The Influence of Rib Raising on the Lung Function of Chronic Obstructive Pulmonary Disease Patients

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Sworn Declaration

I hereby declare that this master's thesis is entirely my own work.

All passages that have been copied or paraphrased from published or unpublished works by other authors have been clearly and correctly indicated as such. All sources and resources that I used in this work have been named. A work with the same content has not been presented to any other examination board either here or abroad.

The work is identical with the work evaluated by the assessor.

Güstrow, 01.06.2010 Susann Friedrich

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Without the help and support of those mentioned here I would never have been able to write this thesis.

Abstract

Keywords: Rib raising, osteopathic technique, COPD, lung function, plethysmography

Aim: Rib raising is described in the osteopathic literature as a technique for the treatment of lung function disorders and diseases such as pneumonia. Scientific proofs of the effectiveness of the technique do not exist. The aim of the investigation is to analyse whether the osteopathic technique of rib raising influences the lung function respective the lung function parameters VC, $FEV_1$and the ratio FEV_1/VC of COPD patients.

Research Question: Can the parameters of the lung function VC, $FEV_1$and the ratio FEV_1/VC of COPD patients be influenced by the application of rib raising?

Methodology: The present study has the experimental research design. The patients were simply blinded and with matching assigned to a treatment and a placebo group. The practice assistants who conducted the measurements of the lung function were blinded respective the group assignment. A sample size of twenty patients per group was aimed for. After determination of the inclusion and exclusion criteria fifty-one patients were invited to participate in the study. Finally twenty patients in each group took part in the study. Following the initial measurement of the lung function the patients of the treatment group were treated with rib raising those of the placebo group with a placebo treatment by the osteopath. The final measurement of the lung function followed the medical control appointment. In the statistical evaluation the homogeneity of the groups respective the matching variables was first tested. Respective the variable COPD-grade the groups were only conditionally homogenous. The properties were shown to be normally distributed with the Kolmogorov-Smirnov-Test. Following this, the t-test was applied in order to determine the differences in the lung function parameters Pre and Post treatment.

Results: The null hypothesis must be accepted and the alternative hypothesis rejected as the values of the lung function parameters after the treatment showed no significant change to those before the treatment.

Conclusion: Rib raising produced no influence on the lung function of the COPD patients in this sample. No generalisation for all COPD patients can be made as the

sample for this study was selected from the patient pool of one practice and was therefore not representative.

Contents

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Lists of Abbreviations

e.g.	for example
e.V.	eingetragener Verein (registered charity)
et al.	et alii (lat.; “and others”)
mod.	modified
p.	page
s.	see

1 Introduction

According to the World Health Organisation (WHO, 2009) 80 million people worldwide suffer from chronic obstructive lung disease (COPD). In 2005 more than 3 million people died from COPD (WHO, 2009). COPD is the fourth most common cause of death worldwide (Richling, 2006). In Europe between 4% and 10% of the population over 45 suffer from a clinically significant COPD (European Lung Foundation, 2009).

The European Lung Foundation says that COPD is one of the widespread diseases that burden the national health budgets of Europe. This will be discussed in more detail in the capital on epidemiology and social medicinal aspects. (s. 2.2 and 2.3)

In my daily osteopathic practice I see patients with restrictions of the respiratory functions through asthma, bronchial and chronic obstructive lung diseases and the resulting reduction in physical performance as described by Vogelmeier et al. (2007). These patients have an, at least, subjective feeling of improvement after treatment and believe that they are able to breathe more freely.

The European Lung Foundation (ELF, 2009) states that COPD cannot be completely cured. However the available treatment possibilities can prevent a worsening of COPD and relieve the suffering (ELF, 2009). The oxygen levels in the blood are substantially reduced by severe cases of COPD. An oxygen supply in indicated for these patients (ELF, 2009). Other medicinal therapies consist of the prescription of antibiotics in the case of bronchial infections, mucolytica, and anti-oxidants (ELF, 2009). According to the COPD recommendations the non-medicinal treatment consists of physical training, physiotherapy, auxiliary methods to eliminate secretions and dietary advice. Physiotherapy is applied with the aim of improving the thorax flexibility and thereby to improve the gas exchange, the drainage and the secretion elimination. There have however been no randomised controlled investigations to date that prove that this effect can be achieved through physiotherapy (Vogelmeier et al., 2007, p e19f).

1.1 Objects and Purpose of the Thesis

COPD patients mostly experience a subjective feeling of improvement following an osteopathic treatment and believe that they can breathe more freely. However I could not explain, which of the treatment I had applied had a positive effect on their ability to breathe. My researches in this question led me to the conclusion that although osteopathic applications are prescribed for the treatment of lung dysfunctions these have not been adequately investigated in terms of their effectiveness. So for example the technique of rib raising was already described by Barber in 1896 as a technique for the treatment of patients with pneumonia (s. 4, Noll et al.). Hebgen described this technique as, amongst other things, stimulation for the sympathicus of the lungs, however I could not find any scientific proof of the effectiveness of this technique and so the subject of this thesis was born.

Beyond that my investigations revealed that various osteopathic studies address the question as to whether osteopathic treatment or carrying out osteopathic techniques have an influence on the lung function of COPD patients. I searched in the following resources: Med Line, Cochrane Library, Scirus, Osteopathic Research Web, Ostmed, Donauuniversität Krems Library, Journal of the American Osteopathic Association (JAOA), International Journal of Osteopathic Medicine (IJOM), Osteopathic Medicine and Primary Care (OMPC) and the Journal of Manipulative and Physiological Therapeutics (JMPT). I found several studies of which I wish to briefly describe three with varying results here and then in greater detail in chapter 3.

Grabner (2007) describes the influence of osteopathic treatment on the lung function of COPD patients. These were tested with a spirometer. The lung function was measured in terms of the parameters vital capacity (VC) and the forced expiratory volume in one second (FEV_1) (s. 2.7.3). The patients of the intervention group displayed a slight improvement in comparison to the control group, the difference in values in however not significant (Grabner, 2007).

Noll et al. (2008) conducted a randomised controlled clinical study in which seven standardised osteopathic techniques were utilized on COPD patients. The measurement of the lung function was carried out with body plethysmography. The lung function was defined by 21 different parameters. The evaluation displayed significant change in six of the 21 parameters measured (Noll et al., 2008). According to Noll the study was badly designed because it was not possible to judge the effect of the individual techniques, therefore she made the following recommendation:

> *"Future studies should evaluate the effect of individual techniques on the respiratory organs, because each individual technique can have a separate positive or negative effect."* (Noll et al., JAOA vol. 108 Nr. 5, May 2008, p. 257)

Noll et al. (2009) investigated, in a further study, the effect of five individual osteopathic techniques respective the lung function of COPD patients. After the application of each technique the respiratory therapists measured a slight worsening of the lung function of the COPD patients in which however rib raising provoked the smallest change. Each technique affected a different parameter of the lung function (Noll et al., 2009).

1.2 Research Question, Aims, Hypothesis and Relevance

In this study I have followed the recommendation of Noll et al. (2008) in that I only examined the effect of one of the seven techniques on the lung function of COPD patients. The chosen osteopathic technique is the rib raising technique (s. 4). So I wish to investigate whether the application of this technique on COPD patients has an effect on their lung function (s. 2.7). This wish generates my research question, which is as follows:

Can rib raising influence the lung function of COPD patients?

The aim of the investigation is to analyse whether the utilization of the osteopathic technique rib raising on COPD patients influences their lung function respective the lung function parameters VC and FEV_1 and the ratio FEV_1/VC (s. 2.7.3)

Hypothesis

Null Hypothesis:

The application of the osteopathic technique rib raising on COPD patients does not influence their lung function respective VC, FEV_1 and the ratio FEV_1/VC.

Alternative Hypothesis:

The application of the osteopathic technique rib raising on COPD patients influences their lung function respective VC, FEV_1 and the ratio FEV_1/VC.

The Relevance for Osteopathy:

The clarification of this question contributes, in my opinion, to raising the predictability respective efficiency and safety of the clinical intervention using osteopathic techniques.

The Relevance for Patients:

According to Sommerfeld (2006) this leads to more predictability of success for patients in the future and the avoidance of purposeless treatments. The selection of adequate therapies can also lead to a reduction of treatment costs.

1.3 Methodology and Structure of the Work

In order to answer my research question I took up contact with the pulmonology practice in Güstrow. Dr Ammenn was prepared to offer me the help of his team and rooms to conduct my investigation. I decided to conduct a simple blind clinical study (s. 5.1.1) and asked the COPD patients who came to the practice for control examinations whether they would take part in the study.

Eventually 40 patients were co-opted who through matching (s. 5.1) were allocated to the treatment and placebo groups. The patients in the treatment group were treated with rib raising and those in the placebo group with a placebo treatment (s. 5.3 and 5.4). Dr Ammenn's team carried out the measurement of the lung function. (s. 5.2)

In the following, I will first describe the basics of COPD after which I will outline some of the existing studies on the subject osteopathy and COPD and the rib raising technique in the context of the osteopathic principles. In chapter 5 I explain the investigation methodology in detail and the results of the investigation in chapter 6. The discussion of the results (s. 7) as well as the summary and conclusions (s. 8) close the work.

2 Chronic Obstructive Pulmonary Diseases: The Basics

This chapter contains the definition, epidemiology, social medicinal aspects, anatomy and physiology, aetiology and pathogenesis as well as the diagnosis and therapy of COPD in the relevant depth for this thesis.

2.1 Definition

COPD is the abbreviation for chronic obstructive pulmonary disease. The WHO defines COPD as follows:

> *„… a lung ailment that is characterized by a persistent blockage of airflow from the lungs. It is an under-diagnosed, life-threatening lung disease that interferes with normal breathing and is not fully reversible. The more familiar terms of chronic bronchitis and emphysema are no longer used; they are now included within the COPD diagnosis”* (WHO, 2009).

The Global Initiative for Chronic Obstructive Pulmonary Disease (GOLD, 2009) defines COPD as an avoidable and treatable illness. COPD is characterised by obstruction of the airways (constriction or blockage) that is normally progressive and not completely reversible. These obstructions are linked with abnormal inflammatory behaviour of the lungs in reaction to damaging particles or gases (GOLD, 2009, p. 6).

Beers et al. define COPD as follows:

> *“An illness that is characterised by chronic bronchitis or emphysema and in general, progressive respiratory channel obstruction. It can be accompanied by hyper-responsiveness of the airways and be partially reversible”* (Beers et al., 2000, p. 694).

The authors are in agreement with their definitions. The ELF (2009) points out that this state of illness was earlier referred to as chronic bronchitis or emphysema.

In the relevant literature COPD is also called Chronic Obstructive Lung Disease or COLD for short (Beers et al., 2000, p. 694).

2.2 Epidemiology

According to the WHO 80 million people worldwide suffer from mild to severe COPD. In 2005 more than 3 million people died as a result of COPD, that is 5% of all deaths worldwide (WHO, 2009).

In Europe between 4% and 10% of all people over 45 suffer from a clinically relevant COPD (ELF, 2009). In 2005 COPD was the cause of death of 4.1% of the men and 2.4% of the women (ELF, 2009).

Further, Siafakas et al. (1995) presume that in Europe only 25% of all COPD cases are known.

2.3 The Social Medicinal Aspects of COPD in Europe

According to the ELF (2009), alone in Europe, the national health budgets are burdened each year with the following costs by the most common lung diseases:

-COPD:	38.7 Billion €
-Asthma	17.7 Billion €
-Pneumonia	10.1 Billion €
-Tuberculosis	2.1 Billion €

COPD is the most common cause for days off due to illness amongst the lung diseases. Within the European Union 41 300 work days per 100 000 inhabitants are lost each year. The productivity loss in Europe caused by COPD reaches a total of € 28.5 billion per year (ELF, 2009).

Richling says that:

> "*COPD has an enormous socio-economic significance. The total economic cost of chronic bronchitis was estimated to be around 6 billion Euro per year for 1991 and 8.4 billion per year for 1998.The economic costs in Germany in connection with COPD were, according to a health insurance company cost survey, 3027 € per patient per year for 2001 […]*" (Richling, 2006, p. 3).

2.4 Anatomy

In order to make the pathophysiology of COPD and the theory of the mode of action of rib raising easier to understand the anatomy of the lungs and the chest will be described in the following as far as necessary. I shall begin with the trachea. I do not describe the upper airways, as they are not relevant for this study.

2.4.1 Lungs

The trachea (windpipe) is a large diameter connective tissue pipe. At the level of the fifth rib the trachea divides into the left and right primary bronchi. The primary bronchi enter the lungs on both sides. In total the bronchi divide into 23 generations. The primary bronchi are followed by the lobar or secondary and segmental or tertiary bronchi. Under reduction of their diameter the bronchi branches are further divided into the bronchioles (Aumüller et al., 2007, p. 541f) and these into the terminal bronchioles. From the 17^{th} branching on they are know as respiratory bronchioles each of which has an alveoli, which are called alveoli ducts from the 20^{th} branching onwards. The alveoli ducts are thickly covered with alveoli (Thews et al., 1991, p. 220). The sections from the secondary bronchi to the terminal bronchioles are the conductive part of the bronchial tree. The respiratory part consists of the respiratory bronchioles and the alveolar sacs (Aumüller et al., 2007, p. 541f).

The lumen of the trachea is held open by cartilaginous rings imbedded in its walls. From the bronchi onwards the cartilage is irregularly embedded (cartilaginous plates). There are smooth muscle fibres beneath and between the cartilaginous rings and plates that make possible changes in the diameter of the bronchi. Bronchioles and the following segments have no cartilaginous stiffening (Thews et al., 1991, p. 220). The lumen is here stabilised by elastic fibre nets radiating through the walls. The continuous smooth muscle fibre layer actively regulates the width of the bronchi lumen (Aumüller et al., 2007, p. 542).

The following illustration shows the construction described above:

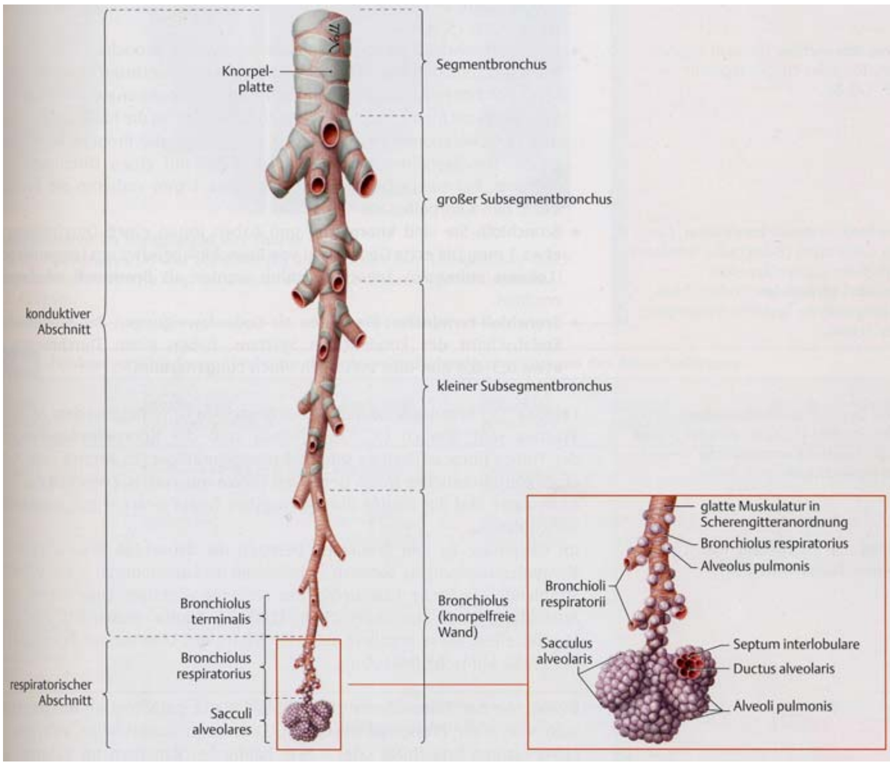


Illustration 1: Intrapulmonary Bronchial Tree, representation of the anatomical and functional sections with cutaway enlargement of the respiratory section.

