisms. The term automatism refers to a movement that is performed involuntarily by striated or smooth muscles. Two types of automatisms can be distinguished: movements that occur continuously or movements of the organs that are characterized by periodicity. Automatisms include diaphragmatic breathing, heart action and peristalsis of the visceral hollow organs in the gastrointestinal tract.

According to Barral and Mercier (2005) the passive movements of the visceral organs occur due to the pressure of the diaphragmatic pump, a well-known phenomenon that can easily be

observed even with simple radiography. According to the observations of the authors the axes of movement of the organs change with pleuropulmonal involvement. The conditions of intrathoracic pressure are modified and the movements of the musculoskeletal system are oriented in different directions than usual. Via a traction chains these pathological movements are transmitted in all directions. Eventually, the whole body can be affected. The different disturbances are good to see and easy to palpate. The authors have detected, that a relatively small participation of pleura can turn out to be very pathogenic, because it causes other disturbances. A small disturbance, repeated million times for months and years, leads to problems, which have seemingly no connection to the original cause. The law of repetition implies that small things can have a big effect and that cause and effect can appear spatially apart (Barral and Mercier, 2005, p.9).

Finet and Williams (2000) examined the movements of the peritoneal organs in relation to breathing. In numerous imaging tests (e.g. sonography and x-ray) specific movements of the organs, caused by breathing, ware identified. These movements, called “mobility by Finet and Williame”, serve the diagnosis of dysfunctions. The treatment aims at restoring the physiological movements and achieving a significant improvement of mobility.

2.1.4. Mobility disturbances

According to Hebgen (2008) an organ loses its mobility fully or partially because of: articular restrictions, muscular restrictions (spasm of viscera) and loss of ligamentous elasticity (ptosis).

Regarding articular restrictions Hebgen (2008) notes that they can lead to a disturbance of both mobility and motility. If only the motility is disturbed, but not the mobility, then it is called “adhesion”. If both, motility and mobility are limited, then it is called “fixation”.

In case of a fixation the axis of movement and the amplitude of movement can be altered. The reasons for a fixation are infections, inflammations, surgical interventions and blunt traumas (Hebgen, 2008).

Regarding adhesions Barral and Mercier (2005) comment that the pleura and parietal peritoneum are consist a permeable epithelium. Depending on the location of the inflammation an abscess can develop from a suppurative focus local or more distantly. Although it heals, the healing goes hand in hand with the formation of adhesions in adjacent tissues. Those adhesions, which are e.g. caused by pleurisy or peritonitis lead to disturbances of mobility and motility.

Regarding muscular restricions Hebgen (2008) notes that only the hollow organs are affected by muscular restrictions. An irritation of an organ can lead to a non-physiological contraction of the smooth muscle and dysfunction of the organ. This leads to a change in motility, especially of its amplitude. If the attachment of the organ is affected through a spasm of the organ, an altered

mobility of the organ can be observed. Reasons for irritations are inflammations, vegetative dysinnervation, allergic reactions and psychosomatic influences.
Regarding loss of ligamentous elasticity Hebgen (2008) notes that through the loss of elasticity of connective tissue, the attachments of organs, e.g. transverse colon, kidneys or bladder, tend to slip down due to the influence of gravity. The amplitude of mobility and motility change. The reasons are the effect of adhesions, anorexia or fast weight loss, loss of elasticity in old age, depression with reduction of muscle tone, pregnancy, delivery by vacuum extraction and multiparity.
According to observations by Barral and Mercier (2005) concerning a variety of conditions in a pulmological hospital, the axes of movement of the visceral organs of the thorax change in patients with progressive diseases or not yet healed residues. The pressure in the thorax is modified and the musculoskeletal system moves in other directions than usual. These pathological movements are transmitted in all directions. Eventually the whole body can be affected.

2.1.5. Restrictions

In the context of visceral fixations one can often find adhesions of the pleura. Adhesions occur at places where the mobility is lowest. The recesses of the pleura have the tendency to be nearly fully repressed with deep inhalation. The fissures enable the lobes of the lungs to slide against each other, which is important mainly during forced inspiration. If someone does not exercise and has a sedentary work there is the increased likehood that adhesions develop in the above mentioned regions (Barral and Mercier, 2005, p. 55).
The most lateral section of the costodiaphragmatic recesses is also the deepest. Here the layers of pleural have nearly no possibility to slide against each other. Thus an adhesion in this area represents a point of fixation for the movement of the lungs. The motility of the lower lobe of the lung has to do a rotary motion around an anteroposterior axis (Barral and Mercier, 2005, p.55).
In case of an adhesion in the region of the horizontal fissure the motility of the upper lobe of the lung changes into a rotation movement in the frontal plane around a sagittal axis, which passes through the adhesion. In case of an adhesion in the region of the oblique fissure the motility of the lower lobe changes into a rotation movement in the frontal plane around the adhesion (Barral and Mercier, 2005, p. 55).
A main characteristic of a visceral osteopathic dysfunction is, that the affected organs are palpably disturbed in their movement. That means that trophic state, tension or volume are altered and the organ function is disturbed (Liem et al., 2014, p. 34).

Regarding patients who had chronical pain in the pelvis Perry (2001) states that adhesions, which are under tension or decrease the mobility of an organ, most likely caused the symptoms, because they lead to an irritation of nociceptors within the adhesions or in the peritoneum. Pain caused by adhesions is usually intensified through rapid movements, intercourse and physical activity (Perry, 2001).

Liem et al. (2014) write that restrictions and tensions in body cavities (change of pressure, musculoskeletal problems, imbalance of muscle tension, wrong posture …) decrease visceral movements and impair the function and the movement of fluids. Vice versa restrictions (tensions, scars and adhesions) in and between the organs and their sliding surfaces can lead to stretching of ligaments of organs and therefore cause tension in parts of the musculoskeletal system, where the organs are anchored. Postoperative adhesions are common and occur in 50 – 95% of the cases. More common reasons for adhesions are inflammations, a perforation of an organ or endometriosies. The parietal pleura, the peritoneum and mesenteria connected with it react sensitively to tension. Moreover, adhesions contain nerve fibres, which suggest the possibility that pain can occur in the adhesions itself. In case of visceral restrictions the axes of movement of the affected tissue and organs changes, which may cause an irritation of receptors and local or general spasms and pain (Liem et al., 2014, p.12)

2.1.6. Pneumonia

Pschyrembel (1998) describes pneumonia as an acute or chronic inflammation of the lung parenchyma, usually of infectious, rarely of allergic, chemical or physical origin. Among infectious diseases in industrialized countries pneumonia represents the most common cause of death (Pschyrembel, 1998, p. 1265).

Hensyl (1990) describes pneumonia as:

> inflammation of the lung parenchyma characterized by consolidation of the affected part, the alveolar air spaces being filled with exudate, inflammatory cells, and fibrin. Most cases are due to infection by bacteria or viruses, a few to inhalation of chemicals or trauma to the chest wall, and a small minority to rickettsias, fungi and yeasts. Distribution may be lobar, segmental, or lobular; when lobular, in association with bronchitis, it is termed bronchopneumonia. (p. 1225)

Collin (2000) explains pneumonia as an “inflammation of a lung, where the tiny alveoli of the lung become filled with fluid” (p. 348).

According to Bösch (2014) pneumonia is an acute microbial infection of the lung parenchyma and the adjacent organs. One can distinguish between community-acquired pneumonia (CAP) and a hospital-acquired pneumonia (HAP). To qualify as HAP the symptoms must develop less than forty-eight hours after hospitalisation or thirty days after discharge from hospital. In Germany the incidence is estimated to be six hundred thousand to eight hundred thousand patients per year. Moreover pneumonia is the most common cause of death caused by an infection. The rate of hospitalisation is by 30%. Incidence and mortality increase with age (Bösch, 2014).

Pneumonia occur through an infection caused by different microorganism. The most important pathogen is Streptococcus pneumoniae. Viral pneumonia is less common. The most common pathogen of CAP is a bacterium, often the cause is a polymicrobial bacterial infection (Bösch, 2014).

Typically the disease begins with acute fever, often chills and pleural- pain. The patients also suffer from cough and dyspnoea. Between younger and older patients (that means under or above sixty-five years) significant differences in symptoms can be observed. Younger patients are more often affected by pleural- pain and fever, while older patients more often suffer from dyspnoea and confusion (Bösch, 2014).

An atypical progression of symptoms can be observed in cases of infections due to mycoplasma, legionella and viruses. In these cases the beginning of the disease is more insidious and concomitant complaints, like cephalalgia, myalgia etc., occur more frequently (Bösch, 2014).

Complications in the context of pneumonia include a septic shock, pneumonic effusion or emphysema, abscess or respiratory failure. Secondary complications can be exsiccation with kidney failure, thrombosis with lung embolism etc. (Bösch, 2014).

Even if clinical and biochemical investigations are carried out in addition to a thorough case history, a radiological examination (e.g. an x-ray, cf. figure 1) is necessary to confirm the diagnosis of pneumonia (Bösch, 2014).

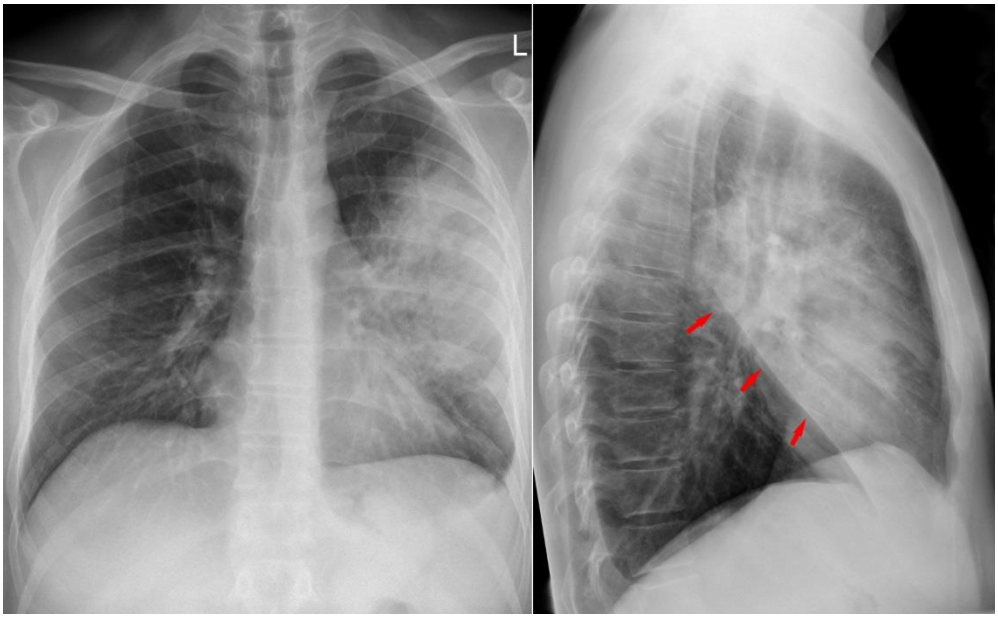

Figure 1: X-ray of a pneumonia diseased lung (cf. p. 49 for source of figure)

Although antibiotics have significantly reduced the mortality rate from pneumonia, the disease remains a leading cause of morbidity and mortality worldwide, particularly among the elderly and those with debilitating diseases (Porth, 2011).

Alexander L., the author of the book “Pneumonia”, writes that pneumonia is an acute inflammatory condition within the parenchyma of the lungs caused by infection that reaches the lower respiratory tract. In most cases, pneumonia develops as a consequence of bacterial colonisation/infection of the upper respiratory tract, followed by microaspiration of infected secretions at a time of impaired host pulmonary defence mechanisms. The prime host defences against foreign particulate matter that reaches the lower respiratory tract are the cough reflex, tracheobronchial (mucociliary) clearance and alveolar macrophage phagocytosis. Activation of the humeral (antibody) immune response provides augmentation of phagocytosis and the acute cellular response. One or more of these defence mechanisms may be impaired by a variety of factors, including underlying cardiopulmonary and neurologic disease, sedative medication, bronchial obstruction, concurrent active viral and mycoplasma bronchitis and toxic/metabolic conditions such as excess alcohol, acidosis and hypoxia. Individuals with an impaired immune system due to immunosuppressive drugs, human immunodeficiency virus, chronic disease, or old age, are more susceptible to infection (Alexander, 2015). Further he writes that pneumonia is often classified to its causative pathogens (i.e. viral, bacterial, fungal or parasitic), but specific

causative pathogens cannot identify in more than half of cases in which testing is done. Classifying pneumonia according to the setting in which it develops is more useful for clinical purposes because the most common pathogens, as well as the outcomes are similar within distinct settings (Alexander, 2015). Alexander also notes that the cause of pneumonia varies according to setting and patient age. Viruses are the most common cause in young children, whereas bacteria are the more frequent cause among older children and adults (Alexander, 2015).

