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The Influence of the Application of a Sternal Recoil Technique on Spirometric Parameters in Smokers

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Hiermit versichere ich, die vorgelegte Masterthese selbständig verfasst zu haben.

Alle Stellen, die wörtlich oder sinngemäß aus veröffentlichten oder nicht veröffentlichten Arbeiten anderer übernommen wurden, wurden als solche gekennzeichnet. Sämtliche Quellen und Hilfsmittel, die ich für die Arbeit genützt habe, sind angegeben. Die Arbeit hat mit gleichem Inhalt noch keiner anderen Prüfungsbehörde vorgelegen.

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Datum Unterschrift

Abstract

Objective:

The mucous membrane of the bronchi is harmed by the multitude of noxous substances in tobacco smoke. The deterioration of respiratory volumes by smoking happens twice as fast than by normal ageing processes in non smokers.

It was the aim of the study to examine the effect of a sternal recoil technique on spirometric parameters (VC, FEV1, FVC and MEF25) in smokers. The recoil technique is described in osteopathic literature as technique for diagnosis and treatment of tissue dysfunctions. According to the „link-concept“ by Chauffour, the recoil technique can be applied on the whole body. The dysfunctions are being dissolved.

Method:

Two groups of 12 smokers each were formed by random assignment of test persons meeting the inclusion criteria. All subjects were treated with recoil technique and sham treatment once each (cross over design). However, the order of the administration of the two methods was additionally reversed in the two groups (RS (recoil-sham)/ and SR (sham-recoil) group). The interval between the treatments was one week. Measurements of the spirometric parameters VC, FEV1, FVC and MEF25 were performed straight in advance and after each treatment.

Results:

The results of this study did not point out significant changes in any spirometric parameter in smokers after application of the recoil-technique.

Conclusion:

According to the results of this study, a single administration of a recoil technique has no significant influence on the lung function (VC, FEV1, FVC and MEF25) of smokers. It cannot be precluded, that the continued smoking overcasts the effects of the technique.

Key words: recoil technique, osteopathy, cigarette smoking, spirometry, lung function, VC, FEV1, FVC, MEF25, Fragerström test, FTNA

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1. Basicals

1.1. Introduction

Within the masters program and during everyday work with patients who smoke, I dealt with the question, whether the recoil technique has an influence on the respiration of smokers.

Well functioning respiration is vital for human beings.
According to a publication of the German Cancer Research Center Heidelberg, the airways and the lungs are being massively damaged by active and passive smoking. The multitude of substances in tobacco smoke damage the mucous membrane of the bronchi.
Lung function is already being diminished by the ageing process in the normal life course, but in smokers the lung volumes are deteriorated twice as fast [1].

In Hoche's [2] treatise of smoking and nicotine addiction it is described, that two thirds of all smokers admittedly regret to have started smoking, but a withdrawal from nicotine addiction succeeds only seldom.

As osteopath I aspire to treat this cohort of smokers adaequately in order to support their lung function. The recoil technique might be appropriate for this purpose.

According to Barral's textbook of visceral osteopathy [3], the recoil technique is a method for diagnosis and treatment. Chauffour [4], the pioneer of the "mechanical link" method, also describes the recoil technique as a method that is applied for osteopathic diagnosis and treatment of tissue dysfunctions.

In 2003, Laubenstein [5] examined the influence of a decoaptation of TH XII on the lung volumes. By his results, he could attest a highly significant improvement, even in the subgroup of the smokers.

The aim of this particular study is to investigate, whether the application of a recoil technique has an effect on the vital capacity and other respiratory parameters in smokers.

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Literature:

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[2] Hoche E., Mühlig S., Nowak D. and Wittchen HU. (2008): Rauchen und die Nikotinabhängigkeit in Deutschland. Zeitschrift für klinische Psychologie und Psychotherapie 37 (1):1-14.

[3] Barral, JP. (2005): Lehrbuch der Visceralen Osteopathie Band 2, 2. Auflage. München: Urban & Fischer Verlag: 16-19

[4] Chauffour P. and Prat E. (2002) : Mechanical Link. Berkeley: North Atlantic Books, California.

[5] Mattias Laubenstein (2003): Einfluss der Dekoaptation von TH XII auf die Lungenvolumina Vitalkapazität und Einsekundenkapazität. Gent: Diploma thesis, IAO Gent.

1.2. Anatomy

The thoracic cavity contains important anatomical structures that can be influenced by the recoil technique. The following section gives a short overview about these structures. Detailed descriptions of the interactions of the organs to each other can be found in standard anatomical literature (e.g. Netter [1], Sobotta [2] and Rauber/Kopsch [3]).

The function of the lung is the gas exchange via the alveoli. Carbon dioxide is released and oxygen is taken up.
The diaphragm separates the thoracic cavity from the abdominal cavity. The thoracic cavity is divided into the pleural cavities and the mediastinum. The pleural cavity is the potential space for the expansion of the lungs [4].
The large number of different vessels, nerves and organs can be recognised in Table 1.

The topographical relations of the lungs
Ribs 1-12
Clavicle
Sternum and subclavic vein
Phrenic nerve and pericardiacophrenic vein
Vagus nerve
Recurrent laryngeal nerve
Trachea
Main bronchi
Pulmonary veins and arteries
Aorta (left)
Esophagus (right)
Heart (more left than right)
Diaphragm
Azygos vein
Hemiazygos vein

Table 1: Topographical relations of the lungs (according to Hebgen, 2005: 190) [4].

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Mediastinum

The mediastinum - and thus the anatomical structures situated inside - are affected by the recoil technique. Fig. 1 depicts the complexity of this area. The mediastinum is the space between the pleural cavities and is divided into a superior and an inferior mediastinum. The inferior mediastinum is additionally subdivided into three parts, the anterior, middle and posterior mediastinum.

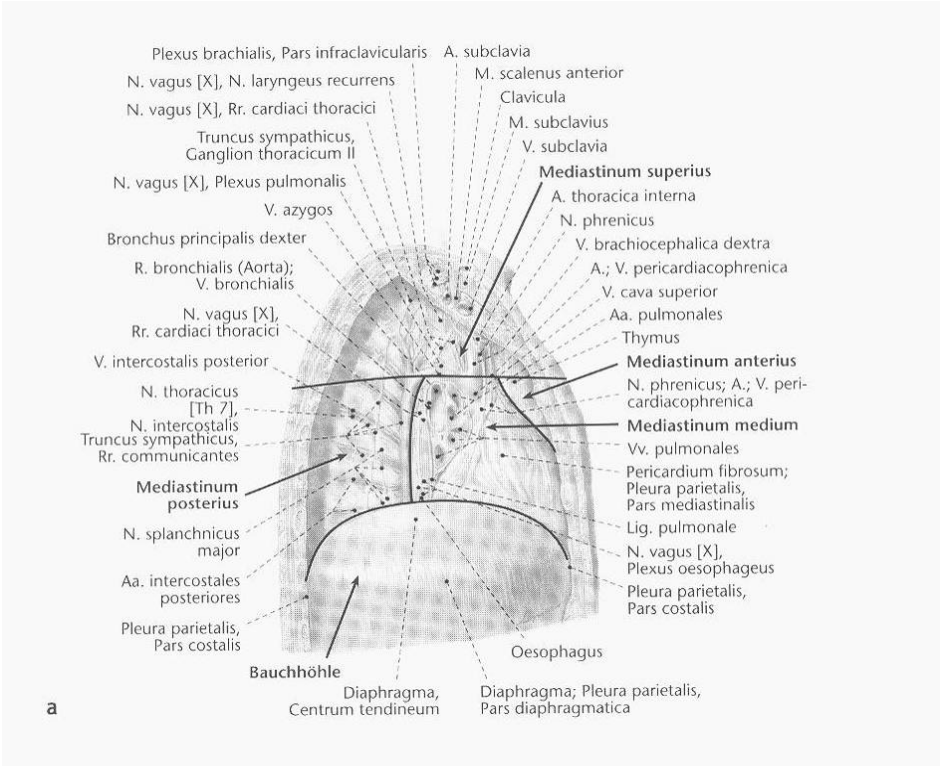

Fig. 1: Mediastinum from the right (Liem 2005: 579) [5].

The proximate anatomical relations of the mediastinum [5] are summarised in Table 2.

Ventral: Sternum, rib cartilage, ribs, endothoracic fascia, thymus, and the transverse muscle of the thorax.
Dorsal: Spine, dorsal thoracic wall, ribs, vena cava superior and the left brachiocephalic vein.
Cranial: First rib, clavicle, thyroid gland, trachea, esophagus.
Caudal: Diaphragm.
Lateral: Root of the lung and the mediastinal part of parietal pleura

Table 2: Anatomical relations of the mediastinum (Liem, 2005: 589) [5].

1.2.1. Biomechanics of the Thorax and Respiratory Mechanics

Respiratory mechanics are described by the pulmonary function parameters pressure, volume and respiratory flow. Since it is the aim to examine the effects of the recoil technique on respiration, I will outline the respiratory mechanics.

Kummer [6] describes the kinematic of the respiratory movements:
The thorax increases in profile by a movement of the ribs around the axis of the collum and the lifting of the sternum. The curvature of the thorax flattens by the contraction of the diaphragm. At that, the diaphragm exerts a pulling force on the lower ribs and seemingly leads to a constriction of the aperture of the thorax.
In principle, respiration bases on the increase and decrease of the space within the thorax. The increase in profile is connected with the lifting of the ribs and the lowering of the diaphragm.
Respiratory movements induced by the lifting and lowering of the ribs, is called “breast breathing”. The movements of the diaphragm are the basis for “diaphragmatic (or abdominal) breathing”. Respiration is a combination of these two basic movements and their distribution is only seldom balanced.

Literature:

[1] Netter, FH. (1995): Atlas der Anatomie des Menschen. Stuttgart: Georg Thieme Verlag.

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[4] Hebgen E. (2005): Viszeralosteopathie Grundlagen und Techniken 3. Auflage. Stuttgart: Hipokrates Verlag: 185-195.

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1.3. The History of Osteopathy

Osteopathy was developed by A.T. Still in the Midwest of the United States of America in the second halft of the 19th century. This was the time after the American Civil War. Still had been enrolled at the medical faculty for some time, but the established therapies with alcohol, mercury salts and opium did not convince him. His disappointment about the orthodox medicine at that time became the basis of his later ideas. He proceeded from the assumption, that god had created man complete.

At a mechanic approach, total well-being should arise when all body structures are arranged correctly and when neither bloodflow nor the transmission of nerve impulses are impaired.
Still developed treatment methods for a broad range of disorders. He treated patients by searching and treating malpositions or functional disorders. He loosened the muscular system with his hands and improved joint mobility. Still was of the opinion, that treatment can not be limited to symptoms only [1].

Still practised in the Midwest of the USA for more than 20 years and developed and improved the mechanic disease model. At that time, the dysfunction was called „osteopathic lesion“. This was the central concept in the development of osteopathy and implied all pathological changes of the tissues.
The term „osteopathic lesion” was not restricted to the joint complexes only. At that time, five kinds were being identified: Osseous, muscular, ligamentous and visceral lesions as well as combined forms. Over time, non-specific as well as specific techniques for the treatment of the viscera were developed, which included the treatment of the covering fasciae and of the associated vessels and nerve structures, whereby osteopathic palpation and treatment was extended to the body cavities [2].

Literature:

[1] Sammut E. and Searle-Barnes P. (2000): Osteopathische Diagnose. München: Richard Pflaum Verlag GmbH & Co KG: 17-19.

[2] Liem T., Dobler T.K. and Puylaert M. (2005): Leitfaden Viszerale Osteopathie 1. Auflage. München: Urban & Fischer: 2-3.

1.4. The Recoil-Technique

In the glossary of the compendium „Osteopathie. Pariteale Techniken“ (“Osteopathy. Parietal Techniques”, translated by myself) by Liem et al. [1], recoil is described as a technique for the correction of dysfunctions.

In the article „The Mechanical Link“, Somody-Neplaz [2] describes the concept of the recoil technique by Chauffour, Prat and Guillot, who have developed a method for osteopathic diagnosis and treatment with this link-concept. According to this concept, the recoil technique can be applied on the whole body for treatment. It consists of three phases:

1. First, the tissue is set in tension right up to the tissue resistance.
2. In the second phase, during exspiration, an impulse is given via a vibration that passes the tissue barrier.
3. In the last phase, the hands are withdrawn.