Source: Aumüller et al: "Atomie Duale Reihe, 2007, Thieme p. 541

The conductive section is lined with epithelial cilia (Aumüller et al., 2007, p. 542).

The alveoli in the respiratory section are the most important part of the lungs for the gas exchange. The alveoli are thin walled, spherical sacks that constitute the sponge like, very elastic consistency of the lungs. A lung contains 300 to 400 million alveoli. Their fine structure offers the perfect conditions for the gas exchange between the air and the capillary blood (Aumüller et al., 2007, p. 542).

The lungs (pulmo) lie in the chest (thorax) and consist of a left and right lung. Each lung has the shape of a rounded, truncated cone with a convex apex (apex pulmonis) and with a concave base (basis pulmonis), which sits on the diaphragm. The position of the chest varies with the breathing phase. The lung tissue is surrounded by the pleura visceralis and the pleura parietalis (serous membranes) and is connected by these to the muscle structure of the thorax (Aumüller et al., 2007).

The innervation of the lung parenchyma is provided by the efferent and parallel afferent fibres of the vegetative nervous system (VNS). The parasympathetic parts of the VNS that serves the lungs are the rami bronchiales of the vagus nerve, the sympathetic parts are the rami pulmonales of the truncus sympathicus which stems out of the ganglion stellatum and the upper thoracic ganglion (Th 2 – Th 5). Afferent fibres mostly run along the vagus nerve.

The truncus sympathicus lies in the thorax with its ganglia close to the vertebral joints as is shown in a cut away in the following diagram. Emphasised in red: truncus sympathicus. Circled in green: the ganglia in front of the vertebral joints.

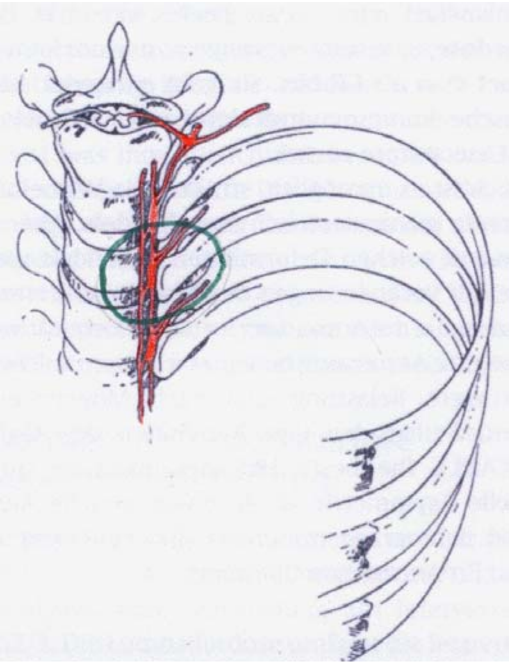


Illustration 2: Cutaway of the truncus sympathicus in front of the vertebral joints.
Source: mod. from Mitchell et al., 2005, .p. 16

2.4.2 Thorax (Chest)

The skeletal elements of the thorax are the thoracic vertebrae, the sternum or breastbone and the twelve pairs of ribs. The thoracic vertebrae and the sternum provide the vertical structure and are joined together by the rib pairs like semi-circular spans. The ribs are connected to the vertebrae and the sternum by joints, which enables the change of volume of the thorax during breathing (Aumüller et al., 2005, p. 264).

The rib heads are articulated on the thoracic vertebral column dorsolateral on the body of two neighbouring thoracic vertebrae (articulatio captis costae). The tubercula costae of the 1st to 10th ribs also form a joint with the transverse processes of the same vertebrae (articulatio costotransversaria) (Aumüller et al. 2005, p. 269). The following diagram illustrates this construction.

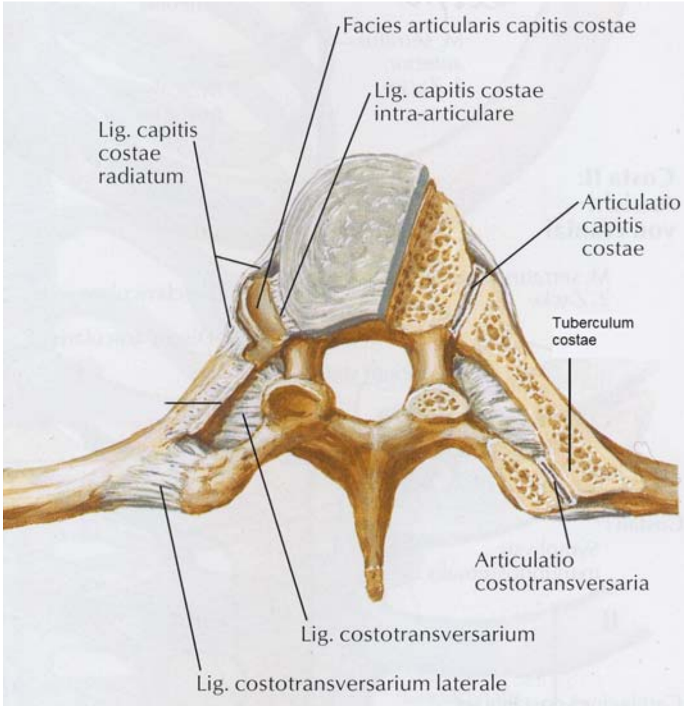


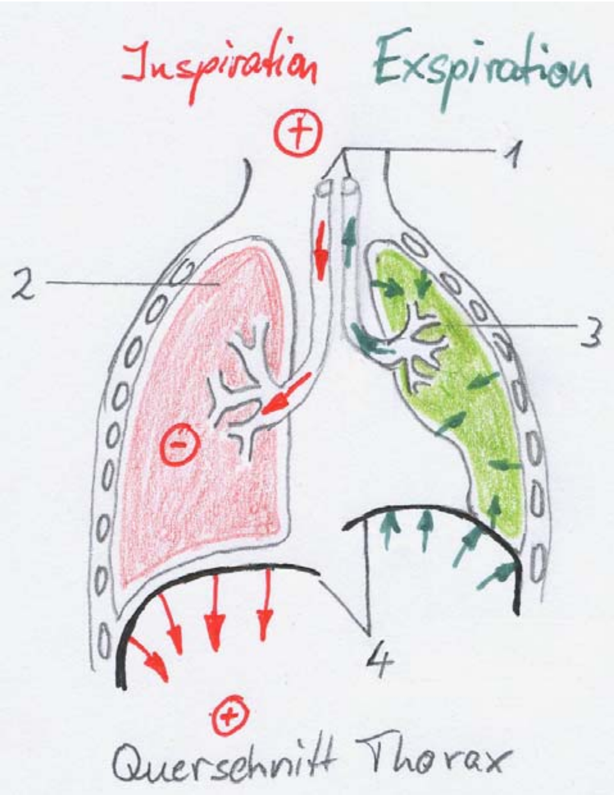
Illustration 3: The Rib Vertebrae Joint
Source: mod. from Netter, 2000, p. 172

2.5 Physiology

In this section the physiology of the respiration and the rib movement is described as far as necessary in order to understand this work.

2.5.1 Physiology of the respiratory process

The expansion and dilation of the chest form the basis of the respiratory mechanism (Kapandji, 1999, p. 144). The lungs tend to constrict so a certain level of tension exists on the surface of the lungs. In order to overcome this tension effort must only be expended during inspiration (breathing in) (Schmidt, 1997, p. 575). During the inspiration phase the volume of the chest is increased by the contraction of the diaphragm, the intrapulmonary pressure becomes negative with respect to the external air pressure and the abdominal cavity and so air flows in through the trachea (Kapandji, 1999, p. 144). The process of expiration (breathing out) normally proceeds passively due to the retraction of the lungs. The volume of the chest is reduced through the relaxation of the diaphragm and the retraction of the lung tissue and the air flows out. The following diagram is a schematic illustration of this process.



1	Trachea
2	Pulmo dexter
3	Pulmo sinister
4	Diaphragm

Illustration 4: Representation of the respiratory process

Source: Own representation based on Schmidt, 1997, p. 575

The vegetative nervous system controls the width of the bronchi. The influence of the sympathicus during inspiration leads mainly to an atony of the smooth bronchial musculature, which causes a widening of the bronchi (bronchodilatation). In the following expiration phase the parasympathicus causes a contraction of the bronchial musculature, which leads to a narrowing of the bronchi (Schmidt, 1997, p. 567).

2.5.2 Physiology of the Rib Joints

The movements of the rib joints are unavoidably coupled. As the following diagram shows this movement can only take place around a mutual axis (Kapandji, 1999, p. 130).

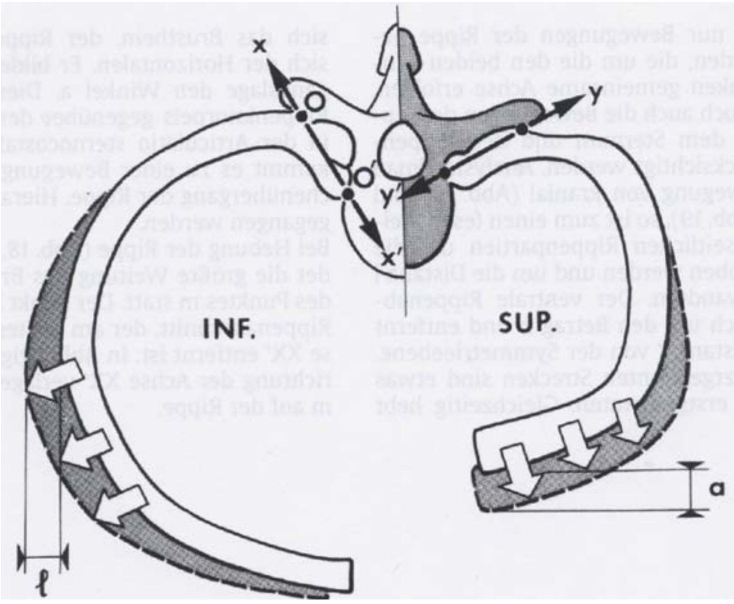


Illustration 5: Representation of the rib movement in its joints

Source: Kapandji, 1999, p.131

The right hand side of the diagram shows the movement of the cranial ribs whereas the left hand side the movement of the caudal ribs. The mutual axis around which the movement takes place is designated left with XX’ and right with YY’. The direction of the rib movement is determined by the gradient of the axis to the sagital plane. In the left hand side of the diagram it can be seen that during inspiration the lifting of the caudal rib mainly leads to an expansion of the chest of distance l in the transversal plane. A lifting of the cranial rib during inspiration (Right hand side of the diagram) cause an enlargement of the sagital chest diameter by a distance of a (Kapandji, 1999, p. 130).

2.6 Aetiology, Pathogenesis and Long-Term Consequences of COPD

Chronic bronchitis and emphysema are brought together under the concept COPD according to the WHO definition from above (WHO, 2009). In the following this concept will be examined in detail in order to demonstrate the pathogenesis of COPD.

2.6.1 Bronchitis

Bronchitis is an inflammation of the bronchi, which can be either acute or chronic. (Urban & Schwarzenberg, 1993, p. 234).

2.6.1.1 Acute Bronchitis

According to Beers et al. acute bronchitis is an acute inflammation of the trachiobronchial tree. The most common cause according to the Deutschen Allergie- und Asthmabund e. V. (DAAB) is a viral infection. Beers et al. divide acute bronchitis into an infectious and an irritative bronchitis. Acute infectious bronchitis develops out of a viral infection and can incur with a bacterial infection, whereas an acute irritative bronchitis is produced by various irritants (Beers et al., 2000, p. 710). These irritants are, for example, acid fumes, ammoniac, sulphur dioxide and environmental irritants such as ozone and nitrogen dioxide as well as tobacco smoke and other smoke. (Beers et al., 2000, p. 710).

At first this leads to an increase of the blood flow in the bronchial mucus membrane. The expiring inflammation process triggers the production of viscous mucus, which leads to a disturbance of the protective function of the bronchial epithelial cilia, as a result the normally sterile bronchi can be colonised by bacteria which in turn leads to more mucus production (Beers et al., 2000, p. 710).

Bronchitis is often preceded by the symptoms of an infection of the upper airways such as a cold, not feeling well or muscle and throat ache. Coughing and expectoration and pain behind the breastbone follow and can be accompanied by fever (DAAB, 2009)

The diagnosis is produced on the basis of the symptoms. If the symptoms are severe then the thorax should be x-rayed in order to exclude possible complications (Beers et al., 2000, p. 711).

The therapy includes bed rest until the fever subsides, increased consumption of fluids, fever reducing medicine, and the symptomatic treatment of the coughing (Beers et al., 2000, p. 711). An anti-biotic is indicated if a high fever continues, heavy sputum is produced or an accompanying COPD occurs (Beers et al., 2000, p. 711).

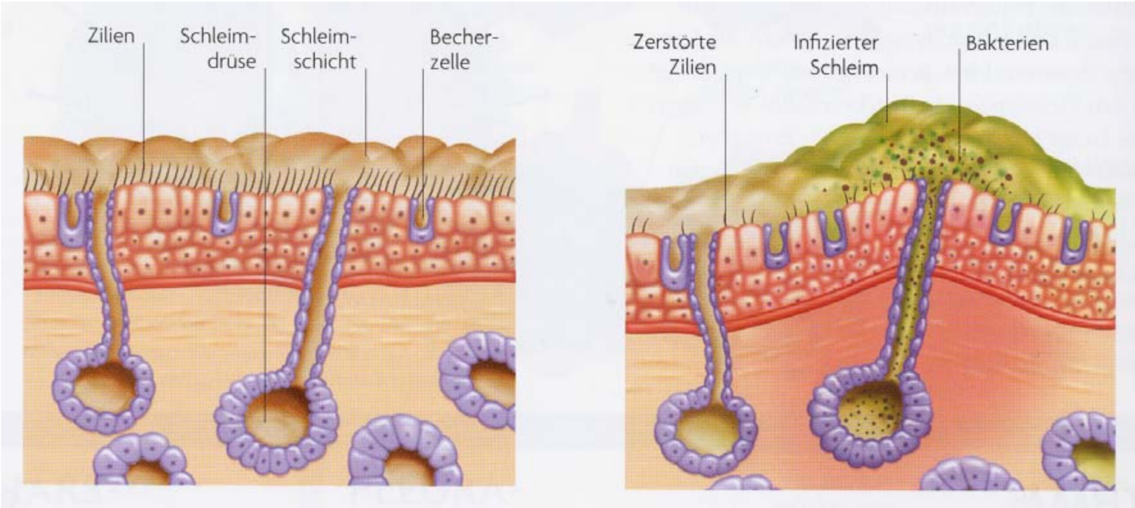
2.6.1.2 Chronic Non-Obstructive Bronchitis

According to the WHO (2009) bronchitis is chronic when persistent or continually reoccurring coughing and sputum exists on most days of at least three consecutive months during at least two consecutive years.