According to Alexander (2015) the mortality rate for adults has decreased substantially over the past two decades. The age- and sex- adjusted mortality rate dropped from 13.5% to 9.5% between 1987 and 2005. The rate of paediatric outpatient visits for community acquired pneumonia has been reported to be 35 to 52 per 1000 children three to six years of age and 74 to 92 per 1,000 children aged two years and younger. The hospitalization rate for children up to 18 years of age is 201.1 per 100,000. According to the data of Disease Control and Preventions, 525 infants and children up to 15 years of age died as a result of pneumonia (or other lower respiratory tract infection) in 2006 (Alexander, 2015)

Marie T. O'Toole and Miller – Keane (2005) explain pneumonia as an "inflammation of the lung with consolidation and exudation" (p.1176). Further they state:

> Pneumonia once was a common cause of death and killed one out of four victims. It is still a serious disease, especially in infants and the elderly, who are most vulnerable. In spite of the advent of antibiotic therapy in the 1940`s and a reduction in the mortality rate for all infectious diseases, pneumonia currently accounts for 37 per cent of hospital deaths and still ranks among the ten leading causes of death in the United States. (p. 1176)

Pneumonia is the single largest infectious cause of death in children worldwide. Pneumonia killed an estimated 922,000 children under the age of 5 in 2015, accounting for 15% of all deaths of children under the age of five years. Pneumonia affects children and families everywhere, but is most prevalent in South Asia and sub-Saharan Africa. Children can be protected from pneumonia; it can be prevented with simple interventions, and treated with low-cost, low-tech medication and care (WHO, 2015).

Alexander (2015) states that the primary risk factors for community acquired pneumonia (CAP) are age, comorbidities and smoking history. Occupational dust exposure and history of childhood pneumonia have also been associated with an increased risk, as has male gender, unemployment and single marital status. The risk for pneumonia is higher for individuals aged 65 years or older compared with younger adults, with the risk further increasing for those aged 85 years and older. Alcoholism and chronic diseases, such as respiratory disease, cardiovascular disease or kidney disease also increase the risk for pneumonia, especially in the older population. In the paediatric population, very young children face an increased risk because their immune

system has not fully developed. Diseases or medications that suppress the immune system increase the risk among all ages. Among the nursing home population, male gender and older age are risk factors for pneumonia. Other risk factors for this population include swallowing difficulty, inability to take oral medications, profound disability, bedridden state and urinary incontinence (Alexander, 2015).

Bösch (2014) mentions that in a clinical survey of about 80% of cases auscultated fine bubbled rales are stated. A positive bronchophony and a positive fremitus also suggest the presence of pneumonia. A biochemical examination comprises a complete blood count including differential blood count, creatinin, electrolytes, transamninases, gGT and CRP or PCT. Regarding hospitalized patients it is also recommendable to do blood cultures for biochemical examination. For very symptomatic patients and hospitalized patients it is appropriate to do a pulse oximetry and a blood gas analysis if available. Radiologically a proof of an infiltrate is necessary. For this it is essential to do an x-ray in two planes or a CT of the thorax. If only a horizontal x-ray image of the thorax is taken, pneumonia cannot be excluded for sure.
Radiological diagnostics are necessary to ascertain the diagnosis pneumonia, because case history, clinical examination and laboratory parameters do not represent a reliable basis for diagnosis (Bösch, 2014).
Alexander (2015) explains that success in reducing the incidence of pneumonia relies on effective strategies to prevent disease. The primary preventive strategy for community acquired pneumonia is immunization with influenza and pneumococcal vaccines, especially for high risk groups (i.e. young children, older individuals and people with compromised immune system). Targeted immunization has been shown to decrease the rate of hospitalization for pneumonia and influenza and to decrease the risk of long- term morbidity and mortality. However, vaccine utilization rates are low, especially regarding pneumococcal vaccination among high risk groups and influenza vaccination among children.
Prevention of health- care- associated pneumonia (HCAP) focuses on care measures to preserve healthy pulmonary defence mechanisms and to reduce transmission of health-care-associated, often multidrug resistant bacterial pathogens. The adherence to guidelines for the prevention of HCAP has been low, with approximately 39% to 66% of hospitals reporting full compliance and up to one-half of nurses reporting that they do not routinely adhere to recommended prevention practices (Alexander, 2015).

2.1.7. Inflammation and its effects on the tissue

Inflammation is a physiological protection mechanism of the organism against harmful influences. It is the consequence of activating the immune system. An inflammation supposes to: fight and eliminate of the destroying influence, prevent of spreading of damage and repair defects. Harmful influences can come from the environment or arise in the organism itself through decomposition processes, remodelling and through faulty processes of life. Since no individual can escape these influences, inflammation processes occur throughout every individual´s life as essential basis for health (Egger, 2005).

According to Egger (2005) the physiological progression of an inflammation comprises vascular response (vasodilatation, exudation), cellular reaction (migration, adhesion, phagocytoses/degranulation) and reaction of tissue (matrix formation for repair of defect, angiogenesis).

During phagocytosis or degranulation the phagocytes stop their migration and build connections (aggregate formation) through specific surface molecules, so called adhesions. Through the formation of coherent associations the phagocytes surround the focus of inflammation and lock it from the organism (sequestration). It depends on the size of the harmful particle and the strength of phagocytosis stimulus if a phagocyte takes the path of phagocytosis or exocytosis. The stimulus of activation for phagocytes increases with the number of receptors occupied by ligands. Thus a non-particular molecular stimulus can trigger a massive exocytosis of active substances and degranulation in case a correspondingly high number of receptors are occupied. The most intensive form of reactivity of a phagocyte is that it becomes self-destructive through its own massive release of active substances. This affects the immediate area of the phagocyte in an uncontrolled way because the unrestrained release of highly active substances damages the tissue, as it is often the case in complicated diseases (Egger, 2005).

Tissue which is damaged through inflammatory and necrotic processes can either be restored through full repair and regeneration or be changed into granulation tissue which leads to the formation of scar tissue (Bankl, 2003).

Scar tissue in the lungs is black because of the sedimentation of anthracotic pigment. Scar tissue tends to shrink and therefore exerts a pull on the surrounding tissues (Bankl, 2003).

Both Egger (2005) and Bankl (2003) describe the effect of an inflammatory process on the tissues. Lung tissue that went through an inflammatory process like pneumonia becomes scared, which causes pulls on the surrounding structures. Due to these pulls the tissue is probably restricted in its motility and possibly also in its mobility.

2.2. Visceral testing

2.2.1. Motility

Testing of the upper, middle and lower lobe of the lungs in supine position according to Barral and Mercier (2005):
Upper lobe: search for the horizontal rotation around the apical segment bronchus (figure 2).
Middle lobe: the upper lobe is slightly pushed against it and with a hand on the middle lobe the horizontal rotation is also tested (figure 2).
Lower lobe: the oblique axis should be identified (figure 2).
The tests for the left lung are the same as for the right lung, though on the left side there is no middle lobe and the angle between the axis of movement and the vertical plane is greater than on the right side.

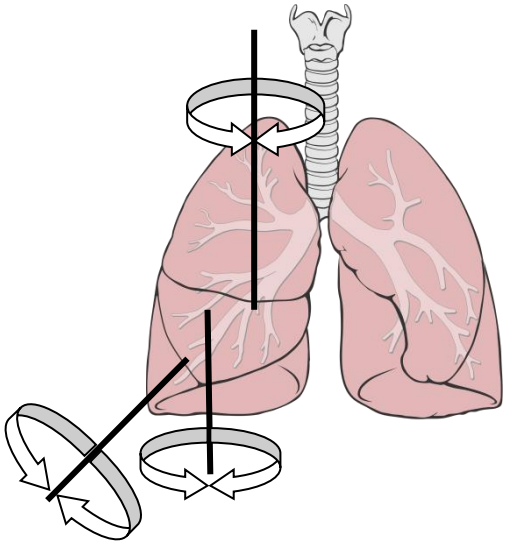

Figure 2: Rotation around the different axes of the lobes of the lungs
(cf. p. 49 for the source of figure)

Due to the horizontal fissure of the right lung it is possible to inhibit the middle and lower lobe with one hand to get the other hand free for examining the upper lobe. This can also be done contrariwise, i.e. to inhibit the upper lobe for examining the middle lobe (figure 3).

Figure 3: Motility testing of upper and middle lobe

For testing adhesions of the oblique fissure an inhibition of the upper- and middle lobe on the right side (figure 4) and an inhibition of the upper lobe on the left side is necessary (figure 5).
If there is an adhesion in the region of the horizontal fissure the motility of the upper lobe will change into a rotation in the frontal plane around a sagittal axis, which passes through the location of the adhesion.
If there is an adhesion in the region of the oblique fissure the motility of the lower lobe will change to a rotation in the frontal plane around the adhesion.

Figure 4: Motility testing of the lower lobe and testing of oblique fissure

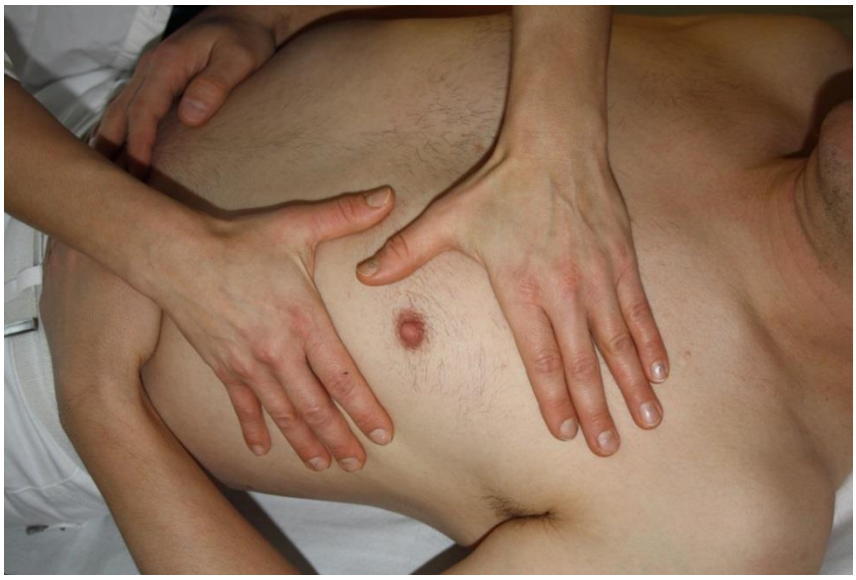

Figure 5: Motility testing of the upper and lower lobes and oblique fissure

Testing of the right middle lobe in a left lying position according to Liem et al. (2014):

Position of hands:

Middle lobe (right): hand posterolateral transverse between the sixth and the eighth rib on the lower lobe, the other hand transverse between the fourth and sixth rib (figure 6).

Figure 6: Testing of the middle lobe in side-lying position

Manoeuvre:

The middle lobe is carefully pushed backwards to inhibit its motion.

Evaluation:

Evaluation of amplitude, force, ease, symmetry of the lobe-motion.

Normal motion:

The upper lobe and the middle lobe turn around cranial-caudal axis.

The lower lobe turns around a slightly oblique (from medial to lateral) axis.

2.2.2. Mobility

According to Liem et al. (2014):

Patient: in supine position

Osteopath: standing, laterally to the patient

Position of hands:

Upper lobe: hands on the first – fourth ribs, fingers pointing cranially (figure 7).

Middle lobe: hands on the fifth – eighth ribs, fingers in rib orientation (figure 8)

Lower lobe: hands on the eighth – tenth ribs, fingers in rib orientation (figure 9).