The effect of this technique is described as the correction of the condition of the tissue. This correction is said to cross the tissue structures in a chain reaction and to dissolve primary as well as secondary dysfunctions in the region of the restrictions.

According to Barral [3], the meaning of recoil is equivalent to the French “rebond”. He describes the recoil technique as follows: A tissue is being moved until the very limit and then it is suddenly being let go. In his oppinion, the recoil technique affects the nerval reflex, the proprio-, mechano-, and baroreceptors, especially in smooth musculature. This technique is suited for diagnosis as well as therapy.

In orthodox medicine, the technique is applied for indicating acute appendicitis by assessing the tenderness of the peritoneum (Blumberg’s sign). The recoil-technique is also described to be used for diagnosis of ligamental problems of the organs.

According to Barral’s considerations, the recoil technique has only a temporary effect. Barral rates the treatment method of Guillot and Guionnet as “excellent”, yielding in good results – which, however, were achieved only by them.

Personally, he likes to use the recoil technique in the beginning and at the end of a treatment to motivate the organs to concentrate on their self-awareness.

Meert [4] describes the recoil technique as an indirect technique. Its effect bases on the restoring force of the tissues that acts after the thrust and thus causes a correction of the pathological barrier.

In the treatise on the osteopathic dysfunction of the arteries by Chauffour et al. [5], they describe the effect of their method, the “osteopathic mechanic entity“ (OME).
Here, the recoil technique is described as a specific osteopathic treatment for primary dysfunctions. At this, the elasticity of the connective tissue is the working agent. A primary dysfunction is described as the function, where the loss of elasticity is highest.
Additionally, the authors bring up the positive influence on the vegetative nervous system. Here, the authors mention the influcence on the sympathicus via the costovertebral joints, and on the parasympaticus via the vagus nerve. The effect on the endogenous ballance is explained with the narrow connection of the fibers of the vegetative nervous system with the arteries.

Schroeder [6] describes the effect of a recoil-technique on a femal patient with a c-shaped scoliosis. Thereby, the adhesions at the mediastinum could be corrected. The liver, the diaphragm, the lungs and the phrenic nerve were treated by means of indirect techniques until they felt unrestricted. Finally the scoliosis was cured.
In this case study, several techniques have been administered. Therefore, the effect of the recoil technique, which has been part of the treatment concept, is difficult to assess.

Firsova [7] examined the effect of a recoil technique on the cardiovascular system and the respiratory system. She attested a significant effect on the systolic blood pressure. However, she did not find any effect on the respiratory system and the diastolic blood pressure. Measurements were performed imediately after administration of the technique and a quarter of an hour later. The spirometric measurements were performed during the application and reveal the respiratory

volumes and respiratory rates. The examinations show, that the recoil technique causes a pressure change in the blood vessels.

Ergott [8] examined the effects of a mobilisation of lungs and thorax and of recoil techniques in lateral position on a female patient with asthma. The aim of this single case study was to examine the patient's susceptibility to asthma. Ergott noticed a rise of the diaphragm, a deeper inspiration and a reduction of the susceptibility to asthma. Since the recoil technique was only one of eight techniques used, particular effects of the recoil technique cannot be specified.

Chappot [9] examined the recoil technique on a single healthy subject. He measured the thoracal and abdominal mobility by means of strain gauge strips. Thereby, he noticed a significant effect on the mobility of abdomen and thorax.

Wieser [10] examined the influence of osteopathic treatment of the mediastinum on the vital capacity. The recoil technique was one aspect of the treatment. One inclusion criterion for the subjects was a reduced mobility in the mediastinum. Again, the recoil technique was used only in combination with other techniques. Main focus was laid on the mobilisation of ligaments in the mediastinum. In this study, no significant group difference could be found.

Fischer [11] describes, that Joppich (2003) could gain significant improvements in his test persons by a sternal recoil techniqe, predominantly in men older than 40 years. Regrettably, I had no access to Joppich's study „Veränderung der Vitalkapazität der Lunge nach sternaler Recoiltechnik" („Changes in the vital capacity of the lungs after sternal recoil technique", translated by myself).
The same accounts for the studies „Wirkungsweise einer sternalen Recoiltechnik auf die physikalischen Eigenschaften der Lunge" ("Effect of a sternal recoil technique on the physical properties of the lungs", translated by myself) by Karottki (2004) and „Die unmittelbare Auswirkung der sternalen Recoiltechnik auf die thorakale Expansion bei der Atmung" ("The immediate consequence of sternal recoil technique on the thoracal expansion during respiration", translated by myself) by Verhaert and Potanznik (2000). Again, I had no access to the primary literature.

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Literature:

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[3] Barral JP. (2005): Lehrbuch der Viszeralen Osteopathie Band 2, 2. Auflage. München: Urban & Fischer: 16-18.

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1.5. History of Tobacco

Smoking is one object of this study. It has an old tradition and history. Here, I want to give a short insight in this issue.
If no other authors are specified, this section about the history of tobacco bases on the deliberations of Haustein und Groneberg [1].

As it is known from archaeological excavations in America, tobacco might be known for approximately 10.000 years. With the discovery of America, the mariners could monitor a widespread smoking culture, which was partially adopted and brought to Europe.
In the European cultural sphere, smoking was documented the first time in an old seafarer document. According to this, Christopher Kolumbus smoked tobacco leaves, coiled in corn leaves, on 11.10.1492. In China, smoking has been known for 2000 years.

Jan Nicot brought the tobacco plant to France in 1556. It was brought to Germany around 1600 [2].
When Rodrigo de Jerez, the discoverer of Kuba, came back to his Spanish native land as a smoker, his fellow countrymen saw how he smoked out of mouth and nose. He was delivered up to the inquisition by a priest, because people thought, that he was possessed by the devil, and therefore, he had to spend ten years in prison [3].

Medical use of tobacco up to the 19th century

In Alsace and in Palatinate, tobacco was cultivated for therapeutic use and sold as powder, ointment, extract and “water”. Bartholin of Copenhagen used tobacco as enema. It was prescribed against strychnine intoxication and tetanus up to the 19th century. In the monograph of Müller, the use of tobacco and its preparations is recommended for hydrops in the lower abdominal region.

Other doctors of the 17th and 18th century knew and prescribed tobacco preparations for oedamata. Nicotine was prescribed for “spastic dysurias”, too. It is known of other authors of this time, that it was administered for tetanus, neuroses, clamped hernia and obstipation.

1.6. The Cigarette

The development of the cigarette started with the change to a mass consumtion good. The „cigarittos“, developed by Hamburg merchants, were common in Spain, Portugal and their colonies. Thereby, Virginia tobacco was filled in paper tubes. In 1830, actresses presented the cigarette to the Parisian citicens.

In the middle of the 19th century, a drying process with high temperature was developed and used in North Carolina. In this way, the nicotine salt became available in the relative acidic dry goods and thus could be inhaled more easily.
The cigarette became established during the Crimean war (1853-1856). The first automatic cigarette fabrication of 3.600 pieces per hour was demonstrated at the Parisian World Exhibition in 1867.
Reynolds started the production of Camel cigarettes in 1913. This tobacco blend became the prototype of the American cigarettes.

Consequential damages by active smoking

Already 150 years ago, long-term damage such as chronic glossitis, pharyngitis, tonsilitis and tongue cancer was reported. The occurrence of lung carcinoma was registered in the United Kingdom in 1920.

In epidemiological studies, it is clearly proven, that there is a correlation between cigarette consumption and the accumulated development of tumors of the lung, trachea, larynx, oral cavity, esophagus, pancreas, kidney and urinary bladder.

Nicotine is taking part in the development of angiopathy in smokers. The chronic exposure can lead to heart deseases, arterial obliteration, impaired circulation and stroke.
Years of inhaling particle bound substances implies the development of bronchitis, tar lung and bronchial carcinoma. The risk of a smoker with a cigarette intake of more than 40 per day is approximately five times higher than risk of non smokers [2].

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Smoking in combination with alcohol intake

The combination of both toxins increases the risks. For example, risk for base of the mouth cancer is 15 times higher for smokers (40 cigarettes per day) who additionally drink 40 g alcohole per day. The development of oesophageal cancer increases by the 150-fold in smokers, who smoke 30 cigarettes per day and additionally drink 120 g alcohole/per day.

Literature:

[1] Haustein KO. and Groneberg D. (2008): Tabakabhängigkeit, 2. Auflage. Berlin/Heidelberg: Springer -Verlag.

[2] Reichel FX. (2002): Taschenatlas der Toxikologie. Stuttgart: Georg Thieme-Verlag: 148-150.

1.7. Ingredients in Cigarette Smoke and their Effects on the Body

All ingredients of cigarette smoke are harmful to the body. The listing of all toxins in tobacco smoke would outrun the size of this thesis. In order to communicate an impression about the hazardousness of cigarette smoke, some of importance will be listed next.

Natural ingredients in tobacco smoke

Some components of the tobacco directly pass into the smoke, such as nicotine, some tobacco alkaloids and tobacco-specific nitrosamines. Other constituents develop by pyrolysis in the glow zone, as e.g. carbon monoxide, benzo[a]pyrene and benzene.

Most of the constituents of cigarette smoke are formed by reduction or oxidation of specific precursors contained in tobacco, e.g. flavouring agents, furans and indoles. Others are formed newly from nitrous materials in the tobacco. Some examples are nitrous gases, ammonia and hydrogen cyanide [1].

More than 3000 different substances and chemical compounds can be detected in tobacco smoke. Apart from the active ingredient nicotine, examples for these are tar,

highly toxic gases such as carbon dioxide (CO_2), carbon monoxide (CO), nitric oxide (NO), nitrogen dioxide (NO_2), formaldehyde, hydrocyanic acid, benzo(a)pyrene, nitrosamines, hydrogen sulphide (H_2S), sulphur dioxide (SO_2), ammonia and arsenic [2].

Nicotine

Nicotine is an alkaloid. It was isolated for the first time by the students Posselt and Reimann in Heidelberg in 1828 [2].

It is a very strong plant toxin and can be detected predominantly in the tobacco plant but also (in variing concentration) in other plants, too.

It is taken in via the bronchial tubes and lungs, oxidated to cotinine in the liver and eliminated with urine with a half life period of the elimiation of two hours [3].

In 1965, Schmitterlöw und Hanson could detect radioactively traced nicotine in the brain and lung two minutes after smoke inhalation [4].

Nornicotine

Dickerson und Janda, two scientists describe substances in tobacco, the so-called „Advanced Glycation Endproducts“, which are known as decisive factors in the development of diabetes, cancer, vessel occlusion, arteriosclerosis and Alzheimer’s disease [5].

Tar

Tar is a mixture of hydrocarbons. At a consumption of 20 cigarettes daily for 20 years six kilograms of soot get into the lung. The tar constituents remain in the lung, damage the mucous membrane and allow the formation of carcinomas. The soot particles migrate into the stellate cells and can be well observed in the lungs in a post-mortem examination [6].

Carbon monoxide

Carbon monoxide is a toxic gas, which is formed in incomplete combustion. This difficulty soluble gas has a higher affinity to haemoglobin than oxygen.

The binding of carbon monoxid to haemoglobin and other chromoproteids, as e.g. myoglobin, is reversible. Carbon monoxide is eliminated by breathing in air low in carbon monoxide within ten to twelfe hours.

The body adapts to higher carbon monoxide concentration by increased release of erythroproteins, leading to erythrozytosis. By that, a hematocrit value of > 65% can be acchieved in cigarette smokers [1].

The high carbon monoxide load leads to a degression of the psychic capacity, photosensivity of the retina and arteriosclerosis. It promotes atheromatosis of the vascular walls and exacerbates mainly peripheral, cranial and cerebral impaired circulation [7].

Hydrocyanic acid

Hydrocyanic acid has a paralysing effect on the respiratory centre, the cilia and the cellular respiratory chain [8].

Dust particles

The inhalatively absorbed suspended dust is deposited at different places of the respiratory tract. Small particles that reach the bronchial tubes and pulmonary alveoli, (i.e. particulate matter with approx. 0,5µm) are hardly deposited. If the bronchial mucous membrane is intact, they are quickly eliminated from the airways and discharged predominantly by the gastrointestinal tract. If there is a pre-existing defect caused by tobacco smoke, a loss of the mucociliary cleaning function can occur. Then these particles are accumulated in the lungs [9].