The causes have not been adequately explained according to Riede et al. (2004), who divide promotive factors into endogenous and exogenic. Some of the endogenous factors are the presence of cystic fibroses (mucoviscidose), Ig-A deficit (immunoglobulin-A deficit, anti-body deficit), and a cino cilia dysplasia. (Riede et al., 2004, p. 596). Riede et al. include the inhalation of cigarette smoke and industrial exhaust fumes, the effects of heat, climatic influence in the form of cold damp and streptococcal infections in the exogenic causes. The statements of the Global Initiative for Chronic Obstructive Lung Disease (GOLD) (2009) agree with those of Riede et al. and identify the inhalation of tobacco smoke (an origin in smoking is present in 90%of the cases) as the most important cause.

The symptoms described above of coughing and sputum as a result of the over production of bronchial mucus provoked by inflammation can linger for many years without causing changes in lung function (GOLD, 2009, p. 6). The DAAB (2009) refers to this as simple chronic bronchitis. The symptoms are most distinct in the morning especially by the most frequent smoker’s bronchitis (DAAB, 2009).

The noxious elements in the breath lead to a permanent irritation of the bronchial mucus membrane, which in turn leads to an inflammation reaction, as displayed in illustration 6. This consists of a hypertrophy of the mucus membrane, an increase in the goblet cells and increased viscous mucus production. This causes damage to the epithelial cilia (Bungeroth, 2005, p. 40). This is turn leads to a breakdown in the cilia cleaning mechanism, which then leads to a higher risk of germinative colonisation of the bronchial mucus membrane (Riede et al., 2004, p. 597).



Healthy bronchial mucus membrane

Bronchial mucus membrane with chronic bronchitis:

Increase in the goblet cells and reduction of the cilia

Illustration 6: Schematic representation of the inflammation of bronchial mucus membrane

Source: based on Parker, 2008, p. 142

The diagnosis is made on the basis of the clinical picture. No change in the lung function is measurable (GOLD, 2009).

The most effective therapy in the case of smoker's bronchitis is to stop smoking, which often leads to the complete disappearance of the symptoms in the long-term (DAAB, 2009).

A chronic obstructive bronchitis can occur through the continuing influence of noxious substances, which I describe in the following section. Not all cases of chronic bronchitis develop an obstruction as is shown in the following quote from GOLD:

> *„Chronic bronchitis, defined as the presence of cough and sputum production for at least 3 months in each of 2 consecutive years, is not necessarily associated with airflow limitation"* (GOLD, 2009, S. 6).

2.6.1.3 Chronic Obstructive Bronchitis

Chronic Obstructive Bronchitis is defined by the presence of shortness of breath in addition to the coughing and sputum in chronic bronchitis (s. 2.5.1.2) (DAAB, 2009).

The shortness of breath is caused by the narrowing of the airways through mucus and the collapse of bronchial walls especially during expiration (Bungeroth, 2005, p. 40). At the beginning the dyspnoea (shortness of breath) only occurs during heavy physical exertion. As the illness progresses it appears by light exertion and later sporadically during periods of rest (DAAB, 2009).

As already described for chronic bronchitis repetitive inflammation processes occur with increased production of mucus. Recurrent mucous inflammation attacks lead eventually to an invasion of fibrous connective tissue and scar formation on the walls of the airways (Riede et al., 2004, p. 597). The initial hypertrophy of the mucus membrane becomes more and more an atrophic process. As a result the bronchial walls become thinner and atonic as a result of which a collapse of the wall can occur especially during expiration (Bungeroth, 2005, p. 40). The following illustration is a schematic presentation of healthy and chronically altered bronchial mucus membrane in cross-section.

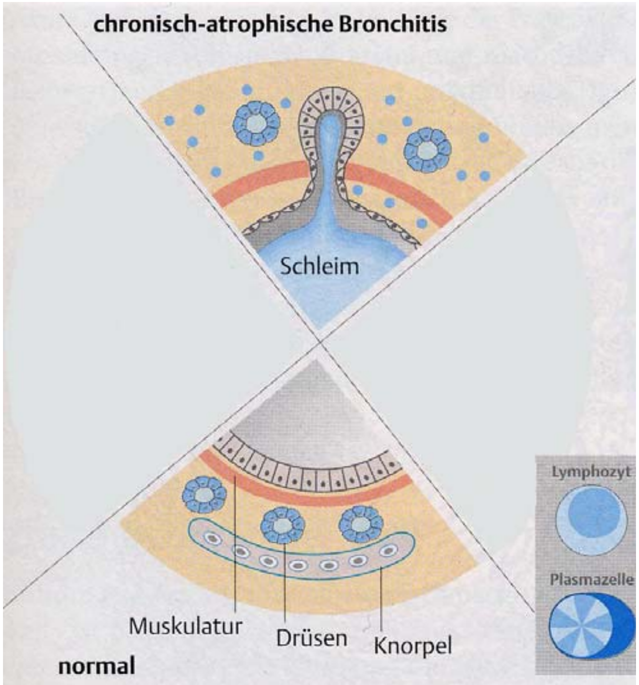


Illustration 7: Healthy and chronically altered bronchial mucus membrane in cross-section
Source: based on Riede, 2004, p. 579

An enduring increase in the tone of the smooth musculature of the bronchial wall the airflow resistance and the dyspnoea both increase (Aumüller et al., 2007, p. 542).

2.6.2 Emphysema

Emphysema is defined as an abnormal enduring expansion of the respiratory section of the lungs (distal of the terminal bronchioles s. 2.4.1) as a result of the destruction of the alveoli walls (Riede et al., p. 607). One differentiates between different forms of emphysema. I will only deal with the COPD relevant description of emphysema here, because GOLD (2008) says the following:

> *„Emphysema, or destruction of the gas exchanging surfaces of the lung (alveoli), is a pathological term that is often (but incorrectly) used clinically and describes only one of several structural abnormalities present in patients with COPD"* (GOLD, 2008, S 3, my emphasis).

The chronic inflammation processes attack the alveoli walls. Tissue damaging substances set free from inflammation cells such as elastase destroy the alveoli septa. As a result an irreversible inflation of the lungs occurs. The surface that is available for gas exchange is reduced (Bungeroth, 2005, p. 40).

2.6.3 Long-term Consequences of COPD

The pathogenesis of COPD is a complex process that can progress to a development of a respiratory insufficiency and a cor pulmonale (Vogelmeier, et al., 2009).

Respiratory Insufficiency

Disturbances of the pulmonary gas exchange with abnormal alteration of the blood gas values is referred to as respiratory insufficiency (Riede et al., 2007, p. 610).

Put simply the obstruction leads to a disturbance of the ventilation. In addition through the destruction of the alveoli walls the gas exchange surface is reduced. The diffusion of O_2 and CO_2 is disturbed leading to both a hypoxaemi (blood O_2 deficiency) and a hypercapnia (blood CO_2 excess).

Cor pulmonale

The WHO defines cor pulmonale as a hypertrophy of the right ventricle produced by illness that influences the function and/or structure of the lungs and thereby causes pulmonary hypertension (Riede et al., 2007, p. 392).

Again, put simply the pulmonary hypertension is caused by various mechanisms triggered by the progression of the COPD pathogenesis. Amongst other things the reduced O_2 in the alveoli trigger a narrowing of the small lung arteries, which in turn raises the flow resistance in the pulmonary circulation. The increase in resistance has to compensated for by an increased activity of the right ventricle, which if it is long-lasting can lead to an enlargement of the right ventricle (Riede et al., 2007, p. 391f).

2.7 The Diagnosis of COPD

According to the COPD guidelines (Vogelmeier et al., 207, p. e5f) the diagnosis of COPD is made with the following points:

- Anamnesis
- Physical examination
- Lung function diagnostic
- Reversibility test with bronchodilatators
- Blood gas analysis
- CO-diffusion capacity
- Stress test
- X-ray of the thorax organs
- Computer tomography of the thorax
- Electrocardiogram, echocardiogram, laboratory examinations and sputum diagnostic

2.7.1 Anamnesis

Chronic coughing and sputum are often the first indications of the presence of a COPD. However not every patient who coughs (with or without sputum) develops a

COPD. Patients mostly visit a doctor for the first time when they become short of breath (by heavy or light physical exertion). A feeling of constriction in the chest and whistling noises when breathing are also possible symptoms (Vogelmeier et al., 2007, p. e5).

When the presence of a COPD is suspected then an anamnesis should contain the following factors: Exposition in terms of tobacco smoke and other risk factors (s. 2.6.1.2), information on other affections of the airways such as asthma, lung diseases in the family anamnesis, occupational anamnesis, progress and severity of the symptomatic, physical resilience, frequency and severity of the exacerbations (dyspnoea attacks), comorbidity (presence of other illnesses) such as heart diseases, breathing disorders during sleep (apnoea) and actual medication (Vogelmeier et al., 2007, p. e 5f).

2.7.2 Physical examination

The findings of the physical examination are dependent on the severity of the COPD (s. 2.7.3 Severity) and so vary from case to case. The symptoms can vary from inconspicuous findings over wheezing, whistling, humming by expiration to diminished breathing sounds, quite heart sounds, as well as lack of concentration, weight loss and peripheral oedema. A flattened diaphragm and a barrel chest with locked ribs during inspiration and almost no perceptible movement during breathing are all signs of chronically inflated lungs (Vogelmeier et al., 2007, p. e6).

2.7.3 Lung function diagnostic

According to Vogelmeier et al. (2007) the lung function diagnostic is conducted in order to:

- Confirm the diagnosis COPD through the ascertainment of an airway obstruction.
- To ascertain the severity of the COPD
- A differential diagnosis of the dyspnoea

The lung function diagnostic is carried out with spirometry or body plethysmography (Vogelmeier et al., 2007, p. e6).

Miller et al. define spirometry as a physical test that measure how a person breathes in and breathes out volumes of air in a given period of time; it is a lung function test (Miller et al., 2005, p. 320).

Body plethysmography is also a method of measuring lung function in which, according to Criée et al. (2009), the volumes of those parts of the lungs that are not accessible to inspiration and expiration are also measured as opposed to by spirometry. Criée et al. go on to say that:

> *"By body plethysmography the level of airway obstruction is measured directly in the form of the airway resistance during relaxed breathing as opposed to spirometry that measures it indirectly by means of reduction of the breath stream during forced expiration"* (Criée et al., 2009, p. 1).

Boenisch et al. add:

> *"The measurement of the lung function in body plethysmography is the most exact and most objective but also most complex method of differential diagnosis of patients with lung and airway diseases. […] Body plethysmography also enables a comprehensive examination of the respiratory mechanism including the elasticity and perfusion of the lungs"* (Boenisch et al., 1999, p. 29).

Vogelmeier et al. (2007) say that the parameters vital capacity (VC) and forced expiratory volume in one second (FEV_1) as well as the determination of the ratio FEV_1/VC are the characteristics with the highest level of clarity for the diagnosis and the determination of the progress of COPD.

Vital capacity (VC):

Vital capacity is the maximum volume of air (in litres) that can be breathed in following maximum expiration (Miller et al., 2005, p. 329). For this measurement average value tables for size, gender and age are used that are integrated into the output of the spirometer or body plethysmograph and automatically taken into account (Boenisch et al., 1999).

Forced expiratory volume in one second (FEV_1):

FEV_1 is the volume of air (in litres) that is breathed out by forced expiration in one second following maximum inspiration (Boenisch et al., 1999, p. 13).

Ratio FEV_1/VC in %:

In order to determine the presence of an obstruction Vogelmeier et al., as well as most national and international recommendations, use the ratio of FEV_1 to VC. An obstruction is present when $FEV_1/VC<70\%$ (Vogelmeier et al., 2009, p. e6).

The guidelines of the Deutschen Atemwegsliga and the Deutschen Gesellschaft für Pneumologie und Beatmungsmedizin use, in agreement with the recommendation for lung diagnostic of the ATS/ERS consensus (agreement of the American Thorax Society and the European Respiratory Society), the ratio FEV_1/VC for the definition of the obstruction. GOLD however uses the ratio FEV_1/FEV (forced vital capacity). Therefore there can be deviation in statements about obstruction from this institution (Vogelmeier et al., 2009, p. e6).

Severity of COPD

The severity of the COPD can be determined after ascertaining the lung function parameters FEV_1, VC and their ratio. According to Vogelmeier et al. the following classification of the levels of severity was carried out by the ATS and ERS:

Level of Severity	Clinical	FEV_1 in relation to index value	FEV_1/VC
I (mild)	with/without symptomatic (coughing, sputum)	> 80 %	< 70 %
II (moderate)	with/without chron. symptoms (coughing, sputum, dyspnoea)	50–80 %	< 70 %
III (severe)	with/without chron. symptoms (coughing, sputum, dyspnoea)	30–50 %	< 70 %
IV (very severe)	Respiratory insufficiency cor pulmonale	< 30 %	< 70 %

Table 1: Classification of COPD severity
Source: based on Vogelmeier et al. 2009

COPD is by definition a progressive disease. The lung function should be controlled (at least once a year) to determine the progress and if necessary to adjust the therapy (s. 2.8) (Vogelmeier et al., 2007, p. e11; GOLD, 2009).

2.7.4 Reversibility test with Bronchodilatators

The obstruction of a COPD is irreversible. Bronchodilatators are medicines that dilate the bronchi (Vogelmeier et al., 2009, p. e6). They activate the sympathetic innervation of the bronchi, which leads to a dilation (Aumüller et al., 2007, p. 565). Short-acting bronchodilatators are used for the test. Asthma bronchial obstruction is reversible (Vogelmeier et al., 2009, p. e6).

The test includes a FEV1 measurement following which the patient inhales a bronchodilatator and 30 minutes later repeats the FEV1 measurement. If the FEV1 has increased by more than 200ml and more than 15% this indicates a reversibility of the obstruction and the non-presence of a COPD (Vogelmeier et al., 2009, p. e7).

The test above all helps to differentiate between COPD and bronchial asthma (Vogelmeier et al., 2009, p. e6).