Figure 7: Mobility testing of upper lobe

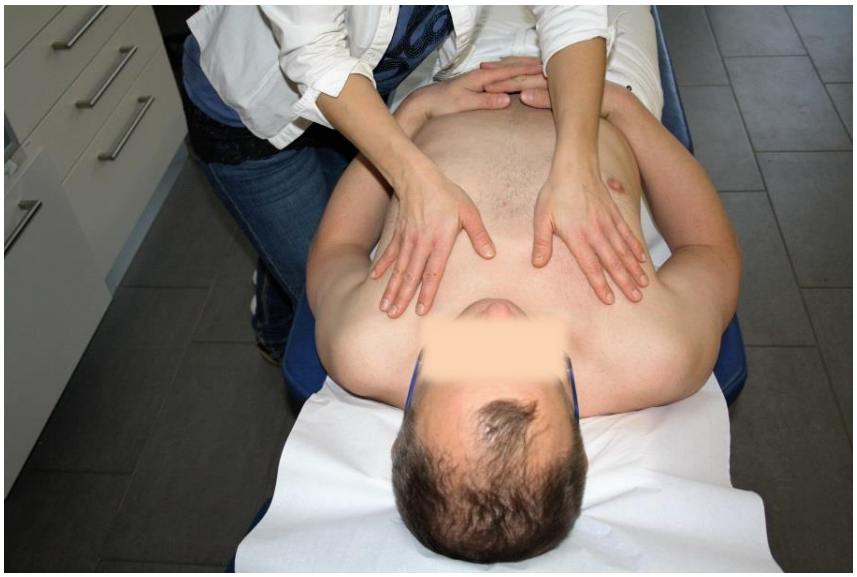

Figure 8: Mobility testing of middle lobe (right hand remains on upper lobe)

Figure 9: Mobility testing of lower lobe

Manoeuvre:

The hands follow the movement of inspiration and expiration.

Awareness of lung-movement.

Evaluation:

Evaluation of amplitude, force, ease and symmetry of movement.

Normal results: Both sides move harmoniously and equally with breathing.

A reduced amplitude of breathing indicates a costovertebral dysfunction and due to the connection to the endothoracic fascia and pleura automatically a dysfunction of the lungs.

The results of the testing indicate a normal or restricted mobility and motility (cf. 2.2., p.17). Due to the fact that pneumonia is a disease involving an inflammatory process (cf. 2.1.6., p.11) which probably causes scar tissue (cf. 2.1.7., p.16), it is obvious that patients with pneumonia in the past have a different mobility and/or motility of their lungs, which is caused by restrictions (cf. 2.1.5., p.10) due to the inflammation in the past. These patients have a different amplitude, force, ease and symmetry of the lobe-motion and movement of their lungs if they have had no osteopathic treatment yet or practise intensive lung training (cf. 2.1.5., p.10) through athletic activities or similar exercises. Although these differences can be sensed by osteopathic hands they cannot be scientifically proved to date (cf. 1.2., p.4). Thus the author of this paper attempts to provide a scientific evaluation of the correlations of pneumonia and mobility and motility of the lungs in the following chapters.

3. Research question and hypotheses

The aim of this experimental basic study in a parallel group design is to examine if there are differences regarding the mobility and motility of the lungs, when persons with and without pneumonia are compared, and are pulmonary mobility and motility present to the same extent (cf. 1.3., p.5)? Thus the research question is: what is the correlation between pneumonia and the mobility and motility of the lungs? Also a secondary research question arises: do patients with and without pneumonia differ in their mobility or motility? Considering the findings of the literature research the assumption is obvious that the following variables have a correlation: mobility, motility and pneumonia. But to determine whether this assumption is right or not the different possibilities of correlations have to be evaluated. To provide an overview of the different possibilities of correlations the main hypotheses A and B and the secondary research questions C and D are investigated:

Hypothesis A

There is a correlation between the mobility and motility of the lungs.

H_0 (A): There is no correlation between the mobility and motility of the lungs (α=0.05).

H_1 (A): There is a correlation between the mobility and motility of the lungs (α=0.05).

Hypothesis B

Patients with and without pneumonia differ in correlation between mobility and motility of the lungs.

H_0 (B1): Patients with pneumonia do not differ with regard to the correlation between mobility and motility of the lungs (α=0.05).

H_1 (B1): Patients with pneumonia differ with regard to the correlation between mobility and motility of the lungs (α=0.05).

H_0 (B2): Patients without pneumonia do not differ with regard to the correlation between mobility and motility of the lungs (α=0.05).

H_1 (B2): Patients without pneumonia differ with regard to the correlation between mobility and motility of the lungs (α=0.05).

Research question C

Patients with and without pneumonia differ in their mobility.

R_0 (C): Patients with and without pneumonia do not differ with regard to their mobility (α=0.05).

R_1 (C): Patients with and without pneumonia differ with regard to their mobility (α=0.05).

Research question D

Patients with and without pneumonia differ in their motility.

R_0 (D): Patients with and without pneumonia do not differ with regard to their motility (α=0.05).

R_1 (D): Patients with and without pneumonia differ with regard to their motility (α=0.05).

4. Methods

4.1. Research design

The present study regarding the correlation of pneumonia and osteopathic visceral tests, concerning lung mobility and –motility, is a blinded experimental basic study in a parallel group design. To answer the research question different persons were tested by an osteopath, retested by a second osteopath and surveyed by a doctor of medicine with a quantitative research method. The osteopaths were blinded of the fact whether a tested person has had pneumonia or not and they were blinded of the results of each other´s findings.

4.2. Criteria for participation

After careful considerations**,** the author of the present study has defined the following inclusion and exclusion criteria, to minimize the source of errors for the outcome**.**

4.2.1. Inclusion criteria

All patients who suffered from diagnosed pneumonia recently or years ago, but had not seen an osteopath since that time.
All patients who had suffered from pneumonia, at least once, which has been documented by medical diagnosis.
All patients who have not suffered from pneumonia which has been documented by medical diagnosis.
Despite the fact that persons aged ≥ 65 years have a higher risk for pneumonia (Wenisch, 2011), no limitation of age is defined to recruit a meaningful number of test persons with diagnosed pneumonia.

4.2.2. Exclusion criteria

Patients who are suffering or have suffered from inflammatory lung -diseases other than pneumonia, like COPD (chronic obstructive lung disease), bronchial asthma, pleurisy, bronchial carcinoma, mediastinal tumour, squamous cell carcinoma, adenocarcinoma as escribed by Bösch (2014).
Patients who are smoking regularly.

Patients who have had a surgery of their lungs.

Patients who have had an osteopathic treatment of their lungs or chest.

4.3. Sample description

Patients visiting Dr. Martin Brachinger or Dr. Michael Stolz in their clinic in Frankenfels and Rabenstein are randomly asked (quasi randomized) to be tested by two osteopaths (Kathrin Grimmer and Reinhard Buchsbaum, qualified by training at the WSO/Vienna). To obtain a sufficient number of patients in the pneumonia-group some patients are also invited by the doctors (balanced randomized). The patients who verbally agreed to be tested receive a letter of consent with information about the testing procedure. By signing a consent form they agreed to the collection of their data (made anonymous). Afterwards the participants were once again informed verbally about the testing procedure. The individual participant is subsequently tested by the first osteopath regarding the motility and mobility of their lungs. The results are documented by the first osteopath on a binary scale for motility and a binary scale for mobility. The first osteopath leaves the room to make space for the second round of testing. The results of the second osteopath are also documented on a binary scale for motility and a binary scale for mobility. The two osteopaths also change in their order. After the testing each test person is questioned by a medical doctor about the exclusion- and inclusion criteria which are also checked in the documented medical history by the medical doctor. The pneumonia -group, which comprises the patients with medically documented pneumonia, and the comparison -group, which comprises the participants with no medically documented pneumonia, are formed for analysis (cf. figure 10).

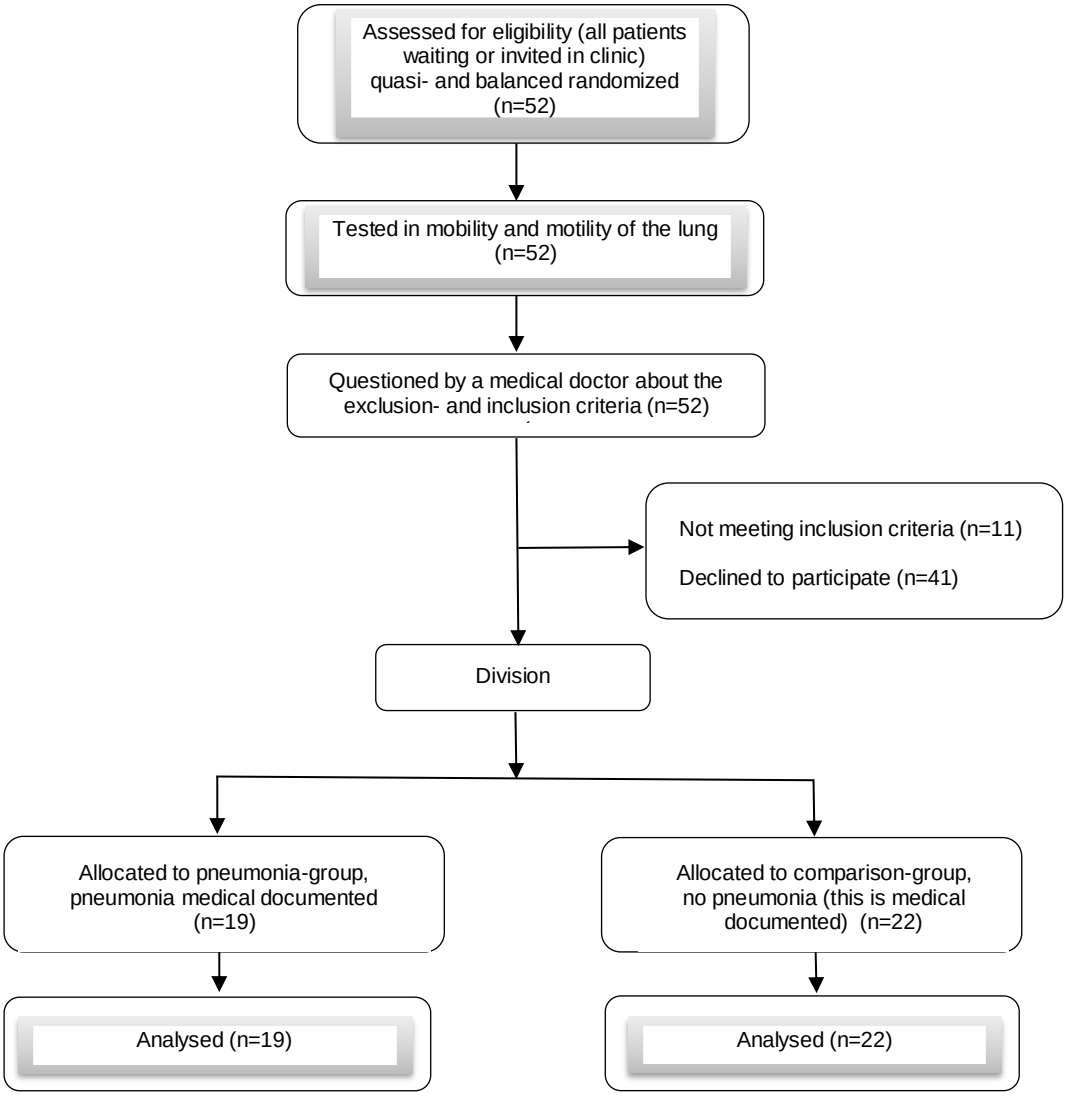

Figure 10: Flow-diagram of procedure

4.4. Data collection

Both examiners record their results on a binary scale with a “yes” or a “no” to the question, if there is a restriction in mobility and on a binary scale with a “yes” or a “no” to the question, if there is a restriction in motility of the lung. To examine whether there is some consistency of the results of the two testers to obtain useful results, a pre-test is carried out in October 2015 and the results are analysed. The pre-testing of 16 persons shows a consistency of 87.5%.

The percentage of 85% - 90% indicates a high level of examiner consistency to provide a high level of reliability (Kundel, 2003).