Hydrocarbons

Hydrocarbons, particularly the aromatic compounds, play a major part as cancerogens. Phenols irritate the mucosa and destroy the ciliary epithel [10].

Concentrations of the noxious substances

Detailled descriptions and ingredients of tobacco smoke can be found in the Internet „Toxikologische Aspekte des Tabakrauchens“ (“Toxicological aspects of smoking tobacco“, translated by myself) [11].

At that, it becomes obvious, that concentrations of harmful substances in the smoke of only one cigarette surmount the standard values many times over.

Literature:

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1.8. Addictive Behaviour

In order to obtain a homogeneous sample of smokers, smokers with addictive behaviour were chosen for this study. In this section, the terms “addictive behaviour” and “drug dependency” will be sketched.

What is addiction?

“Addiction” is a synonym for dependency, that means it describes the reliance on substances or behaviour patterns [1].
Smoking meets the criteria for addiction and was integrated in the tenth edition of the “International Statistical Classification of Diseases and Related Health Problems” (ICD-10), released by the World Health Organisation. For the first time, it got a separate designation under the category „tobacco generated disorders“ (F17.xx) [5].

What is dependency?

The tobacco drug dependency has not only psychic portions but also somatic ones. In medical sense, criteria like strong desire, a kind of necessitation of smoking are considered. Additionally, the unability to be abstinent is appraised.

Abstinence withdrawal symptoms, if smoking is restricted, play a part, too. It is assessed, if smoking was already cessated without success before, or, if smoking is continued, in spite of the occurrence of damages [2].

According to a study by Hoch et al. [3], fifty-six percent of the German regular smokers are addicted to nicotine. The proportion of women is 27,5% and the proportion of men 28,5%.

Explanatory models for the development of an addiction

In addiction research, there are manifold explanatory models for the development of an addiction. In principle, biological, psychological and sociological causes are mutually involved in an addiction and in the development of an addiction. From this results the “biopsychosocial development model” of an addiction [7].

Biological Reasons

Positive feelings like lust and joy are called “reward” in terminology. They are produced and controlled by specialised nerve cells under involvement of the transmitter dopamine in the brain stem.

All addiction causing drugs activate this dopamine reward system in the brain. Continuing drug consumption leads to fundamental changes in the brain and to an artificial neurochemical equilibrium. This necessitates a regular feeding with the addictive substance in order to avoid abstinence withdrawal symptoms.

Considerations from learning theory

Lerning is an attitude change in behaviour brought about by experiences [9].

In considerations from learning theory, tobacco drug dependency is caused by operant conditioning processes.

Sign stimuli, such as a bar or a cigarette lighter are associated with the positive effect of smoking. The psychotropic effect of nicotine with stress reduction, mood lift, sense of identification, and self-assurence can lead to withdrawal after the loss of this effect [6].

The development of the biological addiction to nicotine

The alkaloid „nicotine“, which is present in tobacco beside other chemical compounds, is responsible for the development of a nicotine drug dependency.

Nicotine meets the criteria for psychotropic substances in medicine. Since this substance causes an addiction, it can be denoted as drug.

Since tobacco products are commercially available without legal restrictions, this drug is counted to the “legal drugs” [8].

Meters for nicotine drug dependency

The standard tool for diagnosis of tobacco drug dependency is the international „Fagerström Test for Nicotine Dependence“ (FTND). It is a psychometric test with six questions for acquiring data about the dimensions of tobacco drug dependency in the behaviour of smokers.

It is a expressive predictor for the short- and long-term abstinence after termination of smoking [9].

Literature:

[1] Psychyrembel (2004): Psychyrembel Klinisches Wörterbuch, 260. Auflage. Berlin: Walter de Gruyter.

[2] Batra A., Brömer-Breitenbücher A. and Buchkremer G. (1997): Raucherentwöhnung– Indikationen und Konzeptionen. In: Aßfalg/Buss (Ed.): Die Kunst der Indikation. Kongreßband zur Tagung des Bundesverbandes für stationäre Suchtkrankenhilfe, Geesthacht: Neuland: 104–111.

[3] Hoch E., Muehlig S., Höfler M. et al. (2004): How prevalent is smoking and nicotine dependence in primary care in Germany? Addiction 99: 1586–1598.

[4] Fiore MC., Bailey WC., Choen SJ. et al. (2008): Treating Tabacco Use and Dependence. Clinical Practice Guideline. Rockville: US Department of Health and Human Services, AmJ Publication Health Service.

[5] Weltgesundheitsorganisation (World Health Organization) (1994): Internationale Klassifikation psychischer Störungen, IDC-10. Bern/Göttingen/Toronto/Seattle: Verlag Hans Huber.

[6] Brunnhuber S., Frauenknecht S., Lieb K. (2005): Intensivkurs Psychiatrie und Psychotherapie, 5. Auflage. München: Urban & Fischer Verlag: 231.

[7] Engel Gl. (1977): The need for a new medical model. A challenge for biomedicine. Science 196: 129-136.

[8] Buchkremer G. and Rath N. (1989): Raucherenwöhnung – Psychologische und harmakologische Methode. Stuttgart: Thieme-Verlag: 4-11 and 35-47.

[9] Lenzen D. (1989): Pädagogische Grundbegriffe 2, Jugend-Zeugnis. Reinbeck bei Hamburg: Rowohlt Taschenbuch Verlag GmbH.

2. Objective

No studies dealing with an examination of the lung function of smokers after application of the recoil technique have been published in the scientific literature yet. Object of the actual study is to examine the effects of the recoil technique, as it is described by several authors in osteopathy, on lung function.

The following hypotheses will be examined:

H_1 = A sternal recoil technique has an effect on vital capacity (VC), forced vital capacity (FVC) and forced exspiratory volume in one second (FEV1) of smokers.

H_0 = A sternal recoil technique has no effect on the vital capacity (VC), forced vital capacity (FVC) and the forced exspiratory volume in one second (FEV1) of smokers.

3. Methodology

The current study was approved by the Vienna School of Osteopathy in co-operation with the Donau University Krems.
The informed consent for the examinations was signed by the test persons.

3.1. Test Persons

The test persons were between 20 and 45 years of age and were recruited in the praxis for physiotherapy in Albershausen.
The Fragerström test for nicotine addiction (FTNA, cf. chapter 3.9, German version: Beltz test [1]) yielded in nicotine drug dependency of all test persons. They were being smokers for at least five years, but they had no diagnosed pulmonary disease or allergy. Additionally, they had to meet the other study criteria. The study was designed as crossover pre-test –post-test study. The test persons were recruited by snowball sampling and randomly assigned to two groups.

Randomisation was done by means of the registration list. The list of participants was numbered consecutively, persons with uneven numbers were assigned to group 2,

persons with even numbers to group 1. The test persons registered themselves in the list and they did not know the meaning of the numbers.

Group 1 – RS Group
The test persons of the RS group were treated first with the recoil technique, and one week later with the sham treatment.

Group 2 – SR Group
The test persons were treated first with the sham technique, and one week later with the recoil treatment.

Selection of the test persons
Smokers between 20 and 45 years were recruited with an announcement displayed on a board in the praxis for physiotherapy Weiler in Albertshausen. Additionally patients were asked, whether they knew persons, who were willing to participate in the study.
Then, the test persons were invited and informed about the study. They had to meet the inclustion and exclusion criteria and had to sign a declaration of consent.

Literature:

[1] Bleich S., Havemann-Reinecke U. and Kornhuber J. (2002): Beltz Test, Testmappe. Göttingen: Hogreve Verlag.

3.2. Inclusion Criteria

The test persons had to be between 20 and 45 years of age, had to be smokers for at least five years and achieve at least three points in the Fragerström test for fulfilling the criterion for addiction.
Since smoking is prohibited for young people up to the 16th year of age according to the law for the protection of children and youth (Bundes Jugendschutzgesetz, § 10), the lower cut-off for age was predefined with 20 years.
Lung- and thorax elasticity change with age. Therefore 45 years of age were predefied as upper margin.

3.3. Exclusion Criteria

Persons with cardiological diseases, angina pectoris, hypertension (220/120 mm Hg), osteoporosis, subjects who had to take drugs like cortisone, psychotropic drugs or blood thinners as well as persons with mental disorders, known pulmonary diseases or with acute pain were excluded from participation.
Exclusion criteria were chosen this way, because:

- The recoil technique affects the cardiovascular system. A cardiological influence by compresson of the thorax can not be precluded.

- Psychotropic drugs have an influence on perception. Since spirometric measurements are dependent on the co-operation of the test persons an influence of this kind of drugs can not be precluded.

- The recoil technique might cause harming adverse reactions like fractures or haemorrhages in subjects with osteoporosis and/or taking blood thinners.

3.4. Test Set-up

Instruments used for measurement

For the measurements, a Jaeger pneumotachograph, type “MasterScope” with the following specifications was used:

Flow:	Range:	between 0 and ± 20 l/s
	Precision:	between 0,2 and 12 l/s ± 2 %
	Resolution:	10 ml/s
	Resistance	<0,05 kPa/(l/s) at a flow of 10 l/s
Volume:	Type:	Digital Integration
	Range:	±20 l
	Precision:	± 3 % or ± 50 ml (depending on what is higher)
	Resolution:	1 ml

-

3.5. Measuring Equipment

The equipment for spirometric measurements was a portable hand spirometer (MasterScope) with height-adjustable fixation, a laptop by Fujitsu Siemens Computers with the software “LAB 5.1” by Viasys and a stool (cf. Fig. 2).

Fig. 2: Arrangement of the test equipment.

3.6. Measurement

Personal data of the test persons were entered into a data form (cf. Fig. 3) in advance of the measurements (surname, first name, date of birth, height, sex, weight). Then an identification number was assigned to each test person. Age, relative weight, normal weight, body mass index and body surface was calculated automatically by the software.

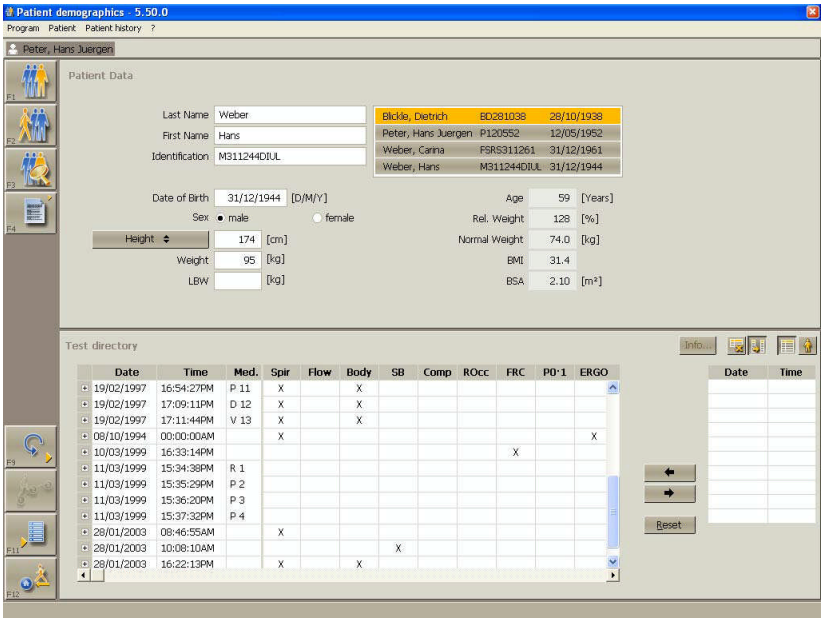

Fig. 3: Example for the data form. (Viasys, 2007: Manual, Version 5.2)

Performance of the Measurement

During the measurements, the subjects sat upright on a stool without seat back. The measuring equipment was organised that way, that the mouthpiece of the pneumotachograph was at the height of the mouth of the test person. A 45° manifold was used in order to prevent saliva to enter the measuring device.

The noses of the test persons were shut with a curly bracket. Narrowing garments were taken off.

In advance of each measurement, the device was calibrated for air pressure, room temperature, air humidity and sea level. Volume calibration was performed by means of a calibration pump made by Viasys.

The respiratory manoevre during the measurement was performed the following way:
In the beginning, the test persons took some breaths via the mouthpiece.
Then, the test person slowly exhaled maximally from normal respiration until the exspiratory residual volume was reached, then slowly inhaled maximally up to the inspiratory vital capacity. Next, the subject had to exhale as forceful and as far as possible and to inhale the same way.