2.7.5 Other diagnostic methods

I wish, in the following table, to briefly sketch other diagnostic methods and their aims according to Vogelmeier et al. (2009):

Diagnostic method	Aim
Blood analysis	Determination of the hypoxemia and hypercapnia of patient with severe COPD
CO-diffusion capacity	Analysis of the lung function restriction by patients with emphysema
Stress test	Differentiation of the causes of the stress dyspnoea, quantification of the stress restrictions
X-rays of the thorax organs	Differential diagnose to other diseases with similar symptoms, identification of emphysema bubbles
CT of the thorax	Quantification and appraisal of the spread of emphysema
Electro and echo cardiograms	Exclusion/estimation of the heart stress of heart diseases
Laboratory examinations	Determination of IgA deficit (s. 2.6.2.1) above all by young patients with COPD

Table 2: Diagnostic methods
Source: Information from Vogelmeier et al., 2007, p. e7f.

2.8 COPD Therapy

COPD is not completely healable according to ELF (2009). The therapy possibilities can however prevent a worsening of the disease and ease the symptoms (ELF, 2009). COPB is treated both medicinally and non-medicinally (Vogelmeier et al., 2007).

2.8.1 Medicinal therapy

The principle medicinal therapy is carried out with bronchial dilating medicines according to ELF (2009). Vogelmeier et al. refer to this as the basic treatment for COPD. Bronchodilatators are Beta-2- Sympathomimetica, Anticholinergica and Thephyllin (Vogelmeier et al., 2007, p. e13). The number of dyspnoea attacks by severe COPD can be reduced by regular inhalation of corticosteroids (ELF, 2009). The oxygen level of the blood is drastically reduced in severe cases of COPD and for such patients the prescription of oxygen is indicated (ELF, 2009). Further medicinal therapies are the prescription of antibiotics in the case of bacterial bronchitis, mucolytica and antioxidants (ELF, 2009).

2.8.2 Non-Medicinal Therapy

The most important part of the therapy is the nicotine withdrawal (90% of the cases are/were smokers) and the reduction of the inhalation of noxious substances according to Vogelmeier et al. (2007). There are many interdisciplinary programmes for nicotine withdrawal (Vogelmeier et al., 2007, p. e11).

According to the COPD guidelines non-medicinal therapy includes physical training, patient training, physiotherapy, resources to eliminate secretion, and dietary advice. Physiotherapy is applied as respiratory therapy with the aim of improving the flexibility of the thorax and associated improvement in the gas exchange, the drainage and the improvement in secretion elimination.

3 Previous Investigations of Osteopathic Treatment of COPD Patients

I am especial interested in three osteopathic studies (Grabner; Noll et al., 2008; Noll et al., 2009) because they all deal with the subject osteopathic treatment and COPD. Grabner and Noll et al. have approached the subject in different ways and arrived at varying conclusions. In this chapter I wish to take a closer look at these three studies.

3.1 Grabner's Study

Andrea Grabner carried out a study on the subject of the influences of osteopathic treatment on the lung function of COPD patients at the Donau Krems University in 2006. It is a randomised study with treatment and placebo groups (Grabner, 2007, p. 50).

Randomisation means that the test subjects are assigned to the test group purely by chance in order to insure that the difference between the two groups is as small as possible. Investigations that use randomisation are often referred to as randomised controlled trials or randomised clinical trials (RCT) (Deinzer, 2007, p. 47).

A doctor has already diagnosed COPD for the patients. After the agreement of the patients and their selection in terms of the exclusion and inclusion criteria 26 patients were recruited. Six patients did not return for the second measurement after which they were excluded from the study (Grabner, 2007, p. 50). Eventually 20 COPD patients took part in the treatment and placebo group phase (Grabner, 2007, p. 64).

With this study Grabner investigated the influence of osteopathic treatment on the lung function parameters vital capacity (VC), forced expiration in one-second volume (FEV_1) and the Tiffeneau Index (FEV_1/VC) of COPD patients (Grabner, 2007, p. 4). The doctor conducted the measurements with a spirometer (s. 2.7.3). Within five days of the first lung measurement Grabner applied the first osteopathic treatment. Four weeks later Grabner treated the patients for the second time. Five weeks after the first measurement the doctor conducted the second spirometer measurements (Grabner, 2007, p. 50).

Both measurements were conducted on summer days with approximately equal ozone levels in order to neutralise the influence of this parameter on the measurements (Grabner, 2007, p. 52).

In the osteopathic diagnostic assessment and treatment Grabner concentrated on the following aspects: structural aspects of the spinal column, thorax and base of the skull, fascial aspects of the thoracic and abdominal cavities, aspects of the nerval provision and the improvement of the provision and disposal in the blood and lymph systems. For the treatment she used the mobilisation of the first rib and the musculus subcalvius, she treated the fixation of the pleural cavity, the diaphragm, the diaphragm respective the thoracic and lumbar vertebrae, the segments of the vertebral column that innervate the diaphragm, the cervical vertebrae and the thoracic vertebrae, the sternum and the ribs in order to influence the innervation, the circulation and the mechanical reference points of the lungs (Grabner, 2007, pp. 45 – 50).

Grabner does not describe the procedure for the placebo treatment.

The statistical evaluation does not produce any significant differences in the lung function parameters named above between the treatment and placebo groups. There is a slight improvement recognisable in the values of the treatment group in comparison to the placebo group (Grabner, 2007, p. 63).

Grabner attributes the causes of these results to the small number of osteopathic treatments and possible errors in the spirometry (Grabner, 2007, p. 65).

3.2 Noll et al. Study (2008)

Noll et al. carried out a study to investigate the effect of osteopathic techniques on the lung function of patients who suffer from COPD. It was a double blind randomised controlled study (Noll et al., 2008. p. 252).

Double blind means that both the patients and the study leader are blinded. This means that neither the patients nor the study leader knows who is receiving the treatment and who the placebo in order to exclude any bias. (Deinzer, 2007, p. 56).

The primary aim of the study was to find out whether the standardised application of seven osteopathic techniques has a direct effect on the lung function parameters of

COPD patients. The secondary aim of the study was to find out whether the patients perceive the treatment as helpful and whether the side effects are minimal (Noll et al., 2008, p. 252).

The participants in the study have a know history of COPD are at least 65 years old and have a airways obstruction with a Tiffeneau Index of < 70% (Noll et al., 2008, p. 252). 64 potential test subjects were recruited of which 29 were excluded because they did not fit the inclusion criterion. 18 patients were assigned to the treatment group and 17 to the placebo group by randomisation (Noll et al., 2008, p. 254).

Certified respiratory therapists, who were blinded to the groups, conducted the measurements with body plethysmography. After the initial lung function measurement the osteopaths treated the patients of the treatment group with a standardised programme of seven osteopathic techniques. Osteopathy often prescribes these techniques for respiratory disorders. The placebo group received a placebo treatment from the therapists. The treatment lasted about 20 minutes for both groups. The standardised programme for the treatment group consisted of soft tissue techniques, rib raising, indirect myofascial release of the abdominal diaphragm, suboccipital decompression, myofascial release of the upper thorax, traction of the musculus pectorals and lymphatic pump with impulse. In the placebo treatment the therapist lightly touches those anatomical structures that are treated in the therapy group. Thereby she lays her hands on the ribcage of the patient, palpates the rib movements and observes the respiratory movements. Following this she lays her hands under the patients rib cage touches the paravertebral musculature and observes segmental restrictions without carrying out a myofascial release. This is followed by lightly touching the cervical vertebral column and the upper thorax aperture. Finally the patient lies on her side and the therapist taps very lightly on the rib cage without draining (Noll et al., 2008, p. 253).

The day following the treatment Noll et al. asked the patients on the telephone whether they had experienced side effects, how they evaluated the treatment, and to which group they thought they belonged (Noll et al., 2008, p. 251).

A comparison of the lung function parameters before and after the treatment shows a statistically significant change in six of the twenty-one parameters measured (Noll et al., 2008, p. 254).

The telephone survey shows that that most of the patients think that the treatment improved their health and that they could breath more easily. Nine of the therapy group and seven of the placebo group correctly guessed to which group they belong (Noll et al., 2008, pp. 254 – 255).

Noll et al. conclude that a treatment with osteopathic techniques can provoke a measurable change in lung function. However the values show a worsening of the parameters that are used to evaluate the obstruction. Noll et al. conjecture that this worsening is possibly provoked by the activating component of the lymphatic pump with impulse technique. The impulse of this technique leads to an increased inflow of air that consequently probably cannot be breathed out in sufficient quantities.

The results show that it is possible to influence the lung function parameters of COPD patients with osteopathic techniques. However undesirable effects for the COPD patients were provoked alongside positive ones. Noll et al. therefore recommend that each individual technique should be investigated in terms of their effects on the lung function of COPD patients in order to be able to exclude undesirable effects of the osteopathic treatment. Moreover they point out that the second lung function measurement was conducted only thirty minutes after the treatment was carried out and so long-term effects of the treatment have not been described (Noll et al., 2008, p. 255).

Noll et al. followed their own recommendation and conducted a study in which they investigated the effects of five individual osteopathic techniques on the lung function of COPD patients. In the following I examine the results of this 2009 study.

3.3 Noll et al. Study 2009

In a randomised controlled study Noll et al. (2009) investigated the effects of five individual osteopathic treatment techniques on the lung function of patients suffering from COPD (Noll et al., 2009, p. 2.5).

Certified respiratory therapists measured the lung function parameters of the COPD patients with body plethysmography. The patients and therapist were not blinded to the sequence of the techniques (Noll et al., 2009, p. 10). The osteopaths carried out four techniques and a control treatment with minimal contacts individually on the COPD patients with a break of four weeks between each one (Noll et al., 2009, p. 2).

The osteopathic techniques are the thoracic lymphatic pump (TLP) with impulse, TLP without impulse, rib raising and myofascial release (Noll et al., 2009, p. 6). The lung function measurement took place thirty minutes before treatment and thirty minute afterwards (Noll et al., 2009, p. 9). The treatment and the measurement of the lung function took place in different buildings of the clinic complex. In order to avoid fatiguing the patients between treatment and measurement they were transported between the buildings in wheelchairs. One day after the treatment Noll et al. questioned the patients per telephone in order to document side effects and other perceptions of the patients respective the treatment (Noll et al., 2009, p. 6).

Eventually twenty-five COPD patients of at least 50 years of age took part in the study (Noll et al., 2009, p. 2).

Following the application of each treatment the respiratory therapists measured a slight worsening in the lung function of the COPD patients whereby rib raising displayed the least change. Each technique effected different parameters of the lung function (Noll et al., 2009, p. 15). Despite the negative change in the lung function parameters the patients experienced the treatments as pleasant, believed that they could breath more easily and recommended the treatment to others (Noll et al., 2009, p. 17). Long-term effects are not known here.

Conclusions of the studies presented

The various authors achieved varying results in terms of the effects of osteopathic techniques on the lung function of COPD sufferers. The recommendation of Noll et al. to investigate the effect of the techniques on the lung function of COPD patients individually appeared to me to be sensible. I decided to investigate the effect of rib raising. After I had closed up the practical part of my investigation and had begun with the evaluation Noll et al. published the second study discussed above in October 2009.

4 Notes on Rib Raising

4.1 Rib Raising in the Context of the Osteopathic Principles

The technique of rib raising is described in varying ways. Noll et al. give the following description in their studies.

The patient is in supine position. The therapist sits beside the patient with her hands under the thorax. The fingertips take up contact with the anguli costae. The therapist bends the fingertips and applies lateral traction to the anguli costae. This traction is maintained. The wrist joints of the therapist remain stretched and the underarms function as a fulcrum on the edge of the treatment table. The therapist moves the hands toward the anterior side of the patient's thorax while the elbows move towards the floor. This movement is repeated several times so that a constant raising and sinking of the thorax takes place until the therapist perceives an improvement in the rib flexibility. The therapist then takes up contact with the next rib and repeats the technique until all ribs on the side are mobilised. Following this, the other side in treated in the same way (Noll et al., 2008, p. 253).

In his book "Viszeralosteopathie – Grundlagen und Thechniken" Eric Hebgen describes a variant of the technique as circulatory technique from Kuchera as follows. The patient is in a supine position. The therapist sits beside the treatment table. The therapist's fingertips make lateral contact with the processi transversi over the ribs. The fingers are positioned both sides so that the patients thorax is raised from the table. The therapist remains in this position until relaxation occurs. Following this, the patient's thorax is shaken eight to ten times in order to stimulate the truncus sympathicus (Hebgen, 2003, p. 11).

Noll et al. describe the technique as maybe one of the oldest and most often described osteopathic techniques for the treatment of infections of the airways. Noll et al. also say:

> *„Although Barber first described rib raising in 1896 as a technique for treating patients with pneumonia, its origin has been attributed to Still, who demonstrated versions of the technique in patients in the sitting, supine, and standing positions. Rib raising was used to improve the mechanical*

> *motion of the rib cage, as well as to beneficially modulate the sympathetic nervous system"* (Noll et al., 2008, p. 510).

According to Noll et al. the technique is also used to improve the flexibility of the ribs and to stimulate the sympathetic nervous system. The stimulation of the truncus sympathicus ganglia, which lay ventral to the capiti costae leads to an improvement of the sympathictonus of the lungs (Noll et al., 2008, p. 513).

Hebgen says that an organ can be influenced by its circulation to which the arterial, venal and lymphatic supply as well as the sympathetic and parasympathetic innervation belong (Hebgen, 2003, p. 3). Whereby a sympathetic compensatory stimulation of an organ through stimulation of the truncus sympathicus is possible with rib raising and other techniques (Hebgen, 2003, p. 10).

A very effective way to treat the lungs osteopathically is external thorax mobilisation, which leads, at the same time, to an improvement in the flexibility of the pleura parietalis (Hebgen, 2003, p. 189). Because rib raising is used as mobilisation of the thorax it can also function theoretically as a possibility for osteopathic treatment of the lungs.

Following this osteopathic theory one can describe rib raising as a technique that works in the sense of osteopathic principles. I wish to explain this further in what follows.

According to Torsten Liem (2002) the reciprocity from structure and function of the hypomobile joint is an aspect of the osteopathic principle, that which moves the structures belongs to the segment's dysfunction (Liem, 2002, p. 36).

A mobilisation of the hypomobile rib vertebrae joint is effected through rib raising through which the flexibility of the thorax is improved (Noll et al., 2008, p. 510). According to Greenmann restriction of thorax flexibility influences the patients respiration (Greenmann, 2000, p. 264). So the mobilisation of the thorax through rib raising can influence the function of the lungs.

Another osteopathic principle, according to Liem (2002) is the blood flow principle. Stagnation is provoked by a restriction of the blood flow, which causes pathology. By removal of the congestion and with the increased flow the nourishment of the tissue is improved and fixation is prevented (Liem, 2002, p. 35). Greenmann describes a curtailment of the low-pressure system of the venal and lymphatic circulations caused by the restriction of the respiratory movement of the ribs. (Greenmann, 2000, p. 305). Eric Hebgen also speaks, as already mentioned above, about the possibility to influence an organ through its circulations. He counts the arterial, venal and lymphatic systems to circulation as well as the sympathetic and parasympathetic innervation. Manipulation or mobilisation of the vertebral column at the respective level leads to an arterial stimulation of the dependent organs (Hebgen, 2003, p. 9). Rib raising mobilises the rib vertebrae joint and so can work stimulating on the lungs. For vegetative compensation through the stimulation of the truncus sympathicus Hebgen prescribes the rib raising technique (Hebgen, 2003, p. 11). This shows that the rib raising technique conforms to another osteopathic principle.