4.5. Validity and reliability

To achieve a good validity the author of the study endeavours to integrate quality criteria, which are commonly used in scientific studies.
Most participants are selected randomly but to achieve a better outcome in the pneumonia -group some persons are also invited by the doctors.
The examiners are blinded regarding the fact whether patients have had pneumonia or not, and regarding the test results of each other.
Further, the examiners are qualified to do the testing, because of their professional training and practical experience. According to Scherfer and Bossmann (2011, p. 242) a measuring instrument is valid if it measures what it is supposed to measure. Thus it can be assumed that the test methods applied in the present study are valid because of the testers' experience.
The measurement method is standardized (for each lobe one test for mobility, for each lobe one test for motility).
The patients who participate the testing are quasi-randomized and balanced-randomized because of the random selection of the day.
The visceral testing of lung -mobility and -motility is part of the training in osteopathic medicine and described by Barral and Mercier (2005) and Liem et al. (2014) and medical documentation is obligatory in general medical practice according to § 51 Abs. 1 Austrian Medical Practitioners Act (Ploier, 2010).
According to Scherfer and Bossmann (2011, p. 247) the reliability of a measuring instrument is given if repeated or simultaneous measurements produce the same results – presuming no changes regarding the person carrying out the measurements – and if existing differences can be detected by the measuring instrument. Since mobility and motility testing is not reliable (but nevertheless used in osteopathic medical practice), an independent tester is involved to minimize the source of error and to increase the specificity and sensitivity of the testing. Both testers have a high level of examiner consistency (cf. 4.4., p.27) to provide a high level of reliability (Kundel 2003).

4.6. Survey dates and study sites

Testing period: October 2015 – March 2016
The pre-testing day takes place at the beginning of October 2015.

There are two testing days at the beginning and at the end of November 2015, and one testing day at the end of January 2016 in Frankenfels/Lower Austria
The fourth testing day takes place in Rabenstein/Pielach/Lower Austria at the beginning of March 2016.

4.7. Cooperating persons

Cooperating persons for the implementation of the clinical study are Dr. Martin Brachinger/Frankenfels/NÖ and Dr. Michael Stolz/Rabenstein/NÖ, who provide their clinic premises for testing and do the medical documentation as well. Another cooperating person is Reinhard Buchsbaum, the second osteopath who does the testing.

4.8. Data processing and analysis

The data are analysed by means of the data processing program SPSS. The three central parameters (variables) mobility (yes/no), motility (yes/no) and pneumonia (yes/no) are based on a dichotomous/nominal measurement level. According to hypotheses A and B the coefficients of correlation are tested by phi. To evaluate the differences between patients with and without pneumonia with regard to their mobility (research question C) on the one hand and motility (research question D) on the other hand, the chi squared test is used. The test results of both testers are also used for calculation, so that the sample size (N) doubles. This method is approved in the concept of the study and therefore realized. The significance level is set at $\alpha=0.05$.
According to the statistical calculation to determine the right sample size for a significance level of $\alpha=0.05$ and a power of 80% each group should comprise 25 persons (i.e. 25 persons in the group with pneumonia, 25 persons in the group without pneumonia). According to the guidelines of the Danube University Krems a minimum of 16 persons per group should be analysed in any case.
In the present study the number of test persons of each group lies between the required minimum of 16 persons and the calculated 25 for a significance level of $\alpha=0.05$ (19 persons in the group medically documented pneumonia, 22 persons in the comparison group without medically documented pneumonia). Thus the descriptive statistic produces a valuable result.

5. Results

The evaluation of the testing results has been done with the help of the statistic program SPSS. Beside the results concerning the hypotheses there are additional results concerning the study population and the tester accordance.

5.1. Study population

There are 41 valid questionnaires, 19 of which have a “yes” regarding the question about past pneumonia, which has been veriefied by medical diagnosis. Three of the 41 questionnaires have a “yes” regarding the question about past pneumonia, however, this has not been verified by medical diagnosis. 19 questionnaires have a “no” regarding the question about past pneumonia and the medical history also confirms this “no”. In total 22 participants did not have medically diagnosed pneumonia in the past (group 1) and 19 participants did have medically diagnosed pneumonia (group 2) in the past (figure 11).

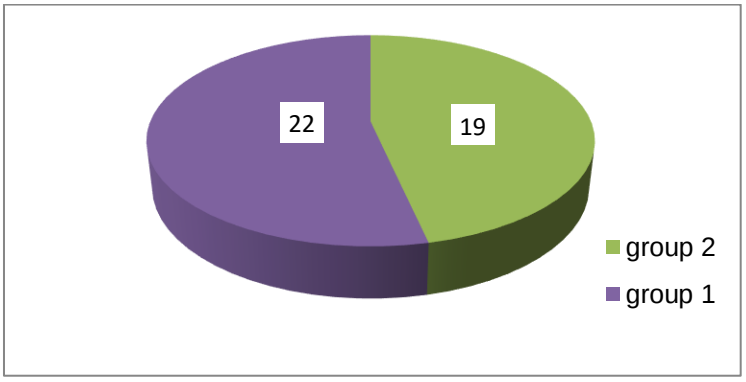

Figure 11: Participants with and without diagnosed pneumonia

19 study participants are male (46.3%) and 22 are female (53.7%) (figure 12).

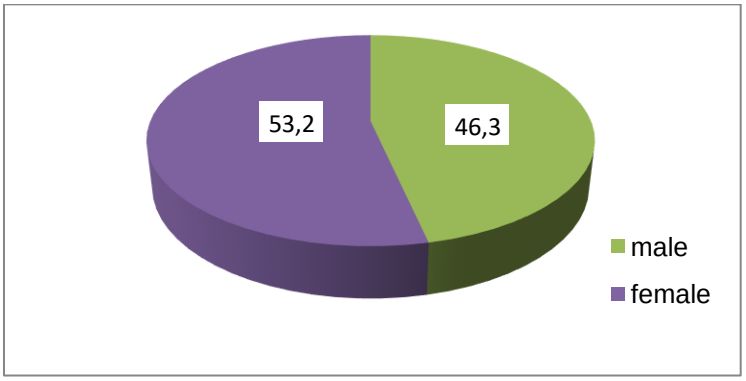

Figure 12: Gender distribution in %

Two participants are younger than 18 years, four persons are between 19 and 30 years old, ten persons are between 31 and 50 years old, 13 participants are between 51 – 65 years old, ten persons are between 66 and 80 years old, two patients are older than 81 years (figure 13).

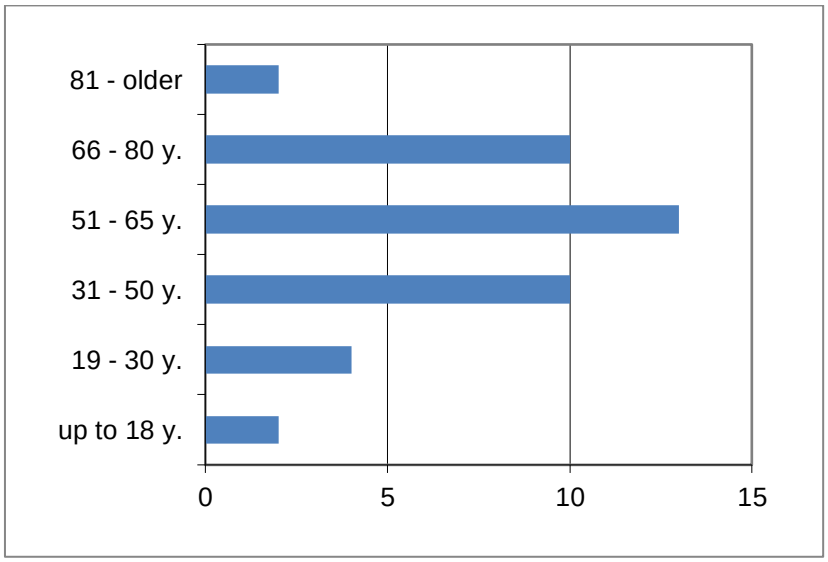

Figure 13: Age of participants (absolute numbers)

Gender-specific effects (χ^2=0.563; p=0.453) or age-specific effects (χ^2=4.528; p=0.478) related to pneumonia are not observed.

Among the patients with medically documented pneumonia in the past (N=19) most have had their pneumonia recently (2015, 2016) (n=8) or in the last five years (N=10) (figure 14).

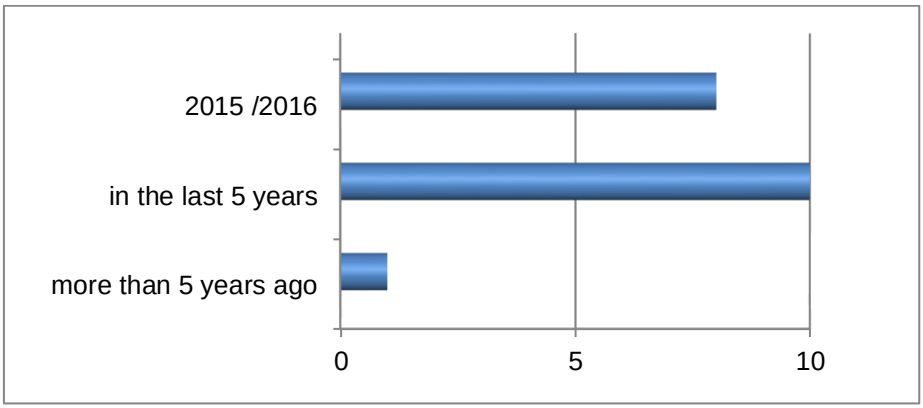

Figure 14: Time of pneumonia (absolute numbers)

5.2. Tester consistency

With the help of the Cohens-kappa-coefficient (K) the consistency of the two testers is proved. The consistency regarding mobility shows a Cohens-kappa-coefficient (K) of 0.892. The Cohens-

kappa-coefficient of motility is calculated with K=0.903. Both results fall in the category of “very good consistency” as described in the article of Grouven (2007, p.65), who defines this category with a K between 0.81 and 1.00.

5.3. Hypothesis A

There is a correlation between the mobility and motility of the lungs.

H_0 (A): There is no correlation between mobility and motility of the lungs.
H_1 (A): There is a correlation between mobility and motility of the lungs.
N=41 minus four patients, where the two testers did not correlate in their results are taken for evaluation. Thus the total sample size is reduced to N = 37 (table 1).

Table 1: Correlation of motility and mobility of total sample size (N=37)

		Restricted Mobility of N		
		YES	NO	Total
Restricted Motility of N	YES	10	9	19
	NO	2	16	18
	Total	12	25	37

The coefficient of correlation is tested with phi, which in this case is 0.443. With α=0.05 the significance value is p=0.007, which leads to the rejection of H_0 and to the verification of H_1: **There is a correlation between mobility and motility of the lungs.**
As shown in table 1, 26 (10+16) persons (70.3%) correlate in their mobility and motility (i.e. that a restricted mobility goes hand in hand with a restricted motility, and a good mobility goes hand in hand with good motility).
The test results of both testers are also used for calculation, so that the sample size (N=41) doubles to N=82 (table 2). (This method is approved in the concept of the study and therefore realized.)

Table 2: Correlation of motility and mobility of doubled total sample size (N=82)

		Restricted Mobility of N		
		YES	NO	Total
Restricted Motility of N	YES	22	20	42
	NO	6	34	40
	Total	28	54	82

The coefficient of correlation is tested with phi, which is in this case 0.394. With α=0.05 the significance value is p=0,000, which also leads to the rejection of H_0 and to the verification of H_1: **There is a correlation between mobility and motility of the lungs.**

5.4. Hypothesis B

Patients with and without pneumonia differ in correlation between mobility and motility of the lung.
H_0 (B1): Patients with pneumonia do not differ with regard to the correlation between mobility and motility of the lungs.
H_1 (B1): Patients with pneumonia differ with regard to the correlation between mobility and motility of the lungs.
H_0 (B2): Patients without pneumonia do not differ with regard to the correlation between mobility and motility of the lungs.
H_1 (B2): Patients without pneumonia differ with regard to the correlation between mobility and motility of the lungs.

5.4.1. Patients with pneumonia

N=19 minus one patient with pneumonia, where the two osteopaths do not correlate in their results, are taken for evaluation, which results in a sample size of N=18 (table 3).

Table 3: Correlation of motility and mobility in pneumonia group (N=18)

		Restricted Mobility of N		
		YES	NO	Total
Restricted Motility of N	YES	9	7	16
	NO	0	2	2
	Total	9	9	18

The coefficient of correlation is tested with phi, which is calculated as 0.354. With α=0.05 the significance value is p=0.134, which leads to the verification of H_0 (B1): **Patients do not differ with regard to the correlation between mobility and motility of the lung.**
The test results of both testers (independent of their consistency) are also used for calculation, so that the sample size (N=19) doubles to N=38 (table 4). (This method is approved in the concept of the study and therefore realized.)