-

Since co-operation of the subjects is crucial for the quality of the measurement, three reproducible trials were performed each time. The test persons were encouraged by always the same commands like “go on, go on, go on!”

Evaluation of the measured data was done by means of the software LAB 5.1 by Viasys (cf. Fig. 4). The results were calculated by the software and the actual results were compared with the normative values.

The results were collected in an internal data base of the evaluation software. Therefore, pretest and posttest data could be easily matched and an external intervention was not possible.

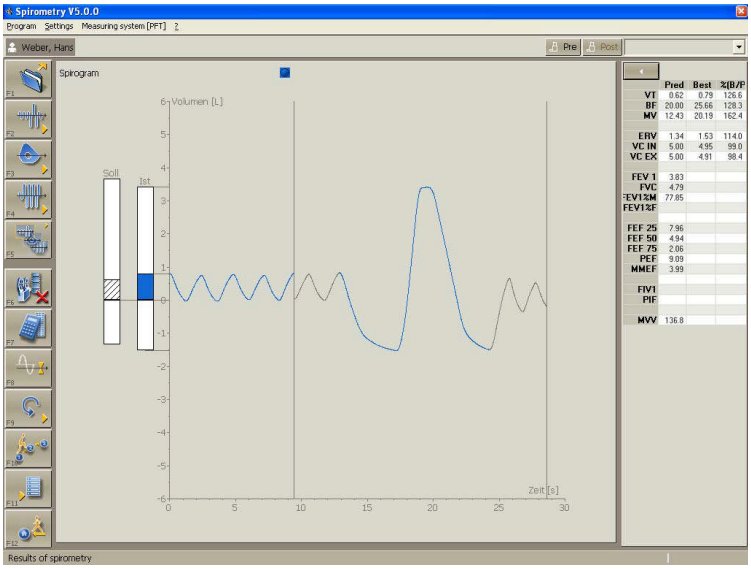

Fig. 4: Example for a spirogram (Viasys, 2007: Manual , Version 5.2).

3.7. Administration of the Techniques

Position of the test persons

The test persons layed in supine position on a therapy table. The legs were supported with a knee roll and the head was placed on a therapy cushion. The sternum was undressed and the test person was free of narrowing clothes. This position was the same for the administration of each technique.

Recoil technique

For administration of the recoil technique, thenar and hypothenar as well as the finger tipps were laid on the sternum. The test person was instructed to breath in and to breath out. During exspiration, the barrier point was fixed and during inspiration, at the point of the highest tension, the hand suddenly was withdrawn, while the test person continued inspiration.

Sham technique

For administration of the sham technique, thenar and hypothenar as well as the finger tipps were laid on the sternum, equal to the hand position during the recoil-technique. Again, the test person was instructed to breath in and to breath out. The hand was held in skin contact, only. Finally, it was withdrawn at the end of the inspiration.

In advance of and after administration of the techniques, the test persons layed for five minutes in a calm position. After that, the measurements were repeated.

3.8. Spirometry

Spirometry is the classical procedure for lung function assessment.
Haber[1] describes, that spirometers became smaller with time. In the beginning the instruments were as large as wardrobes. Nowadays, they fit in a portfolio and the largest part of the device is the computer.

In spirometry, the respiratory volume that can be mobilised by ventilation is registered and measured, but not the total lung volume.
The prototypes of the spirometer were bell spirometers, which consisted of a glass bell jar, a flexible tube and a mouthpiece, the test person was connected with. With these instruments, the respiratory volume was directly assessed by measuring the up- and down-movements of the water level in this closed system.

In contrast, modern instruments use an open system. The respiratory flow is measured in l/sec oder l/min by means of a measuring head for signal detection and by different technical solutions. In this case, the respiratory volume is not measured directly, but this is done afterwards by means of computer software.

Only the mobilisable respiratory volumes can be measured by means of these systems. The residual volume is beyond measurement.

Definitions of Terms

Spirometry

Measurement and registration of the mobilisable respiratory volumes by means of a spirometer[1].

Spirometer systems

In spirometry it can be distinguished between two systems, the open and the closed system [2].

Open spirometer system

In an open system, the subjects inhales the ambient air via a valve. The exhaled air is trapped in a repository and measured. By gas analysis, the breathing gas can be investigated with regard to its composition and concentrations. The advantage of an open system is the low effort and the location-independent determination of the conversion of the respiratory air volume [2].

Closed spirometer system

In a closed system, the subject inhales as well as exhales via a mouthpiece that is connected to the spirometer. At that, the carbon monoxide is absorbed by means of a special device and new oxygen is added. The disatvantage of this system is the high effort [2].

Bodyplethysmography

This system is largely independent from the co-operation of the subjects. With bodyplethysmography two important parameters of lung function can be assessed: The intrathoracic gas volume and the airway resistance during respiration at rest.

This method bases on the principle, that the product of pressure and volume is a constant (Boyle-Mariotte’s law).

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Pneumotachography

Pneumotachography is an open spirometric system, by which instead of the respiratory volumes the respiratory flow rate is measured.

In a pneumotachograph, a flow resistor is integrated in the measuring head and the pressure difference ahead of and after the resistor is measured. This pressure difference is directly proportional to the pressure difference of the respiratory flow rate. That means, that the volume per time, passing the profile is proportional the respiratory flow rate [3].

Lung function indices in spirometry

Total lung capacity

The total lung capacity is the gas quantity that is enclosed in the thorax after maximal inspiration. Formally, it consists of the two functional main parts “vital capacity” and “residual volume”. It can be assessed by bodyplethysmography, only.

Residual volume (RV)

The residual volume is the portion of the total lung capacity that can not be mobilised.

Vital capacity (VC)

Vital capacity is the volume that can be maximally mobilised by voluntary respiration.

The vital capacity can be determined in two directions, resulting in exspiratory and inspiratory vital capacity.

Exspiratory Vital Capacity (EVC)

The exspiratory vital capacity is the air volume that can be maximally exhaled after maximum inspiration. For the measurement, the subject is instructed to inhale as deeply as possible from normal respiration at rest (reaching the level of the TLC) and then to exhale slowly as far as possible (until the RV is reached).

Inspiratory Vital Capacity (IVC)

The inspiratory vital capacity is the maximally inhaled air volume after maximum exspiration. The subject is instructed to exhale slowly as deeply as possible after

normal respiration at rest (until the level of RV) and then to inhale as far as possible (until the level of TLC is reached).

Respiratory Minute Volume (VE)

This is the air volume (in l) that is moved in one direction within one minute.

There is general agreement, that the volume of the *exspirated* air is cummulated (conversion condition is always the body temperature, pressure, saturated compliance).

Forced Exspiratory Volume in one Second (FEV_1)

This parameter is the air volume that can be exhaled within one second after maximum inspiration. The subject is instructed to exhale with the highest effort as possible after maximum inspiration. In the ideal case he reaches the level of the RV.

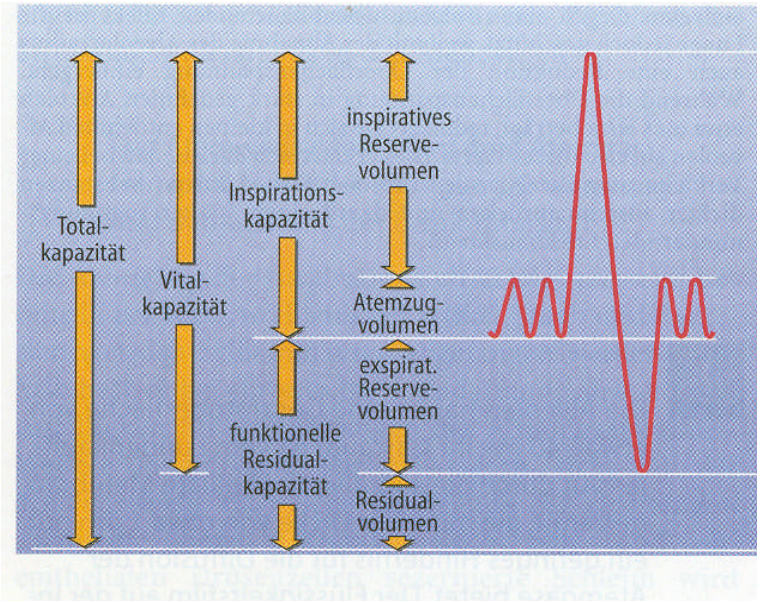

Fig. 5: Lung volumes and capacities [4].

Maximum Exspiratory Flow Rate at 75, 50, 25% of the Vital Capacity ($MEF_{75,50,25}$)

In a flow-volume graph, the points at x= 75%, 50% and 25% of the exspiratory vital capacity demark the maximum exspiratory flow rate at x% [2].

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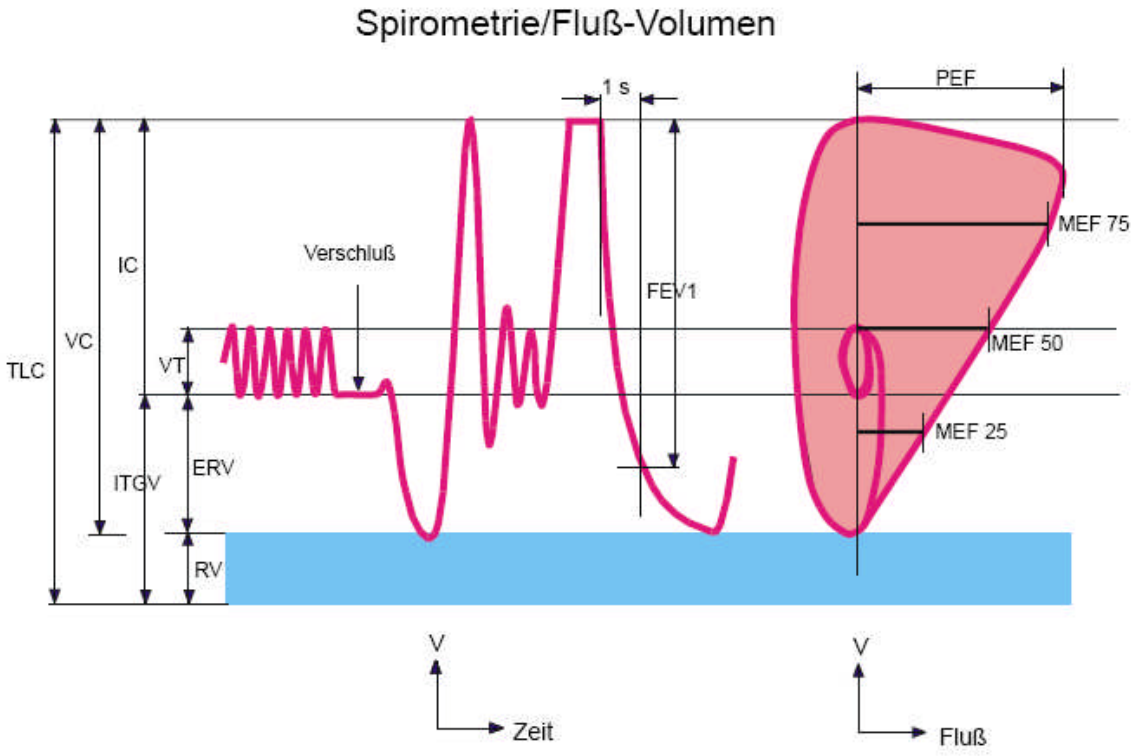

Explanation of the abbreviations:

TLC	total lung capacity
VC	vital capacity
IC	inspiratory capacity
ITGV	intrathoracic gas volume
VT	tidal volume
ERV	exspiratory residual volume
RV	residual volume
FEV1	forced exspiratory volume in one second
V	volume
s	second
PEF	maximal exspiratory flow (peak flow)
MEF75	maximal exspiratory flow at 75 % of the VC MAX or FVC
MEF50	maximal exspiratory flow at 50 % of the VC MAX or FVC
MEF25	maximal exspiratory flow at 25 % of the VC MAX or FVC

-

Literature:

[1] Haber P. (2007): Lungenfunktion und Spiroergometrie, 2. Auflage. Wien/New York: Springer: 11-60.

[2] Marees H.(2002): Sportphysiologie, 9.Auflage. Köln: Sport und Buch Straus: 384.