William and Michael Kuchera think that the self-regulating mechanisms of the body should be regarded as osteopathic principles. The body has mechanisms to protect itself from external influences and to maintain its balance or to compensate for injuries (Kuchera, 19993, p. 4). According to Liem a dysfunction damages the self-healing forces of the body he say:

> *"The investigation of the neurovegatative balance provides information about the blood supply of the organ. If one coordinates the circulation and the respiration with one another one helps the vitality to develop. […] It is a coordinated circulating flow that stimulates the vital machine"* (Liem, 2002, p. 39).

If one follow osteopathic theory then the mobilising and vegetative balancing components of rib raising by a correct application of the technique respective the diagnosis also obeys this osteopathic principle.

4.2 Rib Raising in the Classification of Osteopathic Techniques

Hartmann (1997) divides the osteopathic techniques into three categories. He calls them rhythmic techniques, impulse techniques and slow stress application techniques. According to Hartmann rib raising counts as a rhythmic technique and is called articulation. He says that an articulation contains a repeated passive movement in which lever and fulcrum are used and whose difference to simple passive movements lies in perception of the barrier by the therapist (Hartmann, 1997, p. 27).

Hartmann (1997) says about the effect of an articulation:

> *"To work on a constructed barrier may perhaps seem less effective but is proved by control to be the fastest way to improved mobility of the actual barrier. This movement is not so unpleasant as a capsule stretching but has a strong effect on the mechanoreceptors of the joint"* (Hartmann, 1997, p. 27).

5 Methodology of the Investigation of the Influence of Rib Raising on the Lung function of COPD patients

It was investigated whether the application of rib raising on COPD patients has an influence on their lung function.

5.1 Planned Procedure for the Investigation

The lung specialist Dr. Ammenn has already diagnosed a COPD. The patients with a history of COPD came to an appointment for a control examination in the practice. Here they were informed about the study and asked if they would like to participate. When an agreement had been reached and the inclusion and exclusion criteria had been fulfilled (s. 5.1.3) the patients were assigned with matching (s. 5.1.1) to the groups. The practice assistants did not know the group assignments. The practice assistants then carried out the initial lung function measurement with body plethysmography. Then the patients of the therapy group received the treatment with rib raising (s. 5.3) those of the placebo group the placebo treatment (s. 5.4). The treatment took place in the bronchoscopy room of the practice. The patients of both groups remained in the practice for a follow up examination. The following measurement of the lung function took place about one hour after treatment and was carried out by the practice assistants.

The following flow diagram shows my planned investigation procedure.

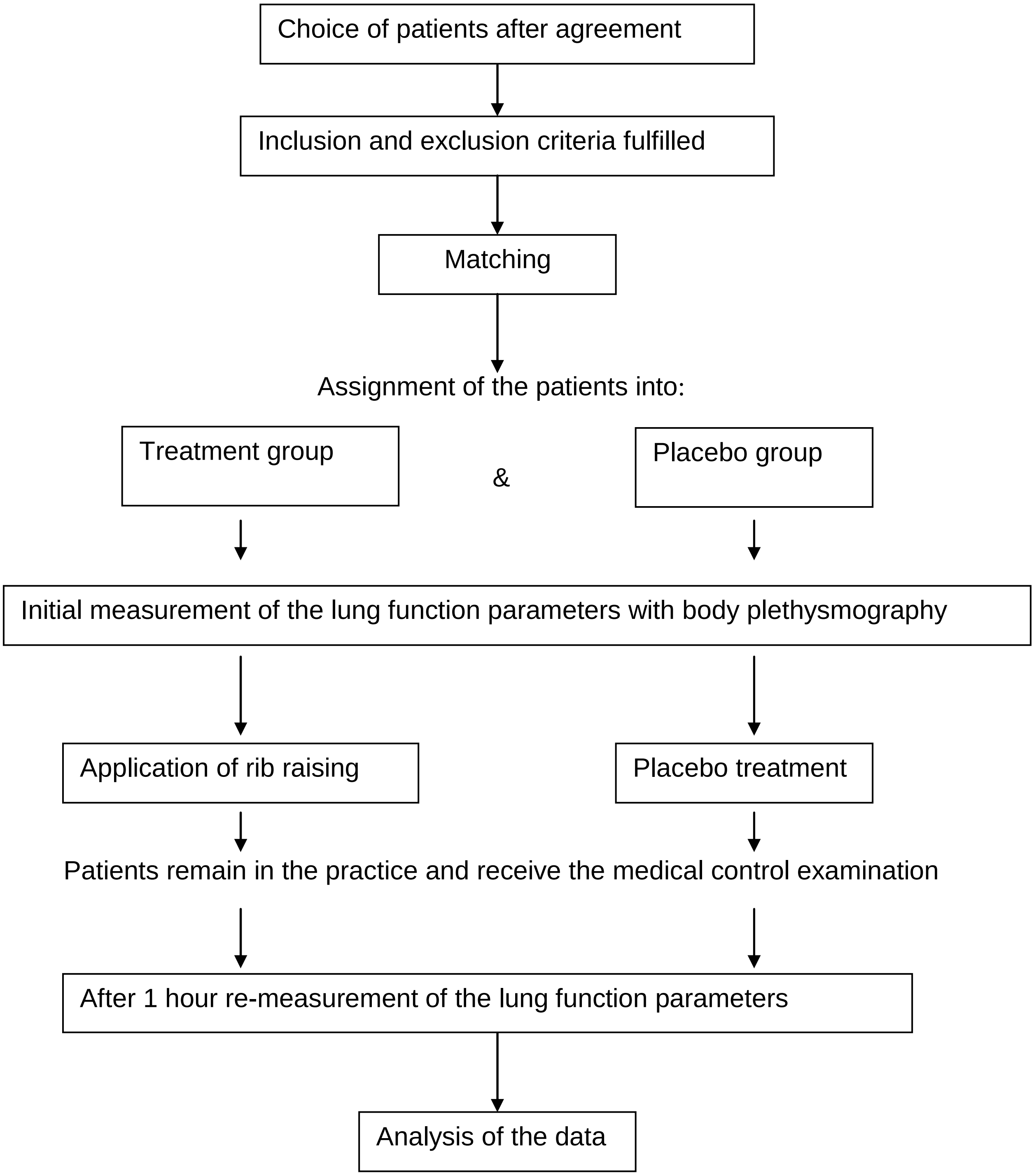


Illustration 8: Flow chart of planned investigation procedure

Source: The Author

5.1.1 Investigation Design

The present study had the experimental research design as propagated by Sommerfeld (2006) and Deinzer (2007). The patients were simply blinded and with matching assigned to treatment and placebo groups The practice assistants were blinded respective the group assignment.

In experimental research the effectiveness of therapeutical interventions is tested (Sommerfeld, 2006, p. 60). With this study I investigated the effectiveness of rib raising on the lung function of COPD patients.

Simple blinding means that the test subjects do not know to which group they have been assigned the investigation leader however does know (Deinzer, 2007, p. 56).

Matching is a control technique for the assignment of test subjects to the groups that can be used in place of randomisation (s. 3.1). Thereby the test subjects are so assigned so that for each person in a group another person exists in the other group who is similar in as many variables as possible (matching variables) e.g. gender, age, size, weight etc. Group differences should thus be avoided (Deinzer, 2007, p. 49).

In my investigation procedure a preselection of the patients was not possible. The patients were asked during their control appointments at the practice to take part in the study. So it was not clear in advance, which pool of COPD patients would take part in the study, which is why I used matching for the assignment of the patients. The matching variables for the assignment of the patients were:

- Gender
- Age
- Level of COPD
- Smoker/non smoker

5.1.2 Aimed for Sample Size, Inclusion and Exclusion Criteria

The aim was to achieve a group size of twenty patients per group.

The diagnosis of COPD has already been made by the lung specialist Dr. Ammenn. The COPCD patients are in therapy (s. 2.8) and under regular control (s. 2.7.3) as by

GOLD (2009) and Vogelmeier et al. (2007). For this study I restricted myself to the patient pool of the lung disease practice that appeared in the practice for their progress control. In order to participate the following criteria must be fulfilled:

Inclusion criteria:

- Patient with COPD grade I – III
- Stable condition of the COPD
- Consistent medication between the treatments.

Exclusion criteria:

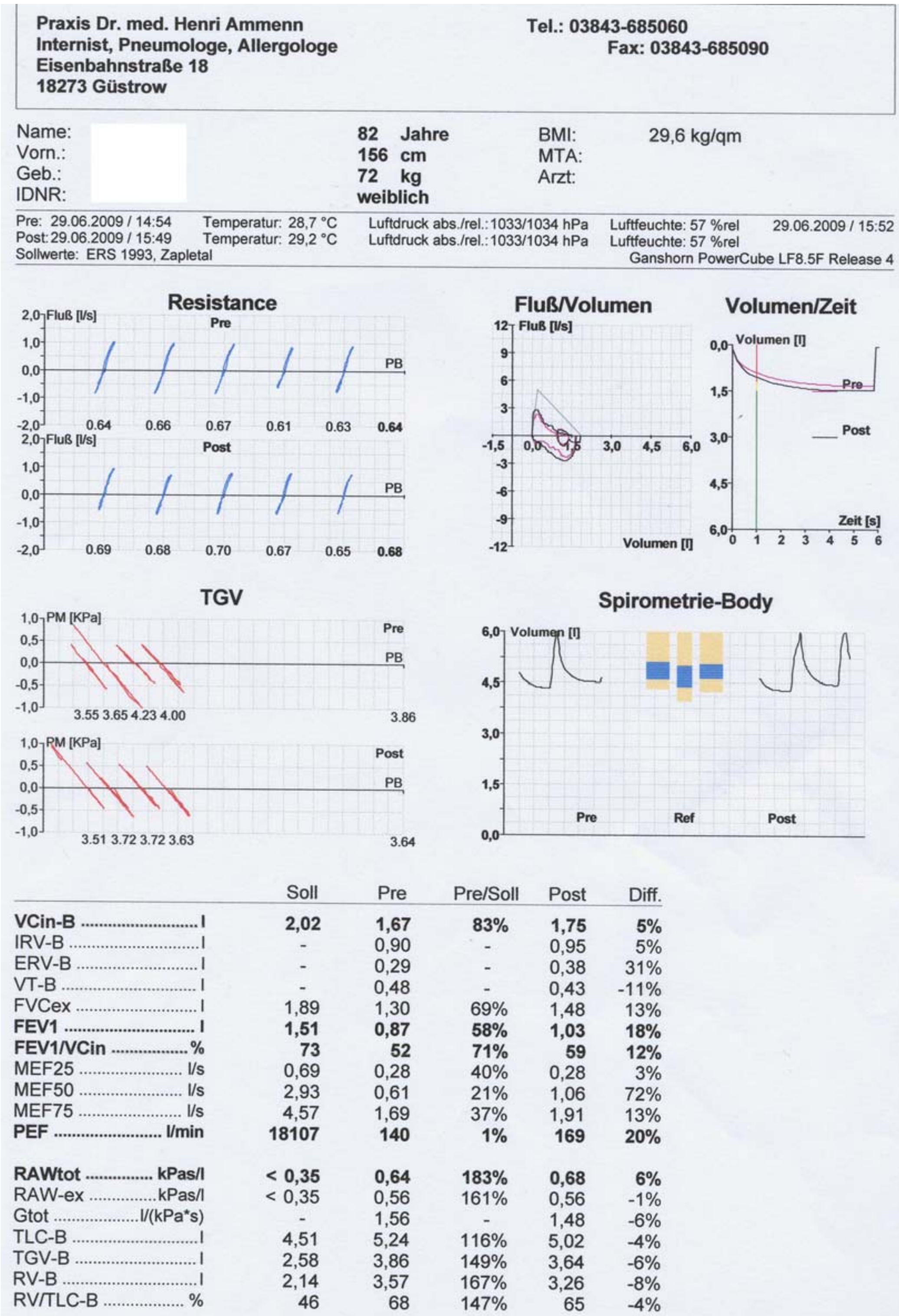
- Patients with COPD grade IV (respiratory insufficiency, cor pulmonale)
- Acute change in the COPD condition or exacerbation
- Change of medication between the measurements
- Acute illness (acute bronchitis, pneumonia)
- Fever

5.2 Measurement of the Lung Function with Body Plethysmography

The Body Plethysmograph in DR. Ammenn's practice is a Ganshom PowerCube LF8.5F Release 4. The apparatus consists, as can be seen in the following illustration, of an airtight cabin in which the patient sits. A computer work place completes the measurements unit (Boenisch et al., 1999, p. 29). According to the manufacturer the measurements of the apparatus fulfil the criteria of the ATS/ERS for the conduct of lung function tests.

Illustration 9: Body Plethysmographic Measurement Unit
Source: Ganshorn Medizin-Elektronic

The schooled personnel conduct the manoeuvre for lung function measurement with the patient. The following measurement protocol is an example for the parameters measured and the deduced values.



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Name: | **82 Jahre** | BMI: 29,6 kg/qm
Vorn.: | **156 cm** | MTA:
Geb.: | **72 kg** | Arzt:
IDNR: | **weiblich**

Pre: 29.06.2009 / 14:54 Temperatur: 28,7 °C Luftdruck abs./rel.: 1033/1034 hPa Luftfeuchte: 57 %rel 29.06.2009 / 15:52
Post: 29.06.2009 / 15:49 Temperatur: 29,2 °C Luftdruck abs./rel.: 1033/1034 hPa Luftfeuchte: 57 %rel
Sollwerte: ERS 1993, Zapletal Ganshorn PowerCube LF8.5F Release 4

	Soll	Pre	Pre/Soll	Post	Diff.
VCin-B l	**2,02**	**1,67**	**83%**	**1,75**	**5%**
IRV-B l	-	0,90	-	0,95	5%
ERV-B l	-	0,29	-	0,38	31%
VT-B l	-	0,48	-	0,43	-11%
FVCex l	1,89	1,30	69%	1,48	13%
FEV1 l	**1,51**	**0,87**	**58%**	**1,03**	**18%**
FEV1/VCin .... %	**73**	**52**	**71%**	**59**	**12%**
MEF25 .... l/s	0,69	0,28	40%	0,28	3%
MEF50 .... l/s	2,93	0,61	21%	1,06	72%
MEF75 .... l/s	4,57	1,69	37%	1,91	13%
PEF .... l/min	**18107**	**140**	**1%**	**169**	**20%**
RAWtot .... kPas/l	**< 0,35**	**0,64**	**183%**	**0,68**	**6%**
RAW-ex .... kPas/l	< 0,35	0,56	161%	0,56	-1%
Gtot .... l/(kPa*s)	-	1,56	-	1,48	-6%
TLC-B l	4,51	5,24	116%	5,02	-4%
TGV-B l	2,58	3,86	149%	3,64	-6%
RV-B l	2,14	3,57	167%	3,26	-8%
RV/TLC-B .... %	46	68	147%	65	-4%

Illustration 10: Lung Function Measurement Protocol

Source: Data sheet from the study

As well as the spirometry parameters (VC, FEV_1, FEV_1/VC) flow/volume curves, respiratory cut off values, lung section volumes, thoracic gas volume (TGV), residual volume (RV), total lung capacity (TLC), airway resistance (RAWtot) and expiratory partial resistance (RAW-ex) were determined (Ganshorn Medizin Elektronic, 2009).