Table 4: Correlation of motility and mobility in pneumonia group (N=38)

		Restricted Mobility of N		
		YES	NO	Total
Restricted Motility of N	YES	19	15	34
	NO	0	4	4
	Total	19	19	38

The coefficient of correlation is tested with phi, which is calculated as 0.343. With α=0.05 the significance value is p=0.034, which leads to the rejection of H_0 and to the verification of H_1 (B1): **Patients differ with regard to the correlation between mobility and motility of the lungs**.

5.4.2. Patients without pneumonia

N=22 patients without pneumonia are taken for evaluation (table 5). Three patients - where the osteopaths do not correlate in their results - are excluded, which results in a sample size of N=19.

Table 5: Correlation of motility and mobility in comparison group (N=19)

		Restricted Mobility of N		
		YES	NO	Total
Restricted Motility of N	YES	1	2	3
	NO	2	14	16
	Total	3	16	19

The coefficient of correlation is tested with phi, which is calculated as 0.208. With α=0.05 the significance value is p=0.364, which leads to the rejection of H_1 and to the verification of H_0 (B2): **Patients do not differ with regard to the correlation between mobility and motility of the lung.**

The testing results of both testers (independent of their consistency) are also used for calculation, so that the sample size (N=22) doubles to N=44 (table 6). (This method is approved in the concept of the study and therefore realized.)

Table 6: Correlation of motility and mobility in comparison group (N=44)

		Restricted Mobility of N		
		YES	NO	Total
Restricted Motility of N	YES	3	5	8
	NO	6	30	36
	Total	9	35	44

The coefficient of correlation is tested with phi, which is calculated as 0.199. With α=0.05 the significance value is p=0.186, which also leads to the rejection of H_1 and to the verification of H_0 (B2): **Patients do not differ with regard to the correlation between mobility and motility of the lungs.**

5.5. Research question C

Patients with and without pneumonia differ in their mobility.

R_0 (C): Patients with and without pneumonia do not differ with regard to their mobility.

R_1 (C): Patients with and without pneumonia differ with regard to their mobility.

N=41 minus two patients, where the two osteopaths do not correlate in their results, are taken for evaluation, which results in a sample size of N=39 (table 7).

Table 7: Cross table of pneumonia according to medical diagnosis and mobility

		Pneumonia according to medical diagnosis		
		YES	NO	Total
Restricted Mobility of total study sample	YES	9	4	13
	NO	9	17	26
	Total	18	21	39

For evaluation the chi-squared-test is used to calculate the significance value p=0.041, with α=0.05. This leads to the rejection of H_0 and to the verification of R_1: **Patients with and without pneumonia differ with regard to their mobility.**

5.6. Research question D

Patients with and without pneumonia differ in their motility.

R_0 (D): Patients with and without pneumonia do not differ with regard to their motility.

R_1 (D): Patients with and without pneumonia differ with regard to their motility.

N=41 minus two patients, where the two osteopaths do not correlate in their results, are taken for evaluation, which results in a sample size of N=39 (table 9).

Table 8: Cross table of pneumonia according to medical diagnosis and motility

		Pneumonia according to medical diagnosis		
		YES	NO	Total
Restricted Motility of total study sample	YES	17	3	20
	NO	2	17	19
	Total	19	20	39

For evaluation the chi-squared-test is used to calculate the significance value p=0.000, with α=0.05. This leads to the rejection of H_0 and to the verification of R_1: **Patients with and without pneumonia differ with regard to their motility.**

6. Discussion

6.1. Comparison with literature and importance for osteopathic medicine

The existing literature about visceral mobility and motility in the context of pneumonia has been researched thoroughly. However, the author of the present study cannot claim that the search has been complete since no literature in languages other than English and German has been used. In the context of the present study French literature might have been informative, but research in this language was not possible due to the author´s lacking language skills.

It is important to obtain more knowledge regarding the lung disease pneumonia, as is illustrated by various papers.

Alexander (2015) writes that the mortality rate for adults has decreased substantially over the past two decades and the age- and sex- adjusted mortality rate dropped from 13.5% to 9.5% between 1987 and 2005. The rate of paediatric outpatient visits for community acquired pneumonia has been reported to be 35 to 52 per 1,000 children 3 to 6 years of age and 74 to 92 per 1,000 children 2 years of age and younger. The hospitalization rate for children up to 18 years of age is about 201 per 100,000. But according to the data of Disease Control and Preventions, 525 infants and children up to 15 years of age still died as a result of pneumonia (or other lower respiratory tract infection) in 2006 in the United States (Alexander, 2015).

According to a statistical study of nine departments of internal medicine in Austria in 2011, 598 persons <65 years old and 1,358 persons ≥65 years old developed pneumonia. The 1,956 persons incurred additional costs of ~3,716 €/person because of longer hospitalization. Among a total population of 8,420,900 there was an incidence of 3.65 cases of pneumonia per 1,000 persons in 2011 (Wenisch, 2014).

Alexander (2015) writes that pneumonia is a substantial healthcare concern, ranking among the most common reasons for emergency department and outpatient visits, hospitalizations and death among both adults and children.

Therefore it is worthwhile also for osteopaths to learn more about import facts regarding the treatment of pneumonia. This suggests the need of basic research in the context of the disease. The present study is meant to be a contribution to osteopathic basic research concerning pneumonia, mobility and motility. Despite the fact that the author has done a proper literature research by using different scientific search engines which produced about 2000 studies, no study could be found that looked at pneumonia, mobility and motility and was comparable with the present study. It is possible that some studies exist in other languages than German and English, but due to the author´s lacking language skills they could not be found. So what is missing in English- and German-speaking osteopathic medicine is some basic research about visceral techniques in the context of pneumonia. Therefore, it was not possible do directly compare the results of the present study with those of a similar study. Nevertheless, there are studies that look at pneumonia and osteopathic medicine, which are summarized in the following paragraphs.

Some studies investigate the importance of osteopathic medicine with regard to pneumonia, such as the study of Hodge et al. (2012), which shows the correlation between lymphatic pump techniques and the improvement of the flow of lymph through the lymphatic system in rats with pneumonia. Both lymphatic pump technique (LPT) and sham treatment (light touch) reduced bacteria in the lungs compared to control. However, LPT cleared more bacteria compared to sham treatment. During the eight days of infection, control rats were unable to clear bacteria from their lungs. It is possible that the Propofol anaesthesia administered to both the LPT and sham treatment groups provided a protective effect during pneumonia. Propofol has been shown to protect against acute lung injury in rats by abrogating the microvascular leakage of water and protein in the lungs and suppressing oxidative and other inflammatory-mediated injuries. Also, light touch may have enhanced protection against pulmonary infection, though the mechanism is uncertain. Importantly, LPT significantly ($p=0.01$) reduced bacterial numbers compared to sham, suggesting LPT induces either a separate or additive protective mechanism compared to sham alone.

The study of Noll et al. (2010) shows the efficacy of osteopathic manipulative treatment (OMT) as an adjunctive treatment in elderly patients with pneumonia. The manipulation techniques of the OMT protocol were administered in the following sequences: thoracolumbar soft tissue, rib raising, doming of the diaphragm, myofascial release, cervical spine soft tissue, suboccipital decompression, thoracic inlet myofascial release, thoracic lymphatic pump, and pedal lymphatic pump. OMT shortened the length of hospital stay, duration of intravenous antibiotics and the incidence of respiratory failure and death relative to conventional care only.

The Intervention review of Yang et al. (2013) shows a good summary of chest physiotherapy - which includes also osteopathic manipulative treatment - for pneumonia in adults. The conclusion was that in six randomized trials none of the physiotherapy measures, including osteopathic manipulative treatment such as paraspinal inhibition, rib raising and myofascial release, improved mortality rates of adults with pneumonia. Neither conventional chest physiotherapy (versus no physiotherapy), nor active cycle of breathing techniques (versus no physiotherapy) and osteopathic manipulative treatment (versus placebo) increased the healing rate or chest X-ray improvement rate. Osteopathic manipulative treatment (versus placebo) and positive expiratory pressure (versus no physiotherapy) reduced the mean duration of hospital stay by 2.0 days respectively. Conventional chest physiotherapy and active cycle of breathing techniques did not. Positive expiratory pressure (versus no physiotherapy) reduced fever duration. Osteopathic manipulative treatment did not. Osteopathic manipulative treatment (versus placebo) reduced the duration of intravenous and total antibiotic treatment.

The studies mentioned above show that osteopathic medicine may play an important role in the treatment of pneumonia and the results of the present study could contribute to the endeavour to fill the gap of basic research regarding the application of visceral techniques in the context of pneumonia. One of the results of the present study is that mobility and motility of the lungs are correlated with each other (cf. 5.3., p.32), which is a useful fact to know in order to work efficiently. If a patient has a restricted mobility of the lungs, it is thus worthwhile to also consider the motility to really solve the problem. Similarly it is worthwhile to test the mobility of lungs when a restriction of motility is found, since both, a good motility and mobility are necessary for good pulmonary function and the health of the body. A restriction of motility is the first clinical sign of a visceral lesion. In case of children, who suffer a first damage if their respiratory tract, it is particularly important to test and if necessary improve the motility of the lungs to probably prevent all sorts of subsequent problems of pleuropulmonary infections, which could bother them as adults (Barral and Mercier, 2005, p.66).
The research efforts of the author also produces an old article of Riley (1919), who describes that during the deadly 1918-1919 Spanish influenza pandemic, osteopaths reduced patient mortality and morbidity by using lymphatic treatment techniques. Nearly 100 years ago, he already pointed to the importance of osteopathic work done in the context of pneumonia. It is thus surprising that not more scientific studies have been implemented since that time, despite the fact that Riley´s article is famous in the osteopathic world. It is possible that such studies exist, but maybe they cannot fulfil the criteria for scientific publishing? Big studies incur costs and if no economic benefits can be drawn from them, it is maybe difficult to find sponsors to finance big studies which also fulfil these criteria?

The presented study is a small one, due to the fact it has been done privately. Nevertheless the results are useful, because no English or German studies with similar content could be found among the available literature.
The result, that patients with and without pneumonia do not differ regarding the correlation between mobility and motility of the lungs (cf. 5.4., p.33, 34) is interesting for osteopathic practice. However, one cannot expect a restricted mobility if there is restricted motility of the lungs, or a restricted motility if there is restricted mobility of the lungs. It is obvious that every person has the capacity to improve his or her physical condition depending on their lifestyle and behaviour. This could lead to the assumption that a person with past pneumonia may have a restricted motility of the lung but not a restricted mobility because of his or her habit to exercise a lot or play a wind instrument, which has a training effect on pulmonary mobility. In the present study, for instance, eight patients with past pneumonia showed a restricted motility of their lungs but not a restricted mobility, as both osteopaths established through their testing. When the osteopaths talked to these persons after testing, some of them explained that they love to go hiking, biking or jogging

and one person mentioned that he plays the trombone in an orchestra. Similarly, the authors Barral and Mercier (2005) explain in their book that if someone does not exercise at all and exerts a sedentary work, the probability is high that adhesions develop at places, where the lung mobility is lowest (Barral and Mercier, 2005, p.54, 55). With these thoughts in mind, maybe more accurate results could have been achieved regarding the mobility of the lungs, had the questionnaire included a question concerning the amount of exercise or playing tough wind instruments.

The doubled testing result (even though different from the singled testing result) that patients with pneumonia differ with regard to the correlation between their mobility and motility from patients without pneumonia (cf. 5.4., p.33, 34) and the testing result, that patients with and without pneumonia differ in their mobility and motility (cf. 5.5., 5.6., p.36, 37) is also valuable for osteopathic medicine when treating pneumonia. As some studies mentioned above already show, osteopathic techniques like lymphatic pump technique and manipulative treatment have an effect on outcomes like reduction of bacterial count in the lung, duration of hospital stay, duration of intravenous and total antibiotic treatment and incidence of respiratory failure and death. However, considering the discovered knowledge even more emphasis could be placed on visceral treatment of the lungs. Maybe outcomes can be improved.

After the statistical analysis the author also wanted to assess the risk to have a restriction in mobility of the patients with and without medically diagnosed pneumonia in the past. The risk assessment shows that the risk of the persons with pneumonia is **two-times** (2.000) higher (table 8).

Table 9: Risk assessment of restricted mobility

Mobility:	Value	95% confidence Interval	
		lower	upper
Cohort analysis pneumonia according to med. diagnosis	**2.000**	1.054	3.795

Additionally, also the risk to have a restriction in motility is assessed among the two groups. The risk assessment shows that the persons with pneumonia have an **eight-times** (8.075) higher risk (table 10).