[3] Schmidt R. and Thews G. (1997): Physiologie des Menschen, 27.Auflage, Berlin Heidelberg New York: Springer –Verlag: 570-571

3.9. The Fragerström Test for Nicotine Addiction (FTNA)

The Fragerström test for nicotine addiction (FTNA) is a questionnaire method for adolescents and adults who consume nicotine. This questionnaire serves the assessment of the degree of severity of the addiction to nicotine.
It comprises six questions about nicotine consumption. Possible answeres are given (two- or four stage).

The test can be completed by the subjects themselves. The answering of the questionnaire needs approximately four minutes.
The test person can achieve between 0 and 10 points.
Objectivity of the performance and evaluation are ensured by the structure of the questonnaire and the normalised way of the performance and count (stencil). The internal consistency of the test is specified with α=0.61. The retest reliability (n= 254) is r=0.88.

The abstinence withdrawal symptoms that have to be expected and the probability of abstinence correlate with the result of the FTNA. According to international studies, smokers, who are calling on a withdrawal treatment, acchieve a score of 5 and more points, the average of the smoking population is 3-4 points [1].

-

FRAGERSTRÖM TEST

From the moment you wake up, how long does it take before you light up the first cigarette?

Under 5 minutes	• 3 points
Within 6-30 minutes	• 2 points
Within 31-60 minutes	• 1 point
Over 60 minutes	• 0 points

Is it hard for you to refrain from smoking in places where it is prohibited?

Yes	• 1 point
No	• 0 points

Which cigarette is the hardest to do without?

The first one of the day	• 1 point
Another	• 0 points

How many cigarettes do you smoke each day?

Under 10	• 0 points
11-20	• 1 point
21-30	• 2 points
Over 30	• 3 points

Do you smoke more in the morning than the rest of the day?

Yes	• 1 point
No	• 0 points

Do you smoke when you are sick or forced to stay in bed?

Yes	• 1 point
No	• 0 points

Total: __ points

-

How many points did you acchieve?

0 - 2: This indicates a minor dependency. You smoke little and only on special occasions. Nevertheless, you should do without smoking in the future. Smokers often yet succeed in this stage by a simple act of free will to quit smoking.

3 - 5: Yet the presence of a medium addiction indicates the use of a withdrawal aid.

6 - 7: You are severely addicted to cigarettes. It is recommendable to participate in a anti-smoking cure!

8 - 10: The same applies to the very strong addiction.

Literature:

[1] Bleich S., Havemann-Reinecke U. and Kornhuber J. (2002): Beltz Test, Testmappe. Göttingen: Hogrefe Verlagsgruppe.

3.10.Statistical Evaluation

Raw-data of the four spirometric measurements (cf. Table 3) were being collected in Microsoft® Excel 2000 tables and subsequently evaluated by means of SPSS 14.0 statistical software.

Group	Test 1	Treatment	Test 2		Test 3	Treatment	Test 4
RS group	Pre-recoil	Recoil tr.	Post-recoil	1 week	Pre-sham	Sham tr.	Post-sham
SR group	Pre-sham	Sham tr.	Post-sham		Pre-recoil	Recoil tr.	Post-recoil

Table 3: Spirometric measurements and treatments in both groups.

The variables (Var) measured during the four tests (test 1 – 4) and describing the lung function are:

Inspiratory vital capacity	… VC_in
Forced vital capacity	… FVC
Forced exspiratory volume in one second	… FEV1
Maximal exspiratory flow at 25% of FVC	… MEF25

The basic question is, whether the effect of a treatment with recoil technique on the lung function of smokers is different from the effect of a sham treatment.

Since the test persons act as their own controls (cross-over design), paired samples t-tests were used to test the according null hypothesis:

H_0: $(Var_{post\text{-}recoil} – Var_{pre\text{-}recoil}) - (Var_{post\text{-}sham} – Var_{pre\text{-}sham}) = 0$

Since both kinds of treatment were performed in reverse order in the two groups, it is possible to assess their longer-term effects. In the RS-group (n=12), the test persons were treated first with recoil technique and one week later with sham-treatment, in the SR-group (n=12), the test persons were treated with sham treatment first, and the recoil technique was applied one week later. By comparing the results of the variables $Var_{Test\ 3} – Var_{Test\ 1}$ of both groups, longer-term effects can be visualised.

For this evaluation, baselines of the variables should be equal in the two groups. Equality during the first spirometric test before the particular first treatment was tested by means of independent samples t-tests.
The according null-hypothesis is:

H_0: $Var_{Test1\text{-}RS} = Var_{Test1\text{-}SR}$

Lung function is dependent on multiple (e.g. environmental) exterior influences. Additionally, cross-over designs are sensible against carry-over effects. Thus, the state before the treatments in the individual groups was compared by means of paired samples t-tests, considering the null-hypothesis:

H_0: $Var_{pre\text{-}Recoil} - Var_{pre\text{-}Sham} = 0$

Afterwards, difference values of the results before the second treatment (test 3) and the results before first treatment (test 1) were computed and then compared by independent samples t-tests.

H_0: $(Var_{Test3\text{-}RS} - Var_{Test1\text{-}RS}) = (Var_{Test3\text{-}SR} - Var_{Test1\text{-}SR})$

All tests were performed two-tailed and p-values <0,05 were considered statistically significant.

Prior to these tests described above, assumptions underlying them were checked by Kolmogorov-Smirnov tests for testing the normal distribution in the population and by Levene's test for checking the homogeneity assumption.

4. Results

4.1. General Data

Group “RS” comprises six female and six male smokers, group “SR” three male and nine female. According to the results of a Fisher’s exact test, groups do not differ significantly in sex (p=0,40). There are also no significant differences in age, body

height and weight as can be observed in the results of idependent samples t-tests, summarised in Table 4.

Variables	Group	N	Mean	SD	t	p
Age	RS	12	32,2	7,1	0,566	0,58
	SR	12	33,8	6,6		
Height	RS	12	173,5	9,0	0,795	0,44
	SR	12	170,7	7,8		
Weight	RS	12	70,7	14,9	0,408	0,69
	SR	12	68,2	15,1		

Table 4: Group means and standard deviations (SD) of the variables age, height and weight as well as results of independent samples t-tests with the independent variable “group”.

4.2. Inspection of the Comparability of the Initial Situations before the Treatments.

1. Are the groups equivalent concerning the baseline of the measured parameters?

Since each of the both groups acts as its own control-group, different baselines do not influence the assessment of the therapeutic success. However, comparable results during the initial measurements (test 1) are of importance in order to assess influences of the order of the treatments on the results (loger-term effects, carry-over effects).

The equivalence of both groups was examined by comparing the results of the initial measurements (test 1) independently of the following treatment (recoil or sham treatment). Mean values and standard deviations, as well as the results of the independent samples t-tests with the independent variable „group“ for the four dependent spirometric parameters are summarised in Table 5.

Variable	Group	N	Mean	SD	t	df	p
VC_in_Test1	SR	12	4,2	1,1	-1,354	22	0,19
	RS	12	4,7	0,8			
FVC_Test1	SR	12	4,4	1,1	-1,129	22	0,27
	RS	12	4,9	0,8			
FEV1_Test1	SR	12	3,4	0,7	-0,949	22	0,35
	RS	12	3,7	0,6			
MEF25_Test1	SR	12	1,4	0,4	-0,820	15,13	0,43
	RS	12	1,6	0,9			

Table 5: Mean values and standard deviations (SD) of the spirometric variables during test 1, as well as results of the independent samples t-tests with the independent variable “group”.

No significant differences between the two groups can be observed in the results of the first lung function test. On average, the members of the RS group, who were treated first with recoil-technique and then with sham-treatment, have a slightly better lung function than the members of the SR group.

2. Are the two days of treatment equivalent with regard to exterior influences (e.g. weather, environment, ...) but also to the previous treatment (carry-over effects)?

Information about this can be gained by a comparison of the results of the tests 1 and 3, which were both performed before treatment. This comparison was done for each group individually (cf. Table 6).

Group	Paired Differences					t	df	p
	Variables	Mean	SD	95% CI (Diff)				
				Lower	Upper			
RS	VC_in_pre-recoil – VC_in_pre-sham	-0,06	0,47	-0,36	0,24	-0,427	11	0,68
	FVC_ pre-recoil – FVC_ pre-sham	-0,10	0,47	-0,40	0,20	-0,719	11	0,49
	FEV1_ pre-recoil – FEV1_ pre-sham	0,08	0,45	-0,20	0,36	0,621	11	0,55
	MEF25_ pre-recoil – MEF25_ pre-sham	0,33	0,58	-0,04	0,70	1,963	11	*0,08*
SR	VC_in_ pre-recoil – VC_in_ pre-sham	-0,11	0,24	-0,27	0,04	-1,687	11	0,12
	FVC_ pre-recoil - FVC_ pre-sham	-0,14	0,12	-0,22	-0,06	-4,088	11	0,002
	FEV1_ pre-recoil - FEV1_ pre-sham	-0,24	0,32	-0,44	-0,04	-2,617	11	0,02
	MEF25_ pre-recoil - MEF25_ pre-sham	-0,12	0,41	-0,38	0,14	-0,997	11	0,34

Table 6: Mean values, standard deviations (SD) and limits of the 95%-confidence intervals of the paired differences of the results of the spirometric variables during test 1 (before treatment 1) and 3 (before treatment 2), as well as the results of a paired samples t-test.

In the RS group, lower values of the MEF 25 and FEV1 can be observed one week after administration of the recoil technique (indicated by positive algebraic signs for the mean difference). In contrary, VC_in and FVC (test 3) are slightly higher in the second measurement compared to the first measurement (test 1). The changes in the variable MEF25 are most distinct. Nevertheless, differences in lung function described by these four variables are not significant. Thus, carry-over effects and other exterior influences can be precluded in this group.

Differences of lung function are more distinct in the group SR, whose members have been treated with sham treatment first and with recoil-technique one week later.
In this case, negative algebraic signs for the mean difference demark a worse lung function in the measurement in advance of the recoil treatment (test 3).
Significantly worse lung function can be observed on basis of the variables FVC and FEV1 during the measurement before recoil treatment (test 3) compared to the measurement before sham treatment (test 1).
Generally, in this group, all spirometric parameters are worse in the measurement in advance of the recoil-treatment (test 3) compared to the initial measurement (test 1).

The different progression (worsening in all variables one week after the sham treatment and improvement in two variables one week after treatments with recoil technique) give reason to examine, whether these group differences are significant or not. (cf. chapter 4.4).
However, it has to be stressed, that due to possible unknown and uncontrollable influences, results of this examination may be interpreted as an estimation, only.

4.3. Comparison of the Effect of the Recoil-Technique and the Sham-Technique on the Results of the Spirometric Tests

For a comparison of the effects of the recoil technique with those of the sham treatments, differences of the results after and before the particular treatment (test 2 – test 1 and test 4 – test 3) were calculated for each single test person.
Negative algebraic signs indicate deteriorations and positive signs improvements. The comparison of the effects of the two different treatment methods was done by means of paired samples t-tests.

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Subsequently, results of the single variables will be presented separatedly.

4.3.1. Inspiratory Vital Capacity (Variable VC_in)

Mean values of the four tests and their 95%-confidence intervals are displayed in Fig. 6. The tests 1 and 3 were performed in advance of the treatments, the tests 2 and 4 after the treatements.