To determine the obstruction and for the progress control of the COPD the parameters VC, FEV_1, and FEV_1/VC are significant (s. 2.7.3).

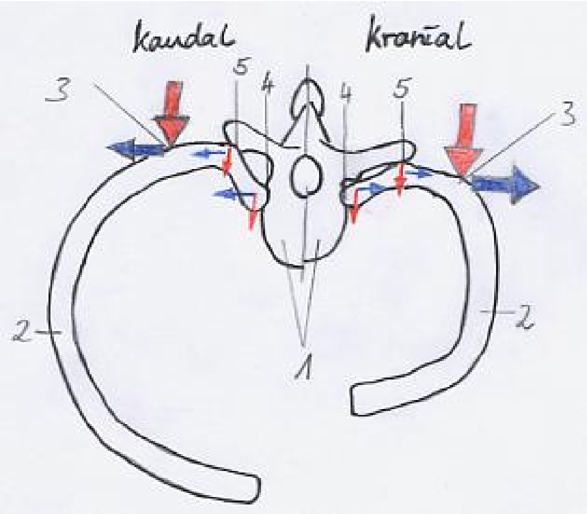
In order to assess whether the application of rib raising influences the lung function of COPD patients the parameters VC, FEV_1, and FEV_1/VC were used as dependent variables.

5.3 Treatment with Rib Raising

I treated patients from the treatment group for maximal twenty minutes with the rib raising technique conducted as described above from Noll et al..

The patient is in the supine position. The therapist sits beside the patient with her hands under the thorax. The fingertips take up contact with the anguli costae. The therapist bends the fingertips and applies lateral traction to the anguli costae. This traction is maintained. The wrist joints of the therapist remain stretched and the underarms function as a fulcrum on the edge of the treatment table. The therapist moves the hands toward the anterior side of the patient’s thorax while the elbows move towards the floor. This movement are repeated several times so that a constant raising and sinking of the thorax takes place until the therapist perceives an improvement in the rib flexibility. The therapist then takes up contact with the next rib and repeats the technique until all ribs on the side are mobilised. Following this the other side in treated in the same way.

The following illustration shows schematically the direction in which the rib joints are moved. The left hand side of the diagram show the caudal ribs whilst the right hand side shows the cranial ribs. At first there is a ventrilisation of the joint (small red arrow) through the contact on the anguli costae and the bending of the fingertips (large red arrow). The application of traction (large blue arrow) provokes a lateralisation of the joint (small blue arrow).



1	Vertebra
2	Caput costae
3	Contact point of the fingertips
4	Rib head joint
5	Tuberculum costae

Illustration 11: Representation of the movement of the rib joints during rib raising
Source: The Author

The choice of this technique is based on two assumptions. Firstly patients mostly claim a subjective feeling of improvement in respiration after treatment with rib raising and secondly the influence of rib raising on the sympathicotonus of the lung is described in the osteopathic literature (s. 4). If one accepts this hypothesis then the application of rib raising stimulates the sympathetic innervation of the lung, which leads to bronchodilatation (s. 2.5.1 and 2.7.4). The obstruction would thus be reduced, which is significant for COPD patients.

5.4 Placebo Treatment

The placebo treatment was also applied as described by Noll et al. (2008).

The therapist lays her hands on the rib cage of each patient, palpates the rib movements and observes the respiratory movement. Following this she lays the hands under the patients thorax, touches the paravertebral musculature and observes segmental restrictions, without conducting myofascial release. In the next step she lays a hand under the dorso-lumbal-junction the other hand on the patients epigastric region and observes the preferred direction of the tissue without conduction a myofascial release. This is followed by a light touch of the cervical vertebral column and the upper thorax aperture.

The placebo treatment lasts twenty minutes at the most.

5.5 Data Collation and Evaluation

The data was collated using Microsoft Excel.

The data was transferred to the programme SPSS with which it was evaluated. Descriptive and inductive statistics were used.

6 Results

In this chapter I describe the procedure followed in the investigation as well as the results and the statistical evaluation.

6.1 Final Composition of the Sample, Schedule

The study ran from 28.05.2009 until 07.07.2009. Fifty-one patients with a history of COPD were informed about the study during the regular control appointment in the practice and asked if they wished to participate.

Five patients did not agree to participate in the study. Forty-six patients in total agreed to participate. They were assigned to the treatment and placebo groups with matching. The treatment group was assigned twenty-four patients and the placebo group twenty-two.

Exclusion from the placebo group

Two of the patients assigned to the placebo group were excluded. One patient was on this day not cooperative in the body plethysmograph and so the lung function values were not representative. By the initial measurement of the lung function values another patient did not have the values indicative of COPD i.e. of an obstruction (s. 2.7.3).

Exclusions from the treatment group

Four of the patients assigned to the treatment group were excluded. Of these two had problems on this day with the measurements in the body plethysmograph. One patient whose COPD was categorised as grade III displayed values on this day for COPD grade IV. The lung function values for a forth patient showed no obstruction on this day (s. 2.7.3).

Sample Size

The test group finally consisted of forty COPD patients with twenty patients in each group.

Length of Treatment/Schedule

The treatment of the treatment group and the placebo group lasted between ten and fifteen per patient.

The final lung function measurement was conducted between thirty and ninety minutes after the treatment. Here the actual procedure deviated from the planned procedure because it was not otherwise possible in the practice.

The procedure followed is displayed in the following flow diagram:

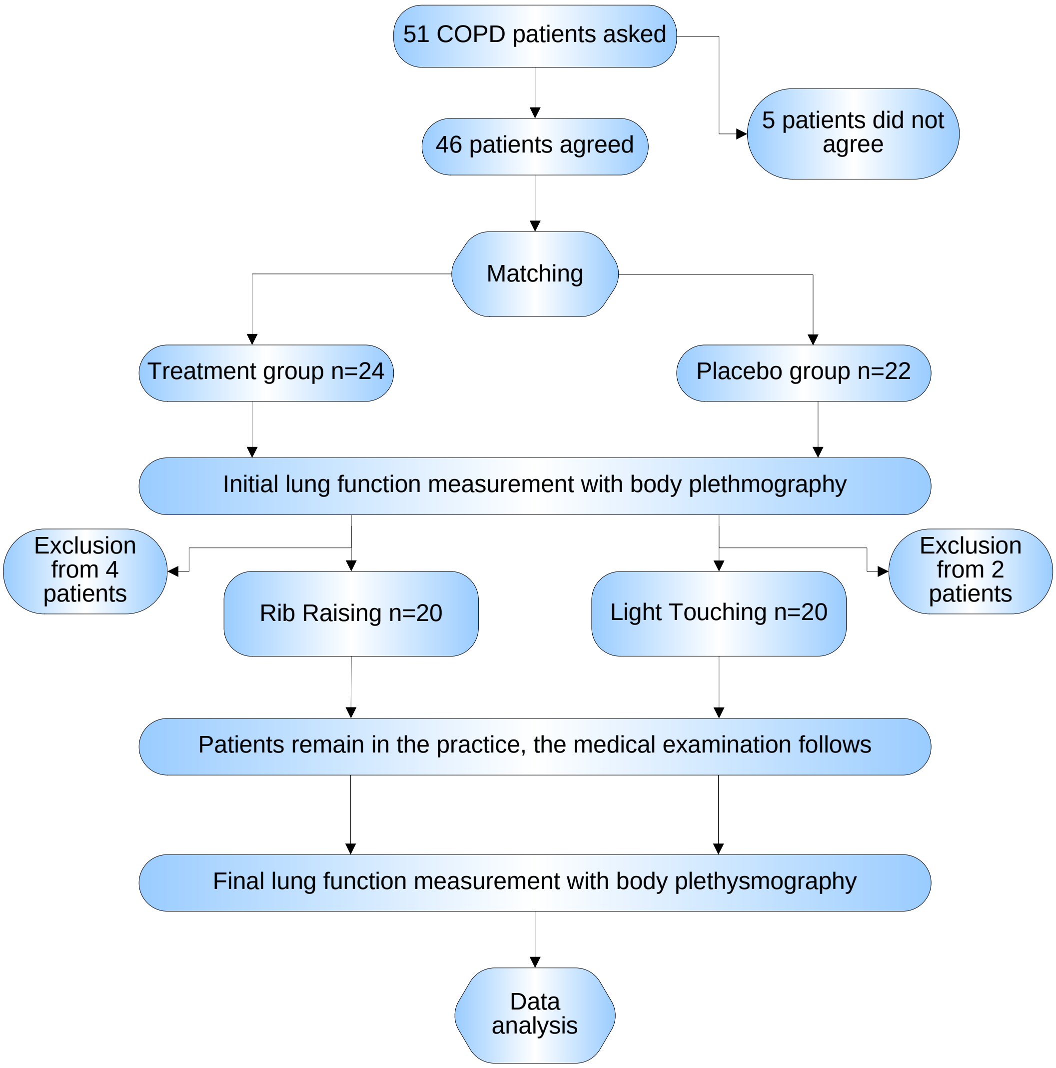


Illustration 12: Flow chart of actual investigation procedure

Source: The Author

6.2 Statistical Evaluation

In the following chapter the data is prepared and collated with descriptive statistics so that one obtains comprehensible results such as values for the mean, median, standard error, or frequency. An overview of the available data is thereby produced. In the following the results of the descriptive statistics are interpreted with inductive statistics. Whether the statements that have been won on the basis of the sample can be generalised for all COPD patients or whether the spread caused by chance prevents such a generalisation will be examined. If the statements can be generalised then one talks of significance. Statements are significant when the error probability p<0,05 (Krentz, 2005, p. 16ff).

6.2.1 Comparability of the Groups

Following Krentz ("2005) the treatment and placebo groups in the present study are independent samples and contain qualitative properties such as gender, smoker/non-smoker and COPD grade as well as quantitative properties such as age. This is significant for the choice of the correct statistical tests (Krentz, 2005, p. 13ff).

To begin with the comparability of the groups was examined respective the matching variables (s. 5.1.1). This is necessary in order to check whether eventual changes in the lung function values in the treatment group can be traced to influences that are also present in the placebo group.

	Group					
	Treatment	placebo	test	statistic	p	significance
Number	20	20				
Age (in year)*	66,85	68,30	T	0,483	,631	n. s.
Gender (% women)	35,0%	30,0%	Chi-Squared	0,114	,736	n. s.
COPD-Grade	see cross-tabulation		Chi-Squared	4,800	,091	n. s.
Non-Smoker %	15,0%	10,0%	Chi-Squared	0,229	,633	n. s.

People who have never smoked
* Age distribution: K-S-Test negative, Normal distribution accepted.

Table 3: Description of the Sample of the Treatment and Placebo Groups respective the matching variables

As can be seen from table 3 the groups are comparable respective the matching variables age, gender and smoker/non-smoker. The T-test (t) was used to evaluate the quantitative variable age. In the treatment group the minimum age was 44 the maximum 80 and in the placebo group the minimum age was 50 and the maximum 82. Thereby the ages of the patients chosen lie in the range given by ELF for the appearance of COPD. The evaluations of the qualitative properties gender, COPD grade and smoker/non-smoker were conducted with the chi-squared-test. If the chi-squared-test is significant the comparability is not present. The test is not significant respective COPD grade but because of the low cell allocation the test is not reliable. Therefore there are doubts concerning the comparability respective COPD grade.

In table four the distribution of the patients of differing grades within the groups can be seen.

COPD-Grade * Cross-Tabulation

			Placebo		
			0 Placebo	1 Treatment	Total
COPD-Grade	1	Number	3	2	5
		% in Placebo	15,0 %	10,0 %	12,5 %
	2	Number	15	10	25
		% in Placebo	75,0 %	50,0 %	62,5 %
	3	Number	2	8	10
		% in Placebo	10,0 %	40,0 %	25,0 %
Total		Number	20	20	40
		% in Placebo	100,0 %	100,0 %	100,0 %

Table 4: Description of the distribution of the patients with COPD grades I – III to the Treatment and Placebo groups

Because the utilisation of very many statistical tests presupposes a normal distribution of the properties the Kolmogorov-Smirnov-Test (K-S-Test, s. Table 3) is first applied (Krentz, 2005, p. 14). As can be seen in the following table the test produced no significance, which means that a normal distribution of the properties is present.

Kolmogorov-Smirnov-Test – Testing for Normal Distribution

	N	Normal Distribution parameter		Most Extreme Difference			Kolmogorov-Smirnov-Z	Asymptotic Significance 2-tailed
		Mean	Standard deviation	Absolute	Positive	Negative		
Age	40	67,58	9,383	,160	,068	-,160	1,014	,255
VC pre	40	2,7073	,73577	,088	,088	-,059	,554	,919
VC post	40	2,7053	,72314	,108	,108	-,063	,682	,741
FEV_1 pre	40	1,5218	,55315	,130	,130	-,087	,820	,512
FEV_1 post	40	1,5040	,51976	,114	,114	-,076	,722	,674
FEV_1/VC pre	40	56,2500	12,39468	,138	,067	-,138	,871	,433
FEV_1/VC post	40	55,6250	12,79160	,088	,072	-,088	,555	,917

Table 5: Description of the Kolmogorov-Smirnov-Test on the normal distribution of the properties

6.2.2 Influence of the Treatment on the Lung Function

The following evaluations serve to answer the research question (s. 1.2).

The evaluated properties of the sample are the values of the lung function before (Pre) and after (Post) the treatment, which is why the samples are called dependent or paired samples (Krentz, 2005, p. 16).

Because in what follows the quantitative, normally distributed properties of two dependent samples should be evaluated the t-test can, according to Krentz (2005), be applied (Krentz, 2005, p. 15). The pair comparison of the properties vital capacity, one-second capacity, and their ratio FEV_1/VC both Pre and Post treatment were carried out.

For the vital capacity (VC) values there was no significant (n.s. = not significant) change in either the treatment or placebo group following treatment. The tables 6 to 9 show the steps of the variance analysis.

Within-Subjects Factors VC

Factor1	Dependent Variable
1	VC_Pre
2	VC_Post

Table 6: Within-Subject-Factors VC

Between-Subjects Factors VC

		Value Label	N
Group	0	Placebo	20
	1	Verum	20

Table 7: Between-Subject-Factors VC

Tests of Within-Subjects Effects VC

Source		Type III Sum of Squares	df	Mean Square	F	Sig.
Factor1	Sphericity Assumed	,000	1	,000	,005	,945
	Greenhouse-Geisser	,000	1,000	,000	,005	,945
	Huynh-Feldt	,000	1,000	,000	,005	,945
	Lower-bound	,000	1,000	,000	,005	,945
Factor1 * Group	Sphericity Assumed	,001	1	,001	,037	,849
	Greenhouse-Geisser	,001	1,000	,001	,037	,849
	Huynh-Feldt	,001	1,000	,001	,037	,849
	Lower-bound	,001	1,000	,001	,037	,849
Error(Factor1)	Sphericity Assumed	,629	38	,017		
	Greenhouse-Geisser	,629	38,000	,017		
	Huynh-Feldt	,629	38,000	,017		
	Lower-bound	,629	38,000	,017		

Table 8: Test of Within-Subject-Factors VC

Tests of Between-Subjects Effects VC

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	585,903	1	585,903	544,656	,000
Group	,000	1	,000	,000	1,000
Error	40,878	38	1,076		

Table 9: Test of Between-Subject-Factors VC

In the following profile plot the distribution of the Pre and Post VC values for the treatment and placebo groups is presented graphically. It shows itself graphically apparently a difference between Pre and Post values. This difference is, however, low and as from the variance analysis resulting not significantly here.