Table 10: Risk assessment of restricted motility

Motility:	Value	95% confidence Interval	
		lower	upper
Cohort analysis pneumonia according to med. diagnosis	**8.075**	2.149	30.343

The result, that patients with pneumonia have a two-times higher risk to have a restriction in mobility and an eight-time higher risk to have a restriction in motility of the lungs, is also helpful with regard to osteopathic testing of the lungs. It could indicate a different texture of the lung tissue due to the formation of invisible scars subsequent to an infectious process (Barral and Mercier, 2005), which causes the ranges of mobility and motility decreases. Along the same lines, Stone (1996) explains that the state of the smooth muscles takes has an influence on the function of organs and that an improvement of the muscle tone can improve the movement and blood supply of the organs (Stone, 1996).

It is interesting that nearly all persons (17 of 19) with medically documented pneumonia in the past (cf. 5.6., table 8, p.37) showed a restricted motility. This result reminds of the statement of Hebgen (2008) who says that reasons for the reduction of motility in frequency and its arhythmical movement are a loss of vitality of the organ, which is a sign of pathology, an articular restriction, a ptosis or a spasm of the viscera. Also Barral and Mercier (2005) state that infectious processes, post infectious residuals or other parenchymatous processes reduce the range of movement of an organ and fix the organ in Exspir. Examples for such processes are pneumonia, hepatitis, cirrhosis and nephritis (Barral and Mercier, 2005).

6.2. Limiting factors of methodology

The mobility- and motility “testing” has been done according to the descriptions of Barral and Mercier (2005) and Liem et al. (2014). Although these methods for assessing restrictions in mobility and motility of the lungs can certainly not be considered valid or gold standard methods. They are used nevertheless in osteopathic practice because no other valid methods are described or they are not even available. To minimize the source of error a second osteopath was acquired for retesting, but nevertheless the testing used in the present study is dependent on the skills of

the examiners. According to Hebgen (2008) a well-trained hand is able to perceive the motility of an organ, but even this is true, problems arise regarding the reproducibility of the study. For a good interrater reliability Bortz and Döring, 2006 explain that the Cohens-kappa-coefficient (K) has to lie between 0.60 and 0.75. Thus it was necessary to train the palpatory skills for several months in practice before the actual start of the study period. During the phase of palpatory training the two osteopaths also needed to give each other feedback regarding their palpation, which helped to recognize and reflect on individual mistakes to eventually improve the palpatory skills.

According to Hebgen (2008) the motility can be altered in its amplitude. The extent of movement can be reduced in one or in both directions. Also the rhythm of the movement may be altered in case of a disturbance: the dormancy between inspiration and expiration can be extended (Hebgen, 2008). Liem et al. (2014) says that a principle characteristic of a visceral osteopathic dysfunction is that the affected organs are palpably disturbed in their movement. With the applied testing methods a reduced or altered range of motility and mobility could be well recognized, in particular after thorough training of the palpatory skills for testing the lungs. However, after the pre-test session the author decided to use a global “yes” and “no” answer to the question whether there is a restriction in motility or mobility of the lungs to simplify the specific testing of the lungs and therefore to achieve better interrater reliability. Future studies in the field may even specify the testing to individual lobes of the lungs.

The patients were just quasi-randomized or balanced-randomized due to the circumstances and with the aim to recruit enough patients for each group. Maybe proper randomization would have produced a better random distribution of the sample population.

For the evaluation of hypotheses A and B the correlation coefficient phi was used and statistical calculations were also carried out with a double sample size. While the result was the same for hypothesis A, the result for hypothesis B was different when a double sample size was used in the pneumonia -group (cf. 5.4.1., p.33). The explanation is that phi is dependent on the sample size (i.e. the higher N, the more likely it is to get a significant result) and sensitive to the marginal cumulative distribution. In the present study calculations with a total sample size of N=38 (cf. 5.4.1., p.33) produced a significant correlation, while calculations for the subgroup (N=18) (cf. 5.4.1., p.33) produced a not significant correlation. Nevertheless, a value of phi=0.3 in principle suggests a relevant context according to Backhaus, Erichson, Weiber (2010, p. 315). This can be observed (although not significant) in the pneumonia group (phi=0.354), but not in the comparison group (phi=0.208) (cf. 5.4.2., p.34).

Since there was such a good tester consistency, calculations involving the double sample size were omitted for the research questions C and D, because they seemed to be not necessary,

According to the statistical calculation to identify the right sample size for a significance level of α=0.05 and a power of 80%, each group should comprise 25 persons (i.e. 25 persons in the group with pneumonia, 25 persons in the group without pneumonia). Despite the efforts of the medical practitioners and the examiners, it was not possible to recruit the required number of persons in time. Thus the pneumonia group comprised 19 persons, and the comparison group 22 persons (cf. 4.3., figure 10, p.27). At the end of the study period both groups were still bigger than the minimum required by the Danube-University-Krems. Nevertheless, it has to be pointed out that an exact number of 25 persons per group may have increased the informative value of this study.

Bösch (2014) states that the diagnosis of pneumonia by means of biochemical investigation requires a complete blood count with differential blood count, creatinin, electrolytes, transamninases, gGT and CRP or PCT. For hospitalized patients it is also recommended to do blood cultures for biochemical examination. For very symptomatic patients and hospitalized patients it is also appropriate to do a pulse oximetry and a blood gas analysis if available. It is also necessary to obtain proof of a possible lung infiltrate. For this purpose it is necessary to do an x-ray in two planes or a CT of the thorax. If only a horizontal x-ray image of the thorax is taken, pneumonia cannot be excluded for sure. However, radiological diagnostics are necessary, to ascertain the diagnosis of pneumonia, because case history, clinical examination and laboratory parameters do not represent a reliable basis for diagnosis (Bösch, 2014). To simplify checking of exclusion and inclusion criteria to recruit patients for this study, documented blood counts were not taken into account. Patients were tested during the time of clinical consultation and checking exclusion and inclusion criteria of the participants should not have cost very much extra time for the doctors. Another reason for not taking into account the blood counts of patients with medically diagnosed pneumonia in the past was that a documented blood count might not have been available in all cases.

6.3. Outlook

Summarizing the discussion above, the following aspects may improve future studies:
Literature and studies in other languages than English and German could be included.
More than two examiners could be acquired to reduce sources of error in testing. Ideally, examiners should be trained in testing well before the data is collected.
The questionnaire should include a question concerning the amount of sports and the amount of playing a tough wind instrument, which train the mobility of the lungs.
To obtain more accurate results the mobility and motility tests of the lungs may also focus more specifically on the individual lobes of the lungs.
A proper randomization would maybe produce a better random distribution of the sample population.

If it is necessary to multiply the sample because the testers do not have a good consistency of their results, a bootstrapping method or a comparable method may be used for resampling to obtain a meaningful result.

An exact number of 25 persons per group would probably increase the informative value of the study.

To ascertain the diagnosis “pneumonia” for attribution to the pneumonia group, it would be more accurate to also include the blood count in the questionnaire.

7. Conclusion

This blinded experimental basic study looks at the correlation between pneumonia and the mobility and motility of the lungs of patients with and without medically diagnosed pneumonia in the past. One group (N=22) without pneumonia and one group (N=19) with medically documented pneumonia were examined by two osteopaths regarding the mobility and motility of their lungs. The results show that there is a correlation of mobility and motility of the lung. Patients with and without pneumonia do not differ in correlation between mobility and motility, but the result of patients with pneumonia indicate that the condition represent a relevant context. Patients with and without pneumonia differ in their mobility, in that the patients with pneumonia have a two-time higher risk of having a restricted mobility and patients with and without pneumonia differ in their motility, in that the patients with pneumonia have an eight-time higher risk to have a restricted motility.

The aim of this experimental basic study in a parallel group design was to examine if there are differences of persons with and without pneumonia regarding the mobility and motility of their lungs and if pulmonary mobility and motility are present to the same extent (cf. 1.3., p.5). Therefore the research question was: what is the correlation between pneumonia and the mobility and motility of the lungs? Also a secondary research question arose: do patients with and without pneumonia differ in their mobility or motility (cf. 3., p.23)? The summarized results above show multiple answers to the questions. On the one hand, it is verified that there is a correlation of mobility and motility (cf. 5.3., p.32) and on the other hand, it is verified that patients with and without pneumonia differ in their mobility (cf. 5.5., p.36) and motility (cf. 5.6., p.37). Patients with (cf. 5.4.1., p. 33) and without (cf. 5.4.2., p.34) pneumonia do not differ with regard to the correlation between mobility and motility of the lungs, but in further consideration patients with pneumonia indicate that their condition represent a relative context (cf. 6.2., p.43).

The results of the present study are well applicable in osteopathic practice, because they are helpful regarding therapeutic considerations and choice of therapy.

The results are also useful to promote a better awareness of patients concerning the tissue tension of the lungs in the context of pneumonia, because osteopaths can provide better explanations if studies in the field are available.

More information about the visceral treatment of the lungs can be useful in osteopathic treatment of pneumonia and in discussions with medical doctors, which may help to better prevent pleuropulmonary infections.

Motility and mobility testing is a fundamental part in osteopathic medicine. Thus it is important to provide some basic research in this field. This will probably contribute to improving the credibility of osteopathic medicine in the medical world, if not immediately, at least in the long run.

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Figure 1: x-ray of a pneumonia diseased lung, p. 13, origin:
„https://upload.wikimedia.org/wikipedia/commons/b/be/Lobaerpneumonie.jpg”

Figure 2: rotation around the different axes of the different lobes of the lungs, p. 18, modified by
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Abbreviations

CAP	community acquired pneumonia
CRP	C-reactive protein
CT	computer tomography
gGT	gamma-Glutamyl-Transferase
HCAP	health care associated pneumonia
LPT	lymphatic pump technique
OMT	osteopathic manipulative treatment
PCT	Procalcitonin
WHO	world health organisation

Attachment A (Letter of information)

Liebe/r Patient/in!

Wenn Sie Ihre Wartezeit auf Ihr Arztgespräch überbrücken wollen, sind folgende Informationen für Sie interessant:

Hallo!

Mein Name ist Kathrin Grimmer, ich arbeite seit 11 Jahren als Physiotherapeutin und habe in dieser Zeit auch meine 7jährige Ausbildung zur Osteopathin an der Wiener Schule für Osteopathie gemacht. Zur Zeit bin ich mit der Erstellung meiner Masterthese beschäftigt, wobei es um die wissenschaftliche Erhebung eines in der Osteopathie oft benutzten Tests geht. **Dazu würde ich Sie um Ihre Mithilfe bitten**!
Ablauf der Testung:
Wenn Sie Lust haben bei dieser Studie mitzuwirken, bekommen Sie von der Ordinationsgehilfin einen Fragebogen ausgehändigt, auf den Sie bitte die für **den Patienten bestimmten Kästchen** ausfüllen. Bitte diesen Fragebogen sowohl zur osteopathischen Testung als auch zu Ihrem Arztgespräch mitnehmen.
In der Wartezeit auf ihr Arztgespräch kommen Sie in den Ordinationsraum und dort testen ich und mein Kollege Hr. Reinhard Buxbaum (ebenfalls Physiotherapeut und Osteopath) ihre Lunge auf die vorhandene Beweglichkeit. Die Testung wird manuell vorgenommen und benötigt maximal 5 Minuten.
Die erhobenen Daten bleiben anonym und werden für die statistische Auswertung verwendet.
Ich danke Ihnen recht herzlich für Ihre Mithilfe!

Alles Gute und viel Gesundheit
wünscht Ihnen Dipl.PT Kathrin Grimmer

Ich bin damit einverstanden, dass eine manuelle osteopathische Testung an meiner Lunge durchgeführt wird und dass die aufgenommenen Daten für eine statistische Auswertung anonym verwendet werden dürfen.

Unterschrift

Liebe/r Frau/Herr !

Hallo!