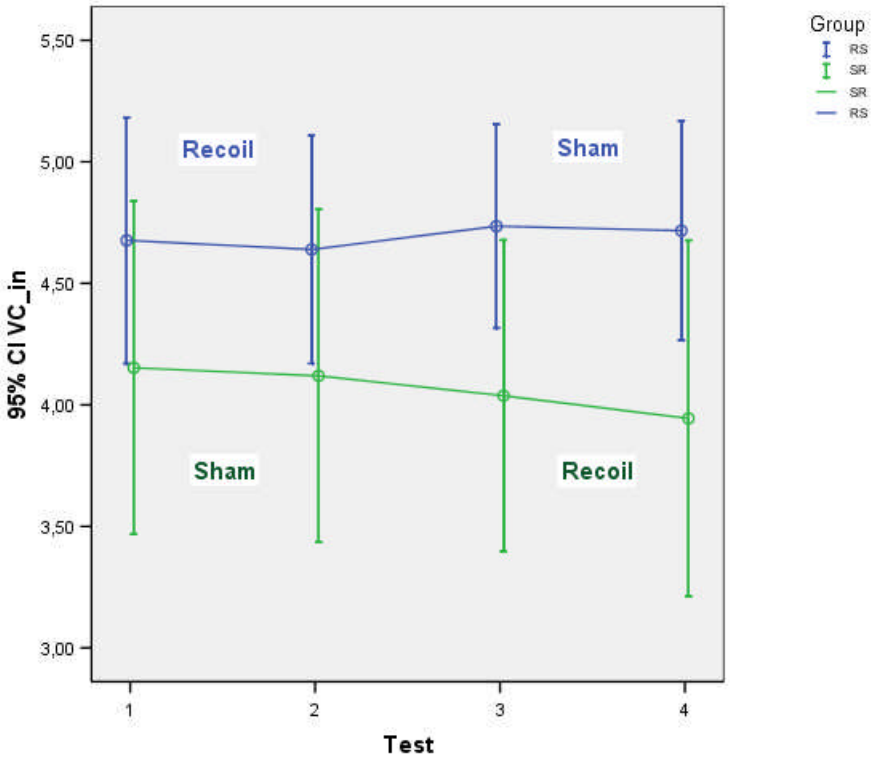

Fig. 6: Mean values and 95%-confidence intervals of the means (95% CI) of the variable inspiratory vital capacity (VC_in) measured during the four spirometric tests. The tests 1 and 3 were performed before treatment, tests 2 and 4 imediately after treatment.

As mentioned above, there are distinct but insignificant differences between the two groups in the mean values of the results of test 1. After treatment (in test 2), the mean vital capacity declines almost parallely in both groups.

During test 3, one week after test 1, group differences are even more distinct than in the first test: While increased VC_in-values were measured in the RS-group one week after the recoil treatment, further decreased values can be observed in the SR-group.

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In test 4, VC_in is further decreased after recoil treament in the SR-group, while they are almost equal after sham treatment in the RS-group.

After organisation of the results by the treatment method without consideration of group membership (cf. Fig. 7), it can be observed, that, independent of the method, values are lower after treatment than before. This effect is less distinct after sham-treatment.

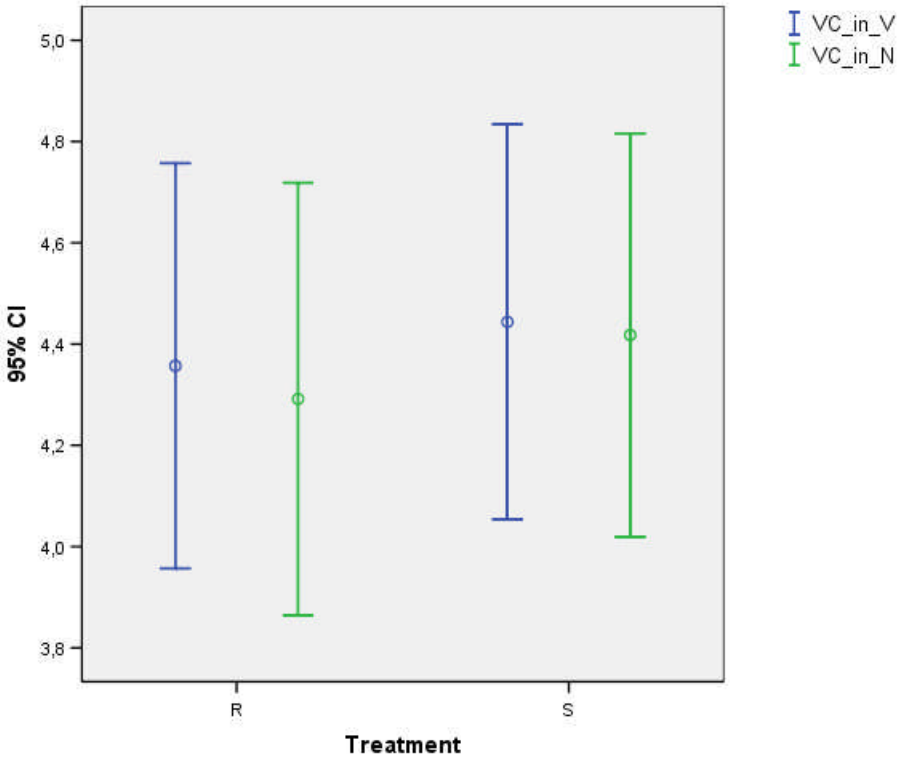

Fig. 7: Mean values and 95%-confidence intervals of the means (95% CI) of the variable inspiratory vital capacity (VC_in) measured before and after treatment with the two techniques. The results of the pre-tests (VC_in_V, tests 1 and 3, respectively) are demarked blue, the results of the post-tests (VC_in_N, tests 2 and 4, respectively) green (R… treatment with the recoil-technique, S…sham-treatment).

The mean values of the changes in vital capacity are displayed in Table 7.

Variables	Mean	N	SD
VC_in_R_D = VC_in_R_N – VC_in_R_V	-0,07	24	0,27
VC_in_S_D = VC_in_S_N – VC_in_S_V	-0,03	24	0,25

Table 7: Mean values and standard deviations (SD) of the differences of the vital capacity (VCin) measured after and before treatment with recoil technique (VC_in_R_D) and sham treatment (VC_in_S_D).

As can already be observed in Fig. 7, it is evident from the results in Table 7, that the mean inspiratory vital capacity decreases after application of either treatment method.

On the basis of the results of the paired samples t-tests (cf. Table 8), it can be seen, that changes in vital capacity by the two treatement methods do not differ noteworthy.

	Paired Differences				t	df	p
Variables	Mean	SD	95% CI (Diff)				
			Lower	Upper			
VC_in_R_D – VC_in_S_D	-0,04	0,38	-0,20	0,12	-0,514	23	0,61

Table 8: Mean value, standard deviation (SD) and 95% confidence interval of the paired difference of the change of vital capacity (Vcin) observed after the two different treatments (VC_in_R_D… change of the vital capacity after treatment with recoil-technique, VC_in_S_D… change of the vital capacity after sham treatment) as well as results of the paired samples t-test.

The recoil technique and sham treatment do not differ significantly in their effects on vital capacity. After administration of the recoil technique, the inspiratory vital capacity decreases by 0,07 l on average, after sham treatement by 0,03 l.

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4.3.2. Forced Vital Capacity (FVC)

Mean values of the results and their 95%-confidence intervals are displayed in Fig. 8. The tests 1 and 3 were performed before the treatements, the tests 2 and 4 afterwards.

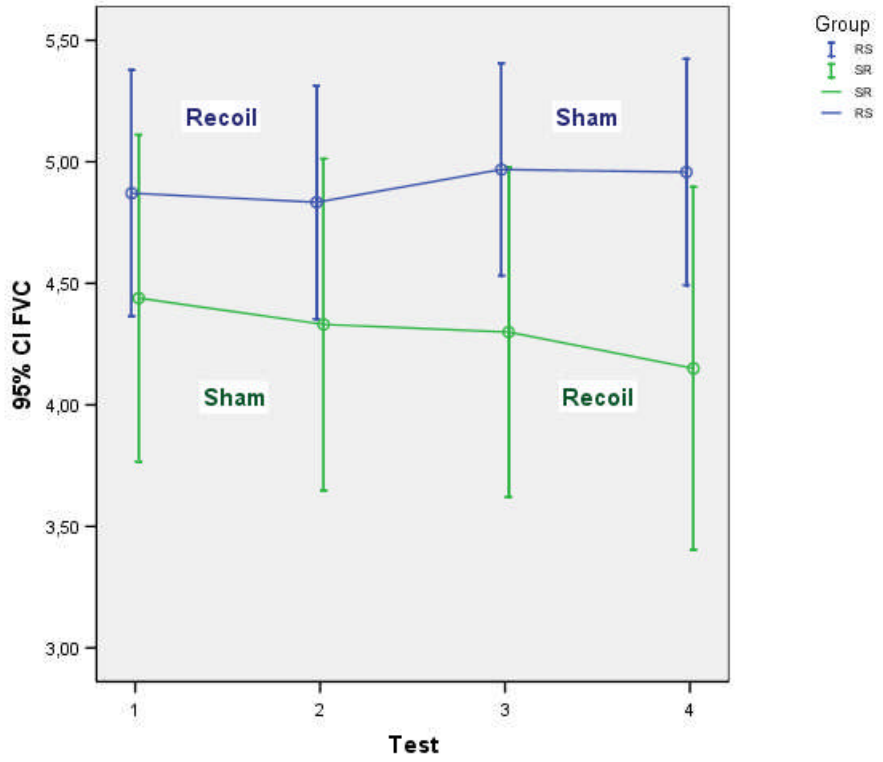

Fig. 8: Mean values and 95%-confidence intervals of the means (95% CI) of the variable forced vital capacity (FVC) measured during the four spirometric tests. The tests 1 and 3 were performed before treatment, tests 2 and 4 imediately after treatment.

During test 1, differences in FVC are a little less distinct than in vital capacity. After treatement (test 2) the mean forced vital capacity is decreased in both groups, whereby this tendency is more pronounced after sham treatment than after recoil treatment.

Group differences have increased further in test 3, which was performed one week after test 1. While higher FVC-values can be observed in the RS group one week after the recoil treatment, they have declined a little bit in the SR-group.

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Results of test 4 show a further declination of the FVC-values in the SR-group after recoil-treatment, while after sham-treatment in the RS-group results are quite the same.

After organisation of the results by the treatment method without consideration of group membership (cf. Fig. 9), again values are lower after treatment than before. As could be already observed in the variable vital capacity, this effect is independent of the treatment method. However, it is less distinct after application of the sham treatment.

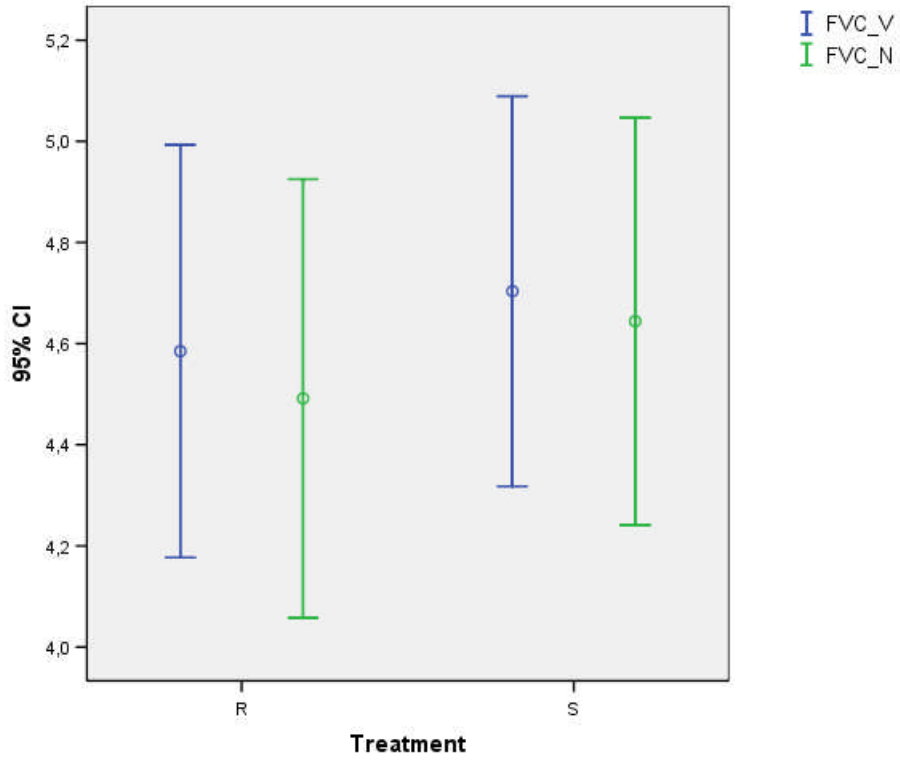

Fig. 9: Mean values and 95%-confidence intervals of the means (95% CI) of the variable forced vital capacity (FVC) measured before and after treatment with the two techniques. The results of the pre-tests (FVC_V, tests 1 and 3, respectively) are demarked blue, the results of the post-tests (FVC_N, tests 2 and 4, respectively) green (R… treatment with the recoil-technique, S…sham-treatment).