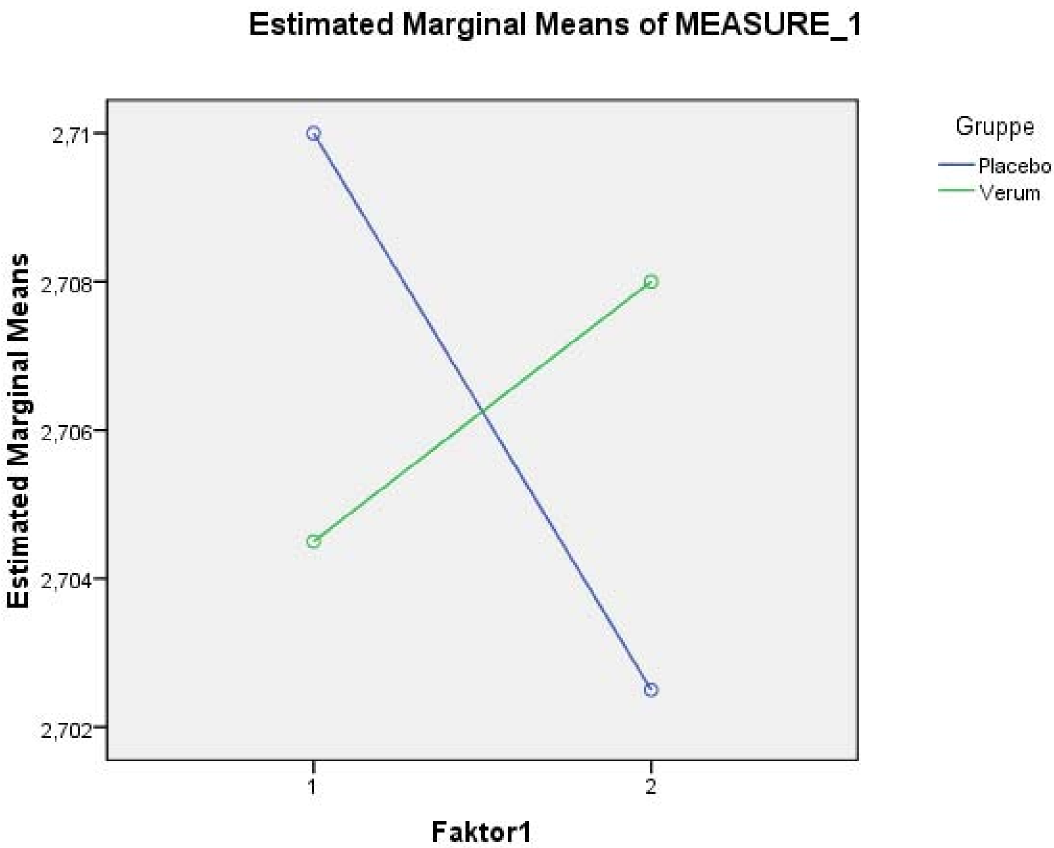


Illustration 13: Graphical presentation of the Pre and Post VC values in the treatment and placebo groups.

The variance analysis of the **one timed vital capacity (FEV_1)** also does not show any significant change as tables 10 to 13 point.

Within-Subjects Factors FEV_1

Factor1	Dependent Variable
1	FEV1_Pre
2	FEV1_Post

Table 10: Within-Subject-Factors of FEV_1

Between-Subjects Factors FEV_1

		Value Label	N
Group	0	Placebo	20
	1	Verum	20

Table 11: Between- Subject-Factors of FEV_1

Tests of Within-Subjects Effects FEV_1

Source		Type III Sum of Squares	df	Mean Square	F	Sig.
Factor1	Sphericity Assumed	,006	1	,006	,295	,590
	Greenhouse-Geisser	,006	1,000	,006	,295	,590
	Huynh-Feldt	,006	1,000	,006	,295	,590
	Lower-bound	,006	1,000	,006	,295	,590
Factor1 * Group	Sphericity Assumed	,011	1	,011	,527	,472
	Greenhouse-Geisser	,011	1,000	,011	,527	,472
	Huynh-Feldt	,011	1,000	,011	,527	,472
	Lower-bound	,011	1,000	,011	,527	,472
Error(Factor1)	Sphericity Assumed	,813	38	,021		
	Greenhouse-Geisser	,813	38,000	,021		
	Huynh-Feldt	,813	38,000	,021		
	Lower-bound	,813	38,000	,021		

Table 12: Test of Within-Subject-Factors FEV_1

Tests of Between-Subjects Effects

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	183,103	1	183,103	326,574	,000
Group	,339	1	,339	,605	,441
Error	21,306	38	,561		

Table 13: Test of Between-Subject-Factors FEV_1

In the following profile-plot the distribution of the Pre and Post FEV_1 values for the treatment and placebo groups is presented graphically. Also here there is hardly any graphical difference between the Pre and Post values.

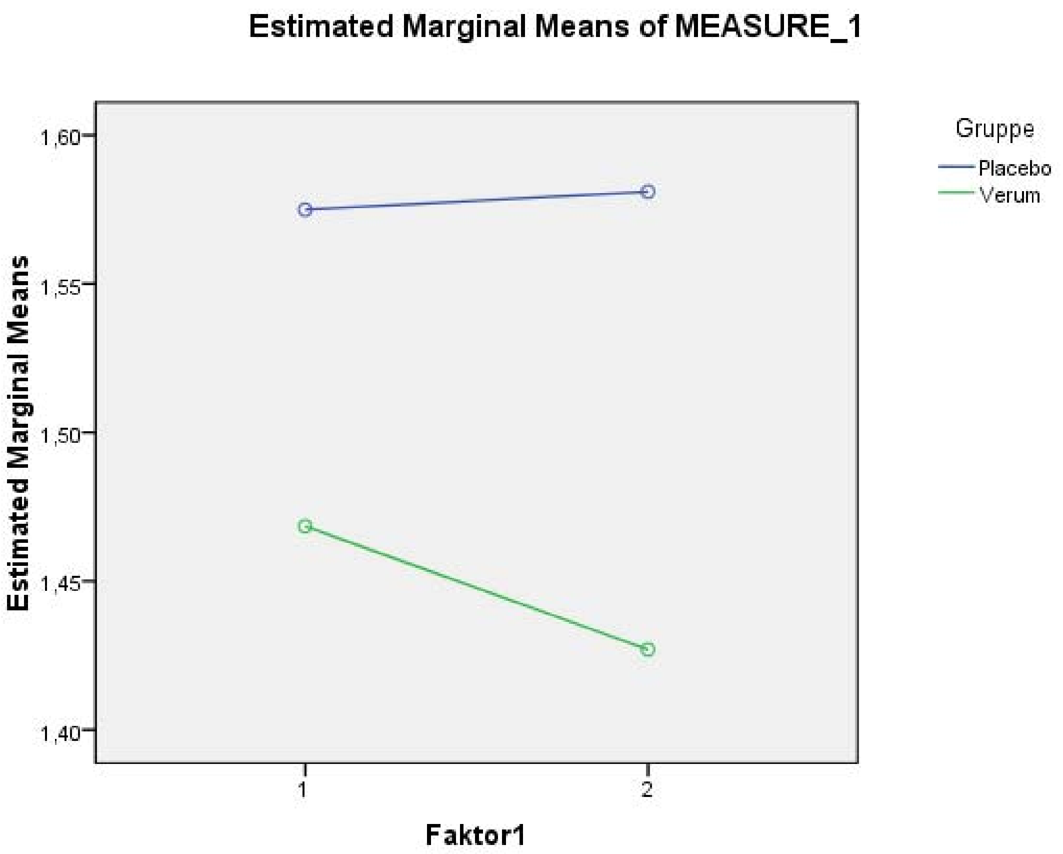


Illustration 14: Graphical presentation of the Pre and Post FEV_1 values in the treatment and placebo groups.

The values of the ratio FEV_1/VC also fail to display any significant change after treatment as the following tables show.

Within-Subjects Factors FEV_1/VC

Factor1	Dependent Variable
1	FEV1_VC_Pre
2	FEV1_VC_Post

Table 14: Within-Subjects Factors of FEV_1/VC

Between-Subjects Factors FEV_1/VC

		Value Label	N
Group	0	Placebo	20
	1	Verum	20

Table 15: Between-Subjects Factors of FEV_1/VC

Tests of Within-Subjects Effects FEV_1/VC

Source		Type III Sum of Squares	df	Mean Square	F	Sig.
Factor1	Sphericity Assumed	7,812	1	7,812	,703	,407
	Greenhouse-Geisser	7,812	1,000	7,812	,703	,407
	Huynh-Feldt	7,812	1,000	7,812	,703	,407
	Lower-bound	7,812	1,000	7,812	,703	,407
Factor1 * Group	Sphericity Assumed	9,113	1	9,113	,819	,371
	Greenhouse-Geisser	9,113	1,000	9,113	,819	,371
	Huynh-Feldt	9,113	1,000	9,113	,819	,371
	Lower-bound	9,113	1,000	9,113	,819	,371
Error(Factor1)	Sphericity Assumed	422,575	38	11,120		
	Greenhouse-Geisser	422,575	38,000	11,120		
	Huynh-Feldt	422,575	38,000	11,120		
	Lower-bound	422,575	38,000	11,120		

Table 16: Test of Within-Subject-Effects of FEV_1/VC

Tests of Between-Subjects Effects FEV_1/VC

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	250320,313	1	250320,313	825,525	,000
Group	418,613	1	418,613	1,381	,247
Error	11522,575	38	303,226		

Table 16: Tests of Between-Subjects Effects of FEV_1/VC

In the following box-plot the distribution of the Pre and Post FEV_1/VC values for the treatment and placebo groups is presented graphically. Also here there is hardly any graphical difference between the Pre and Post values.

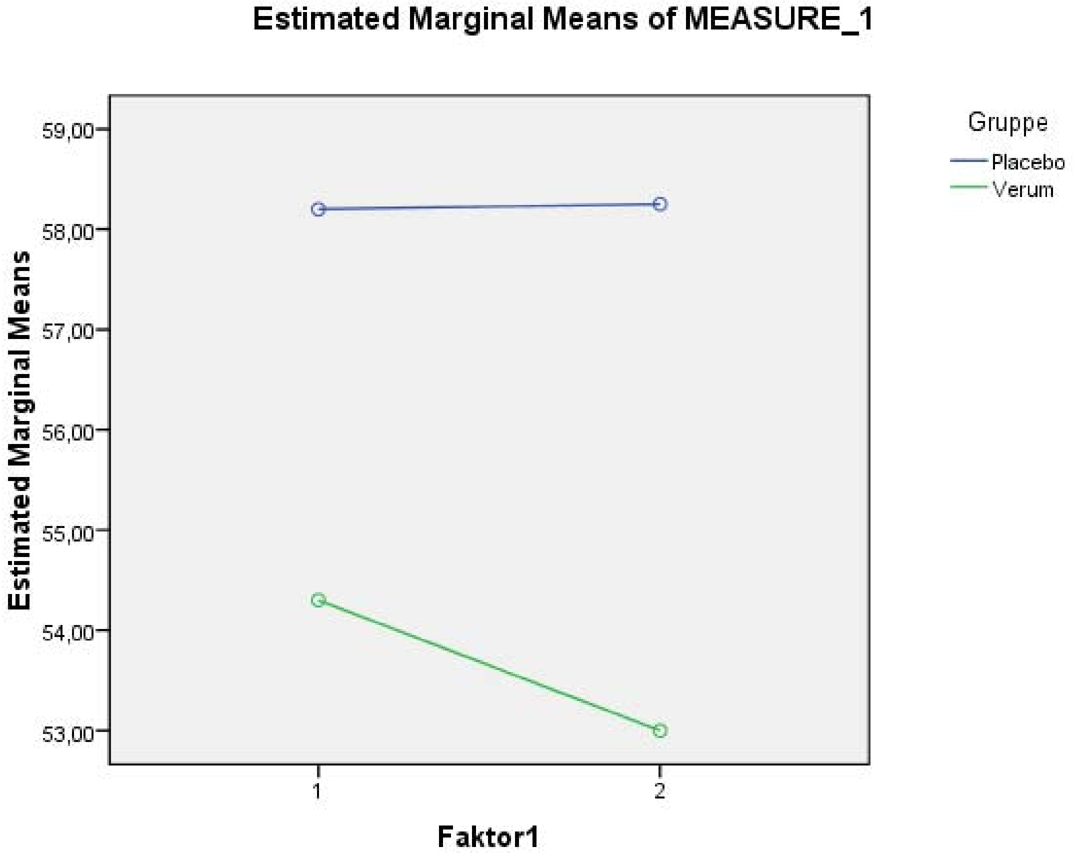


Illustration 15: Graphical presentation of the Pre and Post FEV_1/VC values in the treatment and placebo groups.

7 Discussion

7.1 Evaluation of the Research Hypothesis

The aim of the present study was to investigate whether the application of the osteopathic technique rib raising has an influence on the lung function of COPD patients. Treatment and placebo groups were used in order to guaranty a scientific approach. In one of the studies mentioned above, Noll et al. (2009) did not use either placebo or control groups so that the results of this study are only conditionally meaningful. The results presented in chapter 6 show that the application of the technique rib raising had no influence on the lung function of the selected COPD patients, here defined as VC, FEV_1, and the ratio FEV_1/VC. Similarly there is no recognisable reaction of the placebo group to the placebo treatment. So for the sample selected for this study the alternative hypothesis (s. 1.2) must be rejected and the null hypothesis (s. 1.2) accepted.

7.2 Discussion of the methodology

In order to generalise the claim of a study for the total or population (e.g. all COPD patients) the study must select a representative sample from this population (Trampisch et al., 2000, p. 25f). As the sample in the present study was selected from the patient pool of Dr Ammenn's practice and thus is not a cross-section of the total COPD-patient population, this sample cannot, according to Trampisch (2000), be regarded as representative. This means that the claim of this study cannot be generalised for the total COPD-patient population. The studies mentioned by me (Grabner, Noll et al.) also selected their samples from existing patient pools, which means that their study claims can also not be generalised. It is questionable as to whether within the framework of a master's degree course a clinical study could be conducted that permits a generalisation of its results for the total population.