Mein Name ist Kathrin Grimmer, ich arbeite seit 11 Jahren als Physiotherapeutin und habe in dieser Zeit auch meine 7jährige Ausbildung zur Osteopathin an der Wiener Schule für Osteopathie gemacht. Zur Zeit bin ich mit der Erstellung meiner Masterthese beschäftigt, wobei es um die wissenschaftliche Erhebung eines in der Osteopathie oft benutzten Tests geht. **Dazu würde ich Sie um Ihre Mithilfe bitten**!
Sie wurden persönlich mittels einer medizinischen Suchmaschine aus einer Reihe von Patienten ausgewählt, weil Sie die Kriterien zur Teilnahme an der Masterthesenstudie erfüllen!
Diese findet am **22. Jänner 2016** in der Ordination von **Dr. Martin Brachinger** in Frankenfels statt!
Toll wäre es, wenn Sie **10 Minuten** erübrigen und in der Zeit von **12.15Uhr bis 16Uhr** in die Ordination kommen könnten um an der Studie teilzunehmen!
Ablauf der Studie:

Bitte melden Sie sich persönlich oder telefonisch (02725/400) in der Ordination an, um unnötige Wartezeiten zu vermeiden.
Die Ordinationsgehilfin wird Ihnen zum vereinbarten Termin einen Fragebogen aushändigen, auf den Sie bitte die für den Patienten bestimmten Kästchen ausfüllen.
Anschließend kommen Sie in den Ordinationsraum und dort können wir, mein Kollege Hr. Reinhard Buxbaum (ebenfalls Physiotherapeut und Osteopath) und ich, ihre Lungenlappen auf die vorhandene Beweglichkeit testen. Dies können wir aufgrund unserer langen Ausbildung mittels dem Feingespür unserer Hände durchführen. Danach füllt Hr. Dr. Brachinger gemeinsam mit Ihnen noch einen Fragebogen aus.
Die erhobenen Daten bleiben anonym und werden für die statistische Auswertung verwendet.
!!!Jeden Teilnehmer erwartet ein 5 Euro Gutschein vom Cafehaus Leeb und zusätzlich kann jeder Teilnehmer auch an der Verlosung zu einem Mittagessen im Voralpengasthaus Hofegger mitmachen!!!
Ich danke Ihnen recht herzlich schon im Voraus für Ihre Mithilfe und freue mich auf Ihr Kommen!

Alles Gute und viel Gesundheit
wünscht Ihnen Dipl.PT Kathrin Grimmer

Liebe/r Frau/Herr !

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Diese findet am **3. März 2016** in der Ordination von **Dr. Michael Stolz** in **Rabenstein a. d. Pielach** statt!
Toll wäre es, wenn Sie **10 Minuten** erübrigen und in der Zeit von **15 Uhr bis 18 Uhr** in die Ordination kommen könnten um an der Studie teilzunehmen!
Ablauf der Studie:
Bitte melden Sie sich unter meiner Telefonnummer **0660 3680 011** (Kathrin Grimmer) an, um unnötige Wartezeiten zu vermeiden.
Die Ordinationsgehilfin wird Ihnen zum vereinbarten Termin einen Fragebogen aushändigen, auf den Sie bitte die für den Patienten bestimmten Kästchen ausfüllen.
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!!!Jeden Teilnehmer erwartet ein 5 Euro Gutschein vom Cafe/Pub My Way in Rabenstein und zusätzlich kann jeder Teilnehmer auch an der Verlosung zu einem Mittagessen im Natur- und Seminarhotel Steinschallerhof mitmachen!!!

Ich danke Ihnen recht herzlich schon im Voraus für Ihre Mithilfe und freue mich auf Ihr Kommen!

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wünscht Ihnen Dipl.PT Kathrin Grimmer

Attachment B (Source data and documentation)

Patientennummer:

Persönliche Angaben

VOM PATIENTEN AUSZUFÜLLEN:

Geschlecht:

☐ männlich

☐ weiblich

Alter:

☐ 0 – 18 Jahre

☐ 19 – 30 Jahre

☐ 31 – 50 Jahre

☐ 51 – 65 Jahre

☐ 66 – 80 Jahre

☐ 81 und älter

VOM TESTENDEN OSTEOPATHEN AUSZUFÜLLEN:

Motilitätseinschränkung der Lunge:

☐ Nein

☐ Ja

Mobilitätseinschränkung der Lunge:

☐ Nein

☐ Ja

VOM ARZT AUSZUFÜLLEN:

Hat der Patient andere entzündliche Erkrankungen an der Lunge oder hat er diese gehabt ?

(wie z.B. Asthma, COPD, Pleuritis, bronchiale Karzinome, mediastinale Tumore, Plattenepithelkarzinom, Adenokarzinom, Bronchitis, u.a.)

☐ Ja

☐ Nein

Ist der Patient regelmäßiger Raucher?

☐ Ja

☐ Nein

Hatte der Patient Operationen an der Lunge?

☐ Ja

☐ Nein

War der Patient schon in osteopathischer Behandlung, insbesonders nach der stattgehabten Pneumonie?

☐ Ja

☐ Nein

Wenn bisher ☐ Nein dann weitere Punkte ankreuzen:

Pneumonie (Lungenentzündung) gehabt laut eigenen Angaben:

☐ Ja

☐ Nein

Pneumonie gehabt laut ärztlicher Dokumentation:

☐ Ja

☐ Nein

Zeitpunkt der letzten Pneumonie:

☐ In diesem Jahr (2015) ☐ Vor mehr als 5 Jahren

☐ In den letzten Jahren

VOM 2. TESTENDEN OSTEOPATHEN AUSZUFÜLLEN:

Motilitätseinschränkung der Lunge:

☐ Nein
☐ Ja

Mobilitätseinschränkung der Lunge:

☐ Nein

☐ Ja

Einverständniserklärung bei Minderjährigen
Ich, als Erziehungsberechtigter, bin damit einverstanden, dass eine osteopathische Testung an meiner/m minderjährigen/m Tochter/Sohn durchgeführt wird und dass die aufgenommenen Daten für eine statistische Auswertung anonym verwendet werden dürfen.

Unterschrift: ----------

Attachment C (Summary of test results)

Patient	Geschlecht	Alter	Pneu LEA	Pneu LÄD	Zeit Pneu	Moti 1 Ostp	Moti 2 Osti	Mobi 1 Osti	Mobi 2 Osti	Ausschluss
1	m	31-50	n	n	-	n	n	j	j	n
2	w	51-65	n	n	-	n	n	j	j	n
3	m	31-50	n	n	-	n	j	n	n	n
4	m	51-65	n	n	-	n	n	j	n	n
5	w	81-	n	n	-	n	j	j	j	N
6	m	19-30	j	j	in den letz.J	n	n	n	n	n
7	w	31-50	n	n	-	n	n	n	n	n
8	w	66-80	j	j	mehr als 5 J.	j	j	j	j	n
9	w	19-30	n	n	-	n	n	n	n	n
10	w	31-50	n	n	-	n	n	n	n	n
11	m	51-65	n	n	-	n	n	n	n	n
12	w	51-65	n	n	-	n	n	n	n	n
13	w	51-65	n	n	-	n	n	n	n	n

14	w	66-80	n	n	-	n	n	n	n	n
15	w	66-80	n	n	-	n	n	n	n	n
16	w	19-30	n	n	-	n	n	n	n	N
17	w	51-65	n	n	-	n	n	n	n	n
18	m	51-65	j	n	mehr als 5 J.	j	j	j	j	n
19	m	31-50	n	n	-	n	n	n	n	n
20	m	31-50	j	n	mehr als 5 J.	j	j	n	n	n
21	w	51-65	n	n	-	n	n	n	n	n
22	m	66-80	j	j	in den letz.J	j	j	n	j	n
23	m	51-65	n	j	2015	j	j	n	n	n
24	w	51-65	j	j	in den letz.J	n	n	n	n	n
25	m	66-80	j	j	in den letz.J	j	j	n	n	n
26	m	66-80	j	j	in den letz.J	j	j	j	j	n
27	m	51-65	j	j	in den letz.J	j	j	j	j	n
28	m	66-80	n	n	-	j	j	n	n	n
29	w	66-80	n	j	in den letz.J	j	j	j	j	n
30	m	31-50	j	j	2015	j	j	j	j	n

31	w	50-56	j	j	in den letz.J	j	j	j	j	n
32	w	50-56	j	n	in den letz.J	n	n	n	n	n
Patient	Geschlecht	Alter	Pneu LEA	Pneu LÄD	Zeit Pneu	Moti 1 Ostp	Moti 2 Osti	Mobi 1 Osti	Mobi 2 Osti	Ausschluss
33	w	31-50	j	j	2015	j	j	n	n	n
34	w	81-	j	j	2015	j	j	j	j	n
35	m	66-80	j	j	2016	j	j	j	j	n
36	w	31-50	n	j	2015	j	j	n	n	n
37	m	19-30	j	j	in den letz.J	j	j	j	j	n
38	w	31-50	j	j	in den letz.J	j	j	n	n	n
39	w	0-18	j	j	2015	j	j	n	n	n
40	m	0-18	j	j	2015	j	j	n	n	n
41	m	65-80	n	n	-	n	n	n	n	n

LEA…laut eigenen Angaben

LÄD…laut ärztlicher Diagnose

Pneu…Pneumonie

Moti…Motilitätseinschränkung

Mobi…Mobilitätseinschränkung

Attachment D (Abridged Version)

MOTILITY AND MOBILITY OF THE LUNGS AND THE CORRELATION WITH PNEUMONIA

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at Danube University Krems

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Short CV: Kathrin Grimmer was born in 1980 in Scheibbs/Austria. After her education at the academy of physical therapy in St.Pölten in the years 2000 – 2003 she worked in Vienna in the field of Neurology. At the same time she began her training at the Vienna School of Osteopathy. Since 2005 she has been self-employed in Persenbeug as a physiotherapist and osteopath.

Persenbeug, May 2017

ABSTRACT ENGLISH

OBJECTIVE: In osteopathic training the treatment of the lungs is a fundamental part. Aim of the study is to examine the connection between motility and mobility of patients with and without medically documented pneumonia in the past.

METHODS: This study is an experimental basic trial in a parallel group design. Different persons (N=41), quasi/balanced randomized, were tested by two osteopaths and surveyed by a doctor of medicine with a quantitative research method. The osteopaths were blinded of the fact whether a tested person has had pneumonia or not and of each other´s findings. With the help of the Cohen's kappa coefficient the consistency of the two testers was proved. The coefficients of correlation were tested by phi. To evaluate the differences between patients with and without pneumonia regarding their mobility and motility, the chi-squared test was used.

RESULTS: The significance value p=0.007 suggests that there is a correlation between motility and mobility of the lung. Patients with (p=0.354) and without pneumonia (p=0.208) do not differ regarding the correlation between mobility and motility. However, the significance value p=0.041 shows that the two groups differ with regard to their mobility and with p=0.000 also to their motility (α=0.05).

CONCLUSIONS: There is a correlation between mobility and motility of the lungs. Patients with and without pneumonia do not differ regarding the correlation between mobility and motility, but the results of patients with pneumonia indicate that the condition represent a relevant context. Patients with and without pneumonia differ in their mobility and motility, in that patients with pneumonia have a higher risk to have a restricted mobility and motility.

Keywords**:** motility, mobility, lung, pneumonia, correlation

Introduction

In osteopathic training the treatment of the lungs is a fundamental part. A distinction is made between the motility treatment and the mobility treatment. “Motility” is a slow, invisible movement with low amplitude, “mobility” is a movement caused by the pressure of the diaphragmatic pump [1]. due to the fact that a poor lung motility is the first clinical sign of a visceral lesion, recognizing and subsequently treating the restriction could probably prevent pleuropulmonal infections [2].

According to Stone [3] the state of the smooth muscles has an influence on the function of organs. An improvement of the muscle tone can improve the movement of organs.

Despite the fact that there are studies regarding the effectiveness of osteopathic treatment in cases of pneumonia, there seems to be a lack of information concerning basic studies about the visceral treatment of the lungs, especially with regard to pneumonia.

Therefore the present study could be considered as “trailblazer” for basic research studies concerning the correlation of pneumonia, mobility and motility in osteopathic medicine.

Material and Methods:

The present study regarding the correlation of pneumonia and osteopathic visceral tests, concerning lung- mobility and motility, is a blinded experimental basic study in a parallel group design. To answer the research question different persons were tested by an osteopath, retested by a second osteopath and surveyed by a doctor of medicine with a quantitative research method. The osteopaths were blinded of the fact whether a tested person has had pneumonia or not and they were blinded of the results of each other`s findings.

Inclusion criteria for patients:

- All patients who suffered from diagnosed pneumonia recently or years ago, but had not seen an osteopath since that time.
- All patients who had suffered from pneumonia at least once, which has been documented by medical diagnosis.
- All patients who have not suffered from pneumonia, which has been documented by medical diagnosis.
- Despite the fact that persons aged ≥ 65 years have a higher risk for pneumonia [4] no limitation of age was defined to recruit a meaningful number of test persons with diagnosed pneumonia.