Mean values of the changes in the FVC-values are summarised in Table 9.

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Variables	Mean	N	SD
FVC_R_D = FVC_R_N - FVC_R_V	-0,09	24	0,29
FVC_S_D = FVC_S_N - FVC_S_V	-0,06	24	0,21

Table 9: Mean values and standard deviations (SD) of the differences of the forced vital capacity (FVC) measured before and after treatment with recoil technique (FVC_R_D) and sham treatment (FVC_S_D).

As could be already observed in Fig. 9, it can be seen from the data in Table 9, that the mean forced vital capacity decreased after application of either treatment method. On the basis of the results of the paired samples t-tests (cf. Table 10) it can be observed, that changes of the FVC do not differ considerably after application of the two methods.

	Paired Differences				t	df	Sig. (2-tailed)
Variables	Mean	SD	95% CI (Diff)				
			Lower	Upper			
FVC_S_D - FVC_R_D	0,03	0,39	-0,13	0,20	0,422	23	0,68

Table 10: Mean value, standard deviation (SD) and 95% confidence interval of the paired difference of the change of forced vital capacity (FVC) observed after the two different treatments (FVC_R_D… change of the vital capacity by a treatment with recoil-technique, FVC_S_D… change of the vital capacity by sham treatment) as well as results of the paired samples t-test.

The recoil technique and sham treatment do not differ significantly in their effect on the FVC. After application of the recoil-technique, FVC is reduced by 0,09 l on average, after the sham treatment by 0,06 l.

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4.3.3. Forced Expiratory Volume in one Second (FEV1)

Mean values an 95%-confidence intervals of the results of the four tests are summarised in Fig. 10. The tests 1 and 3 were performed before the treatments, the tests 2 and 4 afterwards.

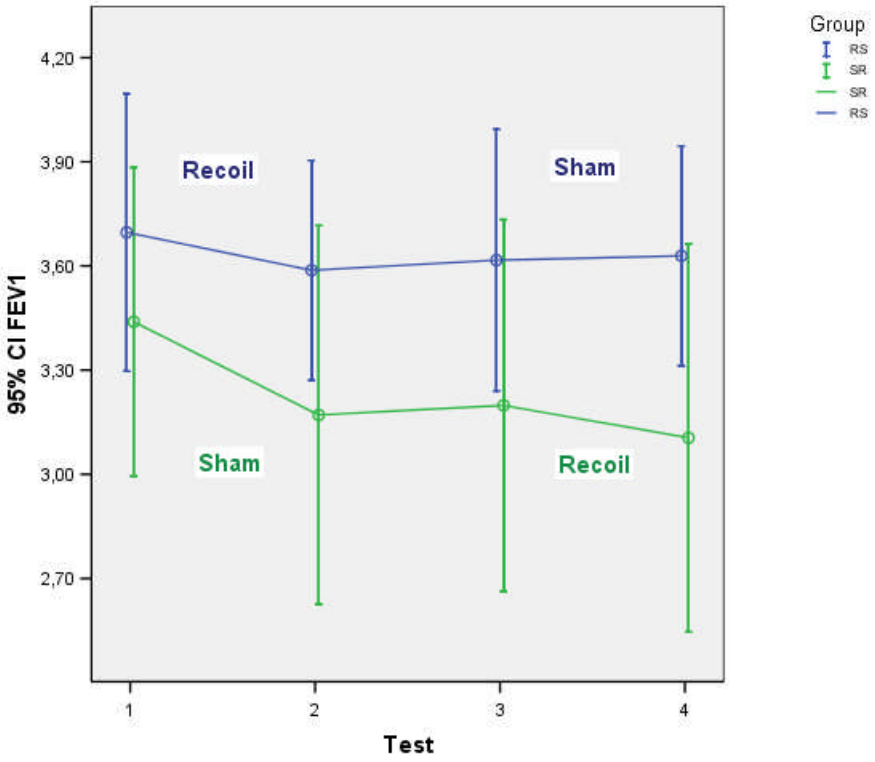

Fig. 10: Mean values and 95%-confidence intervals of the means (95% CI) of the variable forced expiratory volume after one second (FEV1) measured during the four spirometric tests. The tests 1 and 3 were performed before treatment, tests 2 and 4 imediately after treatment.

The differences between the two groups during test 1 are less pronounced than differences in FVC and VC_in.

As could be observed in the other variables, too, the mean FEV1 is decreased in either group after treatment (test 2). This tendency is more distinct after sham treatment than after recoil treatment.

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Group differences of the results of test 3, measured one week after test 1, are similar to those of test 2, but more distinct than those of the very first test.
In test 4, the FEV1-results are lower after recoil treatment, while they are slightly increased after sham treatment.

After organisation of the results by the treatment method without consideration of group membership, (cf. Fig. 11), in either group lower values can be observed after treatment than before. This effect is more distinct in the sham group than in the recoil group.

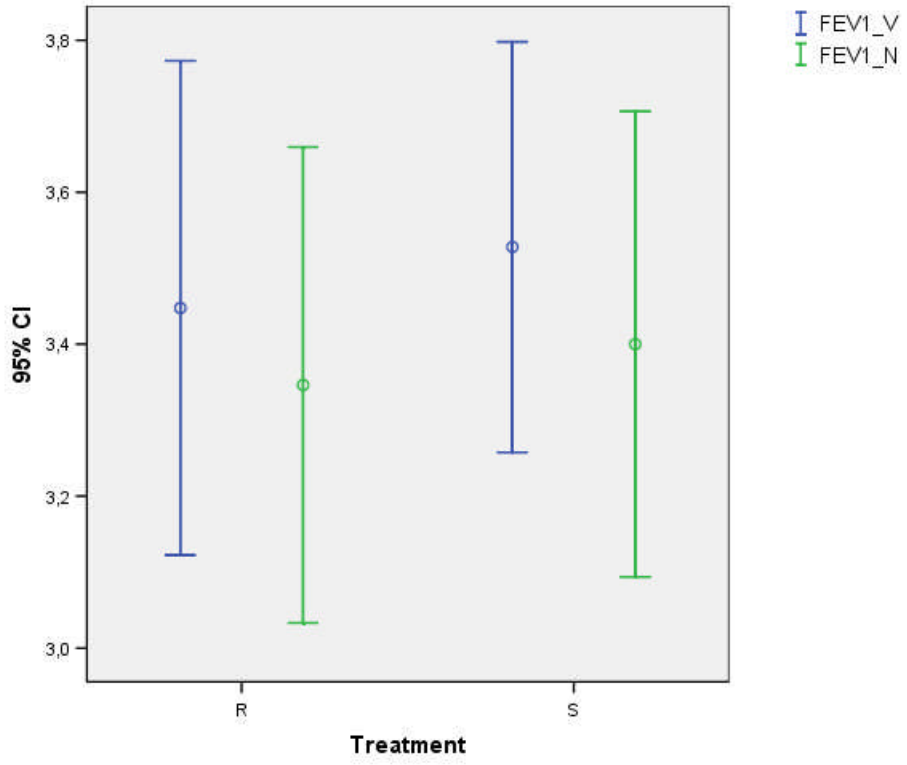

Fig. 11: Mean values and 95%-confidence intervals of the means (95% CI) of the variable forced expiratory volume (FEV1) measured before and after treatment with the two techniques. The results of the pre-tests (FEV1_V, tests 1 and 3, respectively) are demarked blue, the results of the post-tests (FEV1_N, tests 2 and 4, respectively) green (R… treatment with the recoil-technique, S…sham-treatment).

Mean values of the changes in the FEV-1 results are given in Table 11.

Variables	Mean	N	SD
FEV1_R_D = FEV1_R_N - FEV1_R_V	-0,10	24	0,24
FEV1_S_D = FEV1_S_N - FEV1_S_V	-0,13	24	0,31

Table 11: Mean values and standard deviations (SD) of the differences of the forced expiratory volume after one second (FEV1) measured after and before treatment with recoil technique (FEV1_R_D) and sham treatment (FEV1_S_D).

As could be already seen in Fig. 11, also the results in Table 11 indicate, that mean FEV1 values decrease after application of either treatment method.

On the basis of the results of the paired samples t-tests (cf. Table 12) it can be shown, that changes of the FEV1 in the two groups do not differ noteworthy.

	Paired Differences				t	df	Sig. (2-tailed)
Variables	Mean	SD	95% CI (Diff)				
			Lower	Upper			
FEV1_R_D – FEV1_S_D	0,03	0,39	-0,14	0,19	0,335	23	0,74

Table 12: Mean value, standard deviation (SD) and 95% confidence interval of the paired difference of the change of forced expiratory volume after one second (FEV1) observed after the two different treatments (FEV1_R_D… change of the vital capacity after treatment with recoil-technique, FEV1_S_D… change of the vital capacity after sham treatment) as well as results of the paired samples t-test.

The recoil technique and sham treatment do not differ significantly in their effect on the FEV1. After administration of the recoil technique, the FEV1 decreases by 0,10 l on average, after sham treatment by 0,13 l.

4.3.4. Maximal Expiratory Flow at 25% of FVC (MEF25)

Mean values of the results and their 95%-confidence intervals of the four tests are displayed in Fig. 12. The tests 1 and 3 were performed before the treatments, the tests 2 and 4 afterwards.

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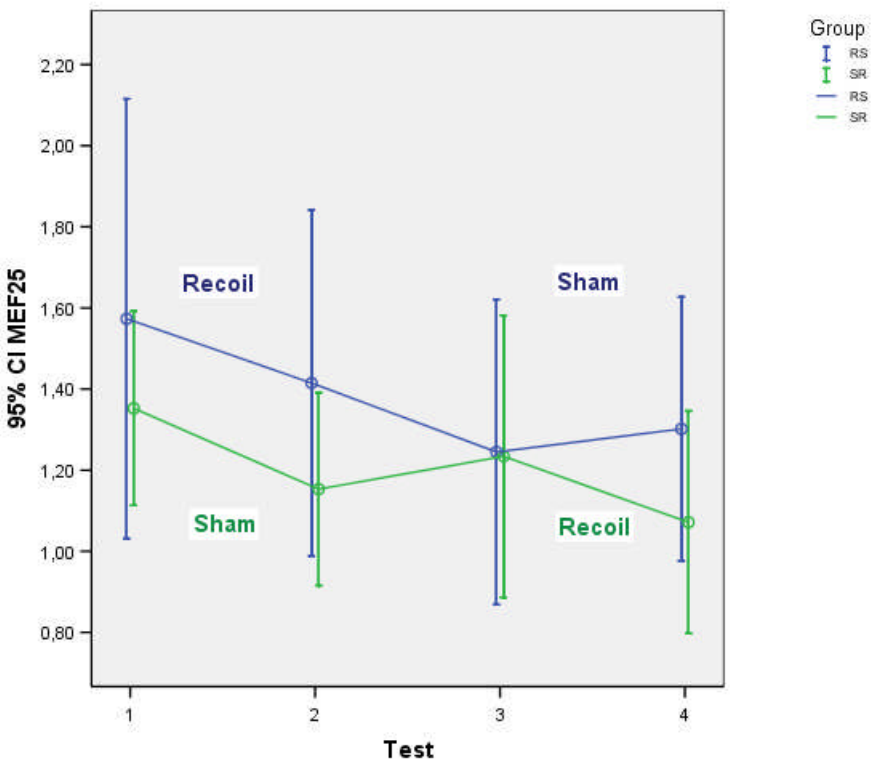

Fig. 12: Mean values and 95%-confidence intervals of the means (95% CI) of the variable “maximal expiratory flow at 25% of FVC” (MEF25) measured during the four spirometric tests. The tests 1 and 3 were performed before treatment, tests 2 and 4 imediately after treatment.

The differences in MEF25 during test 1 are the least distinct compared to the variables presented above.
As could be observed in the other variables, too, the mean MEF 25 decreases after either treatment in both groups. This tendency is slightly more pronounced after sham treatment than after recoil treatment.

During test 3, one week after test 1, the initial situation is almost equal in both groups. This can be lead back to the further decrease of the MEF-35 values after recoil treatment (RS-group) and the re-increased values after sham treatment (SR group), which could be observed in test 2.
MEF25 results of test 4 are further decreased after recoil treatment, while they increase after the sham treatment.

After organisation of the results by the treatment method without consideration of group membership (cf. Fig. 13), mean MEF25 values are lower after treatment

compared to the measurements before. This effect is slightly more distinct in the recoil group than in the sham group.