As I immersed my self in the scientific work I came to the conclusion that it would have been sensible to have conducted a pilot study. A subsequent error analysis would have made avoidance of problems in the realisation possible. In the present study, for example, the matching of the groups respective the variable COPD-grade was not conducted correctly, which led to only a conditional homogeneity of the groups (s. 6.2.1). This could have been avoided in that another person other than the operative osteopath had taken over the matching. In order to control other study errors a second osteopath could have carried out the placebo treatments. Each of the initial and final lung function measurements was carried out by the same practice assistant. This study was conducted in the period from 20.05.2009 till 07.07.2009. On organisational grounds three different practice assistants carried out the measurements on the different days. For the reproducibility of the study it would have been better if the measurements for all the patients in the sample had been carried out by the same practice assistant (Miller et al., 2005, p.154). It was planned to conduct the measurement of the lung function following treatment sixty minutes after the treatment. Due to organisational problem within the practice this was not possible and the measurements took place between thirty and ninety minutes after treatment. The time between treatment and measurement varied also from patient to patient. In view of these study errors it can be seen that the variables of the investigation are not objective and that therefore the procedure is not exactly standardised (Deinzer, 2007, p. 55). According to Deinzer (2007) the internal validity of the investigation is therefore not given.

For future studies I recommend conducting a pilot study with error analysis in order to maintain the quality criteria of empirical scientific work in the main study and thereby to generate reproducible results.

7.3 Rib Raising Discussion

According to the osteopathic literature rib raising is applied to improve the flexibility of the ribs and for the treatment of disorders of the lung function (s. 4). In my work I have only investigated the influence on the lung function. If I had measured the chest circumference during the respiratory phase before and after the treatment I could have additionally investigated whether rib raising has an mobilising influence on the ribs of COPD patients. Hence another described influence of rib raising on the thorax mobility of COPD patients could have been investigated. The literature also describes how rib raising stimulates the truncus sympathicus. It goes on to describe that this leads to a positive influence on the sympathicotonus of the lungs. (s. 4). This is not investigated in the present work, as the sympathicotonus of the lungs cannot be determined with the lung function measurements. For this study rib raising was applied to all the lungs. If one follows the hypothesis then the truncus sympathicus can be stimulated in the area from the 7th cervical vertebra to the 12th thoracic vertebra. The sympathetic innervation of the lungs is only produced in the area of the first four thoracic vertebrae. Through the stimulation of the described section vegetative reactions of other organs could have been provoked according to the hypothesis. The appearance of these effects was not evaluated in the present study

Only one osteopathic technique was undifferentiatedly investigated in this study respective its influence on the lung function, which could lead to the accusation that this does not correspond to an osteopathic treatment, that it contradicts the osteopathic concept. In my opinion however the proof of the effectiveness of osteopathic treatment techniques as well as the proof of the validity of manual investigation techniques is a significant step on the way to making osteopathy a science. On the relationship between osteopathy and science Sommerfeld (2006) says:

> *"Many members of the osteopathic community support the opinion that because osteopathy is a holistic concept whereas science is reductionist the essence of osteopathy gets lost by the scientifically orientated processing and investigation of questions. This argument can be criticised on many levels"* (Sommerfeld, 2006, p. 5).

He goes on to say:

> *"If osteopathy wishes to claim scientific status then knowledge cannot be based purely on success, opinion or convention"* (Sommerfeld, 2006, p. 7).

According to Sommerfeld (2006) the aim of the scientific method can be seen in the improvement of the predictability of natural phenomena. Sommerfeld (2006) sees an essential aim of medical research in the predictability of clinical inventions respective efficiency (the question of use) and security (the question of possible harm). With the clarification of the research question of the present study the attempt was undertaken to answer the questions of use and harm for rib raising for COPD patients. The application of individual osteopathic treatment in accordance with the holistic principle, in my opinion makes the demonstration of causal connections more difficult. This opinion could be a result of the fact that my knowledge of the methodology of scientific work is insufficient. Sommerfeld (2006) says on the subject:

"An adequate methodological approach to the investigation of osteopathic clinical treatments can only be developed via the currently available methods" (Sommerfeld, 2006, p. 5).

7.4 Discussion of the choice of dependent variables

The dependent variables chosen for this study are the lung function parameters VC, FEV_1 and the ratio FEV_1/VC. These parameters are currently used as the standards for GOLD in order to determine the grade or level of obstruction and respectively the level of severity of the COPD (s. 2.7.3). According to Vogelmeier et al. (2007) there is a new possibility to determine the level of severity the BODE-Index (B: body-mass-index, O: obstruction, D: dyspnoea, E: exercise capacity). The impairment of the patient is characterised considerably better through the multidimensional consideration of the extent of the dyspnoea, the physical resilience and the body-mass-index (Vogelmeier et al., 2007, p. e10). The COPD patients mostly reported a feeling of improvement after osteopathic treatment. Noll et al. (2008) surveyed the subjective feeling of improvement by telephone the day after the treatment. Grabner (2007) describes the statements about the subjective feeling of improvement of the respiratory function of the patients. Also in this study only the lung function parameter were used to judge the effectiveness of the osteopathic treatment. Significant improvement in the lung function parameters was not found. With the BODE-Index various differentiated factors are evaluated that constitute the impairment of the COPD patient. Work with the BODE-Index, as dependent variable is an eventual possibility for future osteopathic studies in order to better evaluate the influence of individually applied treatments on COPD patients.

7.5 Thoughts on Scientific Work

I basically know what it means to work scientifically. As I conceived this study I was not aware of all the necessary aspect of this approach and therefore the problems described in this chapter occurred. For future studies I now know the necessity of better and more thorough preparation so that the internal validity of the work is as high as possible. To conduct such a study part-time and to write the thesis showed me my limits. The gain in knowledge that let me surpass those limits, the new knowledge of computer work and even learning the basics of statistics brought me joy in the end. My most important personal realisation from this study is that research is necessary for osteopathy and that scientific work in osteopathy is possible.

8 Summary

Aim: Rib raising is described in the osteopathic literature as a technique for the treatment of lung function disorders and diseases such as pneumonia. Scientific proofs of the effectiveness of the technique do not exist. The aim of the investigation is to analyse whether the osteopathic technique of rib raising influences the lung function respective the lung function parameters VC, $FEV_1$and the ratio FEV_1/VC of COPD patients.

Research Question: Can the parameters of the lung function VC, $FEV_1$and the ratio FEV_1/VC of COPD patients be influenced by the application of rib raising?

Methodology: The present study has the experimental research design. The patients were simply blinded and with matching assigned to a treatment and a placebo group. The practice assistants who conducted the measurements of the lung function were blinded respective the group assignment. A sample size of twenty patients per group was aimed for. After determining of the inclusion and exclusion criteria fifty-one patients were invited to participate in the study. Finally twenty patients in each group took part in the study. Following the initial measurement of the lung function the patients of the treatment group were treated with rib raising those of the placebo group with a placebo treatment by the osteopath. The final measurement of the lung function followed the medical control appointment. In the statistical evaluation the homogeneity of the groups respective the matching variables was first tested. Respective the variable COPD-grade the groups were only conditionally homogenous. The properties were shown to be normally distributed with the Kolmogorov-Smirnov-Test. Following this the t-test was applied in order to determine the differences in the lung function parameters Pre and Post treatment.

Results: The null hypothesis must be accepted and the alternative hypothesis rejected as the values of the lung function parameters after the treatment showed no significant change to those before the treatment.

Conclusion: Rib raising produced no influence on the lung function of the COPD patients in this sample. No generalisation for all COPD patients can be made as the sample for this study was selected from the patient pool of one practice and was therefore not representative.

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Anhang

Anhang 1: Patienteninformation

Patienteninformation

Sehr geehrte Patientin, sehr geehrter Patient,

vielen Dank, dass Sie sich die Zeit nehmen, an meiner Studie teilzunehmen. Das Thema der Studie ist: „Der Einfluss des Rib Raising auf die Lungenfunktion der Patienten mit Chronisch Obstruktiver Lungenerkrankung (COPD)“.

Das Rib Raising ist eine osteopathische Behandlungstechnik, die laut osteopathischer Hypothese einen günstigen Einfluss auf Lungenfunktionsstörungen hat. Die Osteopathie ist eine ganzheitliche Methode, die zu Diagnose und Therapie die Hände einsetzt. Diese Methode wurde von dem amerikanischen Arzt Andrew Taylor Still (1828-1917) begründet. Die wichtigsten Grundlagen sind das Funktionieren des menschlichen Körpers als Einheit, seine Fähigkeit zu Selbstregulation und Selbstheilung, sowie das Wechselspiel von Struktur und Funktion. Die Wirksamkeit vieler osteopathischer Untersuchungs- und Behandlungstechniken ist bisher mit dem klinischen Erfolg begründet worden.

Um Patienten angemessen behandeln zu können, will die Osteopathie mehr und mehr wissenschaftliche Nachweise der Wirksamkeit ihrer Methode.

Diese Studie soll dazu einen Beitrag leisten.

Ablauf der Studie

Nach Erteilen Ihres Einverständnisses erhalten Sie, wie für Sie gewohnt, die erste Lungenfunktionsmessung. Anschließend werden Sie von mir behandelt, was etwa 15 Minuten dauert. Dann gehen Sie in die Kontrolluntersuchung bei Dr. Ammenn. Eine weitere Lungenfunktionsmessung wird im Anschluß daran durchgeführt.

Die Behandlung sowie die zusätzliche Messung der Lungenfunktion sind für Sie kostenlos.

Haben Sie Fragen zur Studie, wenden Sie sich bitte an mich.

Susann Friedrich

Grüner Winkel 16

18273 Güstrow

Tel.: 03843/464687

Bitte unterzeichnen Sie nun die beiliegende Einverständnis-Erklärung.

Ich verbleibe mit freundlichen Grüßen

Susann Friedrich

Anhang 2: Einverständniserklärung der Patientin, des Patienten

Einverständniserklärung der Patientin, des Patienten

Name und Vorname der Patientin/ des Patienten:

…………………………………………………………………………………………………..

Hiermit erkläre ich mich bereit, an der Studie von Frau Susann Friedrich teilzunehmen.

Titel der Studie: „Der Einfluss des Rib Raising auf die Lungenfunktion der Patienten mit Chronisch Obstruktiver Lungenerkrankung (COPD).

Ich bin über den Ablauf der Studie mündlich und schriftlich informiert worden.

Ich bin damit einverstanden, dass meine persönlichen Daten unter Einhaltung des Datenschutzes zu Studienzwecken verwendet werden.

Es ist mir bewusst, dass ich für diese Teilnahme kein Geld erhalten werde und dass die Behandlung sowie die zusätzliche Messung der Lungenfunktion für mich kostenlos sind.

Ort, Datum Unterschrift der Patientin/ des Patienten

Anhang 3: Patientenstammblatt mit Ein- und Ausschlusskriterien

Patientenstammblatt mit Ein- und Ausschlusskriterien

Name:

Vorname:

Geschlecht:

Geb. Datum:

Beruf:

COPD-Grad:

Raucher:

Nichtraucher:

Ehemals Raucher:

Ein-, Ausschlusskriterium	Vorhanden	Nicht vorhanden
Respiratorische Insuffizienz		
Cor pulmonale		
Akute Änderungen		
Exacerbation		
Akute Erkrankungen		
Fieber		

Anhang 4: Beispiel - Protokoll der Bodyplethysmographie

Praxis Dr. med. Henri Ammenn
Internist, Pneumologe, Allergologe
Eisenbahnstraße 18
18273 Güstrow

Tel.: 03843-685060
Fax: 03843-685090

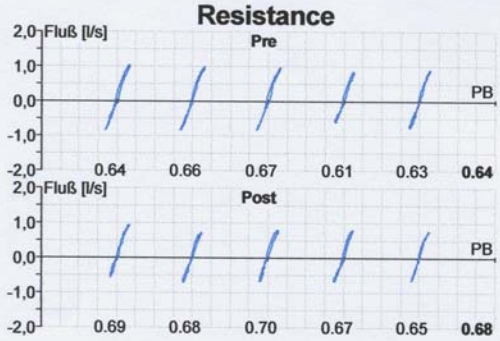
Name:
Vorn.:
Geb.:
IDNR:

82 Jahre
156 cm
72 kg
weiblich

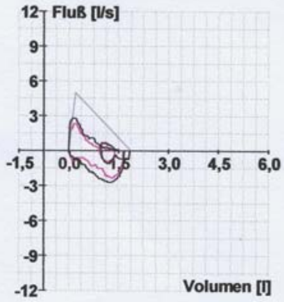
BMI: 29,6 kg/qm
MTA:
Arzt:

Pre: 29.06.2009 / 14:54 Temperatur: 28,7 °C Luftdruck abs./rel.: 1033/1034 hPa Luftfeuchte: 57 %rel 29.06.2009 / 15:52
Post: 29.06.2009 / 15:49 Temperatur: 29,2 °C Luftdruck abs./rel.: 1033/1034 hPa Luftfeuchte: 57 %rel
Sollwerte: ERS 1993, Zapletal Ganshorn PowerCube LF8.5F Release 4

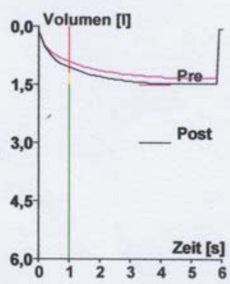
Resistance



Fluß/Volumen

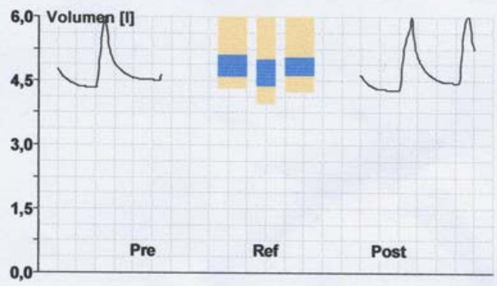


Volumen/Zeit



TGV

Spirometrie-Body



	Soll	Pre	Pre/Soll	Post	Diff.
VCin-B l	**2,02**	**1,67**	**83%**	**1,75**	**5%**
IRV-B l	-	0,90	-	0,95	5%
ERV-B l	-	0,29	-	0,38	31%
VT-B l	-	0,48	-	0,43	-11%
FVCex l	1,89	1,30	69%	1,48	13%
FEV1 l	**1,51**	**0,87**	**58%**	**1,03**	**18%**
FEV1/VCin .... %	**73**	**52**	**71%**	**59**	**12%**
MEF25 .... l/s	0,69	0,28	40%	0,28	3%
MEF50 .... l/s	2,93	0,61	21%	1,06	72%
MEF75 .... l/s	4,57	1,69	37%	1,91	13%
PEF .... l/min	**18107**	**140**	**1%**	**169**	**20%**
RAWtot .... kPas/l	**< 0,35**	**0,64**	**183%**	**0,68**	**6%**
RAW-ex .... kPas/l	< 0,35	0,56	161%	0,56	-1%
Gtot .... l/(kPa*s)	-	1,56	-	1,48	-6%
TLC-B l	4,51	5,24	116%	5,02	-4%
TGV-B l	2,58	3,86	149%	3,64	-6%
RV-B l	2,14	3,57	167%	3,26	-8%
RV/TLC-B .... %	46	68	147%	65	-4%