Exclusion criteria for patients:

- Patients who are suffering from inflammatory lung diseases other than pneumonia, like COPD (chronic obstructive lung disease), bronchial asthma, pleurisy, bronchial carcinoma, mediastinal tumour, squamous cell carcinoma, adenocarcinoma [5].
- Patients who are smoking regularly.
- Patients who have had surgery of their lungs.
- Patients who have had an osteopathic treatment on the lung or chest.

Patients visiting two doctors of medicine in their clinics are randomly asked to be tested by two osteopaths. To obtain a sufficient number of patients in the pneumonia group some patients are also invited by the doctors. The patients who verbally agree to be tested receive a letter of consent with information about the testing procedure. The individual test persons are subsequently tested by the two osteopaths regarding the motility and mobility of their lungs. The results are documented in a binary scale. The two osteopaths also change in their order. After the testing the participant is questioned by the medical doctor about the exclusion and inclusion criteria and these criteria are also checked in the documented medical history of the patient. Subsequently the pneumonia group and the comparison group are formed for analysis. The aim of this experimental basic study in a parallel group design is to examine if there is a correlation between pneumonia and the mobility and/or motility of the lung.

Statistics:

The data is analysed by the data processing program SPSS. The three central parameters mobility (yes/no), motility (yes/no) and pneumonia (yes/no) are based on a dichotomous/nominal measurement level. The coefficients of correlation for hypotheses A and B are tested by phi. To evaluate the differences between patients with and without pneumonia with regard to their mobility (research question C) and motility (research question D), the chi-squared test is used. The test results of both testers are also used for calculation, so that the sample size (N) doubles. The significance level is set at $\alpha=0.05$.

Results:

There are 41 valid questionnaires, n=19 allocated to the pneumonia group, n=22 allocated to the comparison group.

19 test persons were male (46.3%), 22 were female (53.7%).

Most of the patients with medically diagnosed pneumonia in the past (n=19) had the disease recently (2015, 2016) (n=8) or in the last five years (n=10).

Most participants are older than 30 and younger than 80.

With the help of the Cohen's kappa coefficient (κ) the consistency of the testers is proved. The consistency regarding mobility shows a Cohen's kappa coefficient (κ) of 0.892. The Cohen's

kappa coefficient of motility is κ= 0.903. Both results are defined as “very good consistency” [6].

Hypothesis A

There is a correlation between the mobility and motility of the lung.

H_0 (A): There is no correlation, (α=0.05).

H_1 (A): There is a correlation, (α=0.05).

N=41 minus four patients, where the two testers did not correlate in their results, are taken for evaluation. Thus the total sample size is reduced to N=37.

The coefficient of correlation is tested with phi, which is in this case 0.443. With α=0.05 the significance values p=0.007, which leads to the verification of H_1: **There is a correlation** (Φ≠0).

The test results of both testers are also used for calculation, so that the sample size (N=41) doubles to N=82.

The coefficient of correlation is tested with Phi, which is in this case 0.394. With α=0.05 the significance values p=0.000, which also leads to the rejection of H0 and to the verification of H1: **There is a correlation** (Φ≠0).

Hypothesis B

Patients with and without pneumonia differ in correlation between mobility and motility of the lungs.

H_0 (B): Patients do not differ with regard to the correlation between mobility and motility of the lungs, (α=0.05).

H_1 (B): Patients differ with regard to the correlation between mobility and motility of the lungs, (α=0.05).

- **Patients with pneumonia**

N=19 minus one patient with pneumonia, where the two osteopaths do not correlate in their results, are taken for evaluation, which results in a sample size of N=18.

The coefficient of correlation is tested with phi, which is calculated as 0.354. With α=0.05 the significance values p=0.134, which leads to the verification of H_0: **Patients do not differ with regard to the correlation** between mobility and motility of the lungs.

The test results of both testers (independent of their consistency) are also used for calculation, so that the sample size (N=19) doubles to N=38.

The coefficient of correlation is tested with phi, which is calculated as 0.343. With α=0.05 the significance values p=0.034, which leads to the verification of H_1: **Patients differ refer to the correlation** between mobility and motility of the lung.

- **Patients without pneumonia**

N=22 patients without pneumonia minus 3 patients where the osteopaths do not correlate in their results, are taken for evaluation, which results in a sample size of N=19.

The coefficient of correlation is tested with phi, which is calculated as 0.208. With α=0.05 the significance values p=0.364, which leads to the rejection of H_1 and to the verification of H_0: **Patients do not differ with regard to the correlation** between mobility and motility of the lungs.

The testing results of both testers (independent of their consistency) are also used for calculation, so that the sample size (N=22) doubles to N=44.

The coefficient of correlation is tested with phi, which is calculated as 0.199. With α=0.05 the significance values p=0.186, which leads also to the rejection of H_1 and to the verification of H_0: **Patients do not differ with regard to the correlation** between mobility and motility of the lungs.

Research question C

Patients with and without pneumonia differ in their mobility.

R_0 (C): Patients do not differ with regard to their mobility, (α=0.05).

R_1 (C): Patients differ with regard to their mobility, (α=0.05).

N=41 minus two patients, where the two osteopaths do not correlate in their results, are taken for evaluation, which results in a sample size of N=39.

For evaluation the Chi-squared test is used to calculate the significance value p=0.041, with α=0.05. This leads to the verification of R_1: **Patients differ with regard to their mobility**.

Additionally, also the risk to have a restriction in mobility is assessed among the two groups. The risk assessment shows that the persons with pneumonia have a **two-time** (2.000) higher risk.

Research question D

Patients with and without pneumonia differ in their motility.

R_0 (D): Patients with and without pneumonia do not differ with regard to their motility, (α=0.05).

R_1 (D): Patients with and without pneumonia differ with regard to their motility, (α=0.05).

N=41 minus two patients, where the two osteopaths do not correlate in their results, are taken for evaluation, which results in a sample size of N=39.

For evaluation the chi-squared test is used to calculate the significance value p=0.000, with α=0.05. This leads to the verification of R_1: **Patients differ with regard to their motility**.

Additionally, also the risk to have a restriction in motility is assessed among the two groups. The risk assessment shows that the persons with pneumonia have an **eight-time** (8.075) higher risk.

Discussion:

The existing literature of visceral mobility and motility in the context of pneumonia has been researched thoroughly, but the search cannot claim to be complete. No literature in other languages than English and German has been considered.

Some studies look at the importance of osteopathic medicine with regard to pneumonia, such as the study of Hodge et al. [7], which shows the correlation between lymphatic pump techniques and the improvement of the flow of lymph through the lymphatic system in rats with pneumonia. Both lymphatic pump technique (LPT) and sham treatment reduced bacteria in the lungs compared to control. However, LPT cleared more bacteria compared to sham treatment.

The study of Noll et al. [8] shows the efficacy of osteopathic manipulative treatment (OMT) as an adjunctive treatment in elderly patients with pneumonia.

The Intervention review of Yang et al. [9] provides a good summary of chest physiotherapy, which also includes osteopathic manipulative treatment, for pneumonia in adults. Osteopathic manipulative treatment (versus placebo) and positive expiratory pressure (versus no physiotherapy) reduced the mean duration of hospitalization by 2.0 days respectively. Osteopathic manipulative treatment (versus placebo) reduced the duration of intravenous and total antibiotic treatment.

In his article Riley [10] describes that during the deadly 1918-1919 Spanish influenza pandemic, osteopaths reduced patient mortality and morbidity by using lymphatic treatment techniques.

The studies mentioned above show that the context of pneumonia is of importance in osteopathic medicine. However, basic research studies about visceral techniques in the context of pneumonia are still missing. Thus the results of the present study could contribute to the endeavour to fill this gap. One of the results of the present study is that mobility and motility of the lungs are correlated with each other, which is a useful fact to know in order to work efficiently. If a patient has a restricted mobility of the lungs, it is thus worthwhile to also consider the motility to really solve the problem. Similarly, it is worthwhile to test the mobility of the lungs if a restriction of motility is identified.

The result that patients with pneumonia differ in their mobility and motility compared to patients without pneumonia is again important for osteopathic medicine when it comes to treating pneumonia. As some of the above mentioned studies already show, osteopathic techniques like lymphatic pump technique and manipulative treatment have an effect on outcomes like

reduction of bacterial count in the lung, duration of hospital stay, duration of intravenous and total antibiotic treatment and incidence of respiratory failure and death. Considering the results of the present study even more emphasis could be placed on the visceral treatment of the lungs to see whether outcomes can be improved.

The result, that patients with pneumonia have a two-time higher risk to have a restriction in mobility and an eight-time higher risk to have a restriction in motility of the lungs, could indicate a different texture of the lung tissue due to the formation of invisible scars subsequent to an infectious process [1], which causes the mobility and the motility ranges to decrease. This supports the presumption that the state of smooth muscles has an influence on the function of organs and that an improvement of the muscle tone can improve the movement and blood supply of the organs [3].

The mobility and motility "testing" has been done according to the descriptions of Barral and Mercier [2] and Liem et al. [11]. Although these methods for assessing restrictions in mobility and motility of the lungs can certainly not be considered valid or gold standard methods, they are used nevertheless in osteopathic practice because no other valid methods are described or even available. To minimize the source of error a second osteopath was acquired for retesting, but nevertheless the testing used in the present study is dependent on the skills of the examiners. Therefore problems arise regarding the reproducibility of the study. To achieve a good interrater reliability [12] it was necessary to train the palpatory skills for several months in practice before the actual start of the study period. During the phase of palpatory training the two osteopaths also needed to give each other feedback regarding their palpation, which helped to recognize and reflect on individual mistakes to eventually improve the palpatory skills.

The patients were just quasi-randomized or balanced-randomized due to the circumstances and with the aim to recruit enough patients for each group. Maybe proper randomization would have produced a better random distribution of the sample population.

For the evaluation of hypotheses A and B the correlation coefficient phi was used and statistical calculations were also carried out with a double sample size. While the result was the same for hypothesis A, the result for hypothesis B was different when a double sample size was used. The explanation is that phi is depending on the size of sample (i.e. the higher N, the more likely a significant result) and sensitive to the marginal cumulative distribution. In the present study calculations with a total sample size of N=37 produced a significant correlation, while calculations for the subgroups (N=18, N=19) produced a not significant correlation. Nevertheless, a value of phi=0.3 in principle suggests a relevant context [13], as can be observed (although not significant) in the pneumonia group (phi=0.354), but not in the comparison group (phi=0.208).

Since there was such a good consistency among the testers, calculations involving the double sample size were omitted for the research questions C and D, because they seemed to be not necessary.

According to the statistical calculation to identify the right sample size for a significance level of α=0.05 and a power of 80% each group should comprise 25 persons. Despite of the efforts of the medical practitioners and the examiners it was not possible to recruit the required number of persons in time. Thus the pneumonia group comprised 19 persons and the comparison group 22 persons. It has to be pointed out that an exact number of 25 persons per group may have increased the informative value of this study.

Conclusion:

This blinded experimental basic study looks at the correlation between pneumonia and the mobility and motility of the lungs of patients with and without medically diagnosed pneumonia in the past. One group (N=22) without pneumonia and one group (N=19) with medically documented pneumonia were examined regarding the mobility and motility of their lungs by two osteopaths. The results show that there is a correlation of mobility and motility of the lung. Patients with and without pneumonia do not differ with regard to the correlation between mobility and motility, but it has to be said that the result of patients with pneumonia indicate that the condition represent a relevant context. Patients with and without pneumonia differ in their mobility, in that the patients with pneumonia have a two-time higher risk of having a restricted mobility and patients with and without pneumonia differ in their motility, in that the patients with pneumonia have an eight-time higher risk to have a restricted motility.

The results of the present study are well applicable in osteopathic practice, because they are helpful regarding therapeutic considerations and choice of therapy. More information about the visceral treatment of the lungs can be useful in osteopathic treatment of pneumonia and in discussions with medical doctors, which may help to better prevent pleuropulmonary infections.

Motility and mobility testing is a fundamental part in osteopathic medicine. Thus it is important to provide some basic research in this field. This will probably contribute to improving the credibility of osteopathic medicine in the medical world, if not immediately, at least in the long run.

Disclosure:

The author has no personal financial or institutional interest in any of the drugs, materials, or devices described in this article.

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