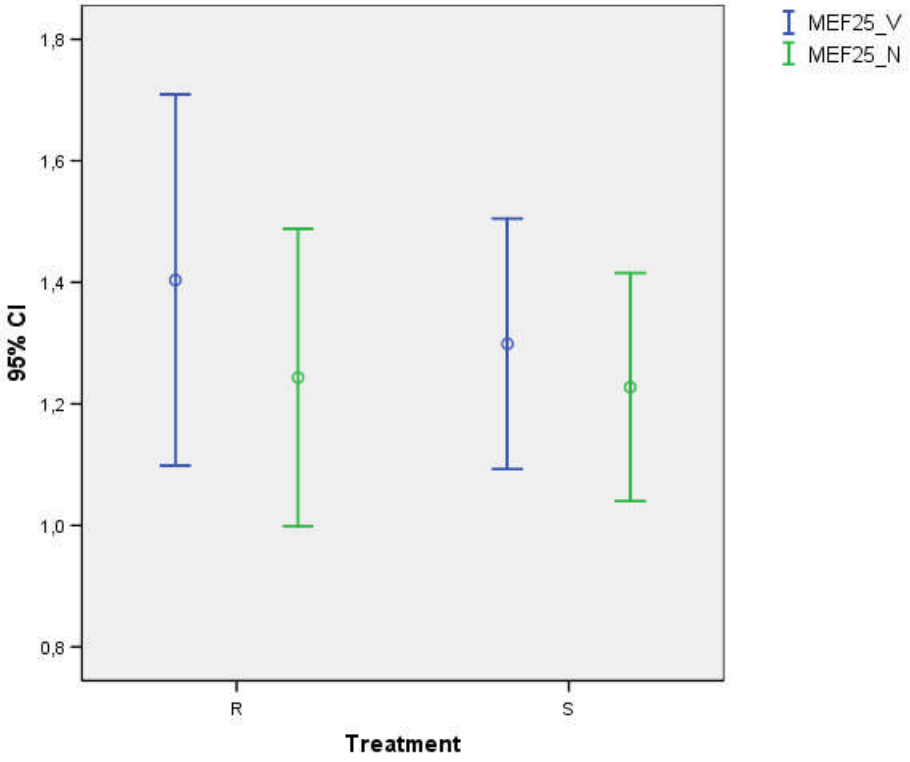

Fig. 13: Mean values and 95%-confidence intervals of the means (95% CI) of the variable “maximal expiratory flow at 25% of FVC” (MEF25) measured before and after treatment with the two techniques. The results of the pre-tests (MEF25_V, tests 1 and 3, respectively) are demarked blue, the results of the post-tests (MEF25_N, tests 2 and 4, respectively) green (R… treatment with the recoil-technique, S…sham-treatment).

The mean values of the changes in MEF25 values are given in Table 13.

Variables	Mean	N	SD
MEF25_R_D = MEF25_R_N - MEF25_R_V	-0,16	24	0,24
MEF25_S_D = MEF25_S_N - MEF25_S_V	-0,07	24	0,28

Table 13: Mean values and standard deviations (SD) of the differences of the maximal expiratory flow at 25% of FVC (MEF25) measured after and before treatment with recoil technique (MEF25_R_D) and sham treatment (MEF25_S_D).

As can be seen in Table 13 and Fig. 13, mean MEF25 values decreased after application of either treatment method.

On the basis of the results of the paired samples t-tests (cf. Table 14) it can be noticed, that the changes in the MEF25 by the two treatement methods do not differ to a high extent.

	Paired Differences				t	Df	p
Variable	Mean	SD	95% CI (Diff)				
			Lower	Upper			
MEF25_S_D - MEF25_R_D	0,09	0,37	-0,07	0,24	1,187	23	0,25

Table 14: Mean value, standard deviation (SD) and 95% confidence interval of the paired difference of the change of the maximal expiratory flow at 25% of FVC (MEF25) observed after the two different treatments (MEF25_R_D… change of the vital capacity after treatment with recoil-technique, MEF25_S_D… change of the vital capacity after sham treatment) as well as results of the paired samples t-test.

The recoil technique and sham treatment do not differ significantly in their effect on the MEF25. After administration of the recoil technique, the MEF25 decreased by 0,16 l on average, after sham treatment by 0,07 l.

4.4. Possible Longer-Term Effects of the Techniques

Deteriorations of all spirometric variables can be observed directly after application of the recoil technique (and of the sham treatment, too). However, different progressions can be observed in the both groups in the measurement in advance of the second treatment (test 3). Since this possibly can be lead back to longer-term treatment effects (carry-over effects), it can not be precluded, that the results after administration of the recoil technique indicate an influence of initial worsenings only, which might be followed by improvements.

By subtracting the results of test 3 from those of test 1 and by comparing the difference values of both groups, it shall be assessed, if there is a later therapeutic success of the recoil-technique compared to sham treatment.

These mean differences of the results of both groups, standard deviations, as well as results of the independent samples t-tests are summarised in Table 15. Due to the sensibility of lung function on exterior influences and the period of one week between the two measurements, this can be a coarse appraisal only.

	Group	N	Mean	SD	t	p
VC_in_D31	RS	12	0,06	0,47	1,135	0,27
	SR	12	-0,12	0,24		
FVC_D31	RS	12	0,10	0,47	1,698	0,11
	SR	12	-0,14	0,12		
FEV1_D31	RS	12	-0,08	0,45	1,016	0,32
	SR	12	-0,24	0,32		
MEF25_D31	RS	12	-0,33	0,58	-1,024	0,32
	SR	12	-0,12	0,41		

Table 15: Mean values and standard deviations (SD) of the differences of the results gained during the first and third spirometric tests performed before treatment 1 (test 1) and 2 (test 3) as well as results of the independent samples t-tests performed with the independent variable “group”.

While deteriorations of the lung function can be observed in all variables in the group SR after sham treatment (indicated by negative algebraic signs), there are improvements in vital capacity and FVC in the RS group. However, differences between the two groups are not significant. Therefore, it can be assumed - again with the restriction, that exterior uncontrollable influences might exist – that recoil technique has no significant influence on the lung function of smokers.

5. Discussion

It was the aim of this study to investigate, if a sternal recoil technique has an effect on vital capacity, forced vital capacity, maximal expiratory flow at 25% of FVC, and FEV1 in smokers.
The results of this study did not point out significant changes in any spirometric parameter in smokers after application of a single recoil-technique.
Directly after application of either technique (recoil or sham), mean values of the spirometric parameters were lower than before and one week after application of the recoil technique (in group RS), improvements could be observed in inspiratory vital capacity and forced vital capacity, only. However, they were not significant, either.
One week after application of the sham treatment (in group SR), results of all variables were worse compared to the initial state.

There are different explanations for these results:

Number of treatments
The recoil technique was administered only once. Maybe, a longer treatment period would be appropriate to cause positive changes.

Time between treatment and spirometric measurement
The spirometric measurements were performed immediately (5 minutes) after the treatments. Functional changes might take a longer time.
Since no distinct improvements could be observed in the follow up measurements one week later, it is not very likely, that this is the only reason for the present results. However, it would be suggestive to perform another measurement (e.g. one hour after treatment) to preclude effects of an initial worsening caused by the treatment, particularly, because it is not for sure, that a potential effect of the treatment persists for one week (until the next measurement).

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Exterior influences

The livestyle of the test persons during the time of the study could not be controlled. Additionally, spirometric measurements depend on the co-operation of the subjects and are error prone due to possible influences by environment and weather.
Thus, it can not be precluded, that these unknown factors affected the results.
In the SR group, all results of the spirometric measurements were worse during the third measurement compared to the initial situation. The deteriorations of the respiratory parameters FVC and FEV1 even were statistically significant. This might be a hint for such exterior influences.

In the literature about the effects of the recoil technique, either improved (Fischer, 2003) [1] or constant lung function (Firsova, 2006 [2]; Wieser, 2006 [3]) but no deterioration is described. There was no hint, that smokers were involved in these studies.
In the actual study, deteriorations of the results could be observed in both groups between the first and third measurement. It cannot be precluded, that the continued smoking overcasted the effects of the technique.

Also in orthodox medical literature, no explanatory model for the deterioration of the results could be found.

Generally, most of the studies dealing with recoil technique that are quoted in this thesis, were designed that way, that the recoil technique was only a part of a complex treatment strategy. In others a different study design was used, so that it is impossible to compare them with the actual one.

Sample size

A further methodological restriction, that possibly affects the results of the study is the sample size. The influence of chance, and thus of the individual test persons, is higher in small samples, what might lead to biased results.

Literature:

[1] Fischer C. (2003) : Auswirkung einer Manipulation der oberen Brustwirbelsäule auf die Vitalkapazität der Lunge aus der Sicht der Osteopathie. Gent: Thesis, IAO.

[2] Firsova S(2006): Effets d'une technique ostéopathique thoracique de « recoil » sur le système cardiovasculaire et la ventilation pulmonaire. Lausanne : Thesis, Ecole Suisse d'Ostéopathie.

[3] Wieser R. (2006): Can Vital Capacity be improved by Osteopathic Treatment of the Mediastinum?. Vienna: Thesis, Wiener Schule für Osteopathie.

[4] Bleich S., Havemann-Reinecke U. and Kornhuber J. (2002): Beltz Test, Testmappe. Göttingen: Hogreve Verlag.

6. Summary and Conclusion

From an osteopathic view, the cohort of smokers is important, because approximately 70.000 per year die of the consequences of nicotine addiction and thus it is the most important single cause of disease and death.
There are many treatment concepts and programmes to escape this addiction, but unfortunately, success rate is still low, and in consequence smoking affects health. The mucous membrane of the bronchi is harmed by the multitude of noxous substances in tobacco smoke. The deterioration of respiratory volumes by smoking progresses twice as fast than by normal ageing processes in non smokers.

It was the aim of the study to examine the effect of a sternal recoil technique on spirometric parameters (VC, FEV1, FVC and MEF25) in smokers. The recoil technique is described in osteopathic literature as technique for diagnosis and treatment of tissue dysfunctions. According to the „link-concept" by Chauffour, the recoil technique can be applied on the whole body.

In order to obtain a homogeneous sample of smokers, smokers with addictive behaviour according to the Fragerström test for nicotine addiction (FTNA) were chosen for this study. They were being smokers for at least five years, but they had no diagnosed pulmonary disease or allergy. Additionally, they had to meet other study criteria.

Two groups of 12 smokers each were formed by random assignment of test persons meeting the criteria. All subjects were treated with recoil technique and sham treatment once each (cross over design). However, the order of the administration of the two methods was reversed in the two groups (RS (recoil-sham) group and SR (sham-recoil) group). The interval between the treatments was one week. Measurements of the spirometric parameters VC, FEV1, FVC and MEF25 were performed straight in advance and after each treatment.

The results of this study did not point out significant changes in any spirometric parameter in smokers after application of the recoil-technique.
Directly after application of either technique (recoil or sham), mean values of the spirometric parameters were lower than before and one week after application of the recoil technique (in group RS), improvements could be observed in inspiratory vital capacity and forced vital capacity, only. However, they were not significant, either.

There are no firm explanations for these deteriorations. In order to be able to assess the effect of a recoil technique, further studies have to be done. The published studies dealing with recoil technique are not comprehensive enough and too different to make a clear point.
The results of this study beg the question, if a recoil technique would have a positve effect on lung function under other conditions. Under consideration of the restrictions of this study, more treatments, a longer time between treatments and spirometric measurements, a higher sample size and more strict inclusion and exclusion criteria can be recommended.

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Appendix

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Probanden Einverständniserklärung

Liebe/r Proband/in,

Ich möchten Sie gerne bitten, an einer Studie teilzunehmen, die Ich im Moment in meiner Praxis durchführe.

Ich würden mich freuen, wenn Sie an der Studie teilnehmen, da sie der Verbesserung unserer Behandlung dient, und somit dem Wohl der Patienten.

Bitte senden Sie dieses Blatt mit Ihrem Kreuz unten und Ihrer Unterschrift an uns zurück.

Name: _____. Vorname: _____.

Ich stimme der Teilnahme an der Studie zu:____

Ich stimme der Teilnahme an der Studie nicht zu:____

Unterschrift:_____

Studienleiter: Joachim Weiler Osteopath DO (IAO)