Fascia – key for stability, sensomotor function and symmetry

The effects of orthopathic treatment according to the fascia distortion model (FDM) on stability, sensomotor function and symmetry in the upright stance

Master Thesis to obtain the degree

Master of Science in Osteopathy

at the **Donau Universität Krems**

submitted

at the **Wiener Schule für Osteopathie**

*by **Astrid Geiger***

Vienna, December 2007

Supervised by *Dr. Georg Harrer*
Translated by *Mag.Barbara Schnürch*

DECLARATION

Hereby I declare that I have written the present master thesis on my own.

I have clearly marked as quotes all parts of the text that I have copied literally or rephrased from published or unpublished works of other authors.

All sources and references I have used in writing this thesis are listed in the bibliography. No thesis with the same content was submitted to any other examination board before.

Date

Signature

Acknowledgements

I would like to thank the large number of test persons for their participation in this study. Without them it would not have been possible to carry out this work.

My sincerest gratitude goes to Dr. Georg Harrer who supervised my work on this thesis and who inspired me to write this paper by imparting his commitment to and knowledge of orthopathy as teacher at the Vienna School of Osteopathy (Wiener Schule für Osteopathie) and who helped me by providing valuable information on the topic.

Special thanks also go to Univ.-Doz. Dr. Gabriele Khan who infected me with her enthusiasm for statistics and familiarized me with the sheer unlimited possibilities of the software program SPSS.

I also owe gratitude to Dr. Andrea Lagler who was a big help for me with regard to questions of ethics.

And finally, I would like to express my gratitude for the work of my test supervisors Ing. Martin Geiger and Ing. Andreas Semmelweiß without whom the simple blinding of the study would not have been possible. Both believed in me at all times and supported and encouraged me in difficult phases.

Table of contents

Abstract

The present paper looks at the effects of two different kinds of treatment on stability, sensomotor function and symmetry. The hypotheses regarding the lateral triggerband in the thigh according to the principles of the fascia distortion model of Dr. Stephen Typaldos, D.O, are examined to find out whether an improvement of the mentioned parameters can be achieved. The study is designed as randomized blind study with 75 test persons equally divided into experimental group, comparison group and control group. The special technique applied in this study has its origin in orthopathy, while the global technique is derived from massage. The first consists in a treatment of the lateral triggerband of the thigh according to the fascia distortion model; the latter applies friction according to traditional therapeutic massage. The test parameters were assessed by means of an S3 disc and the data collected and analyzed with the corresponding software. Via an Excel file the collected data were imported into the SPSS software to calculate the results. The hypothesis regarding sensomotoric function could be confirmed, but the variance analysis of groups A, B and C showed that no significant difference could be observed between the three groups at the two measurements. This means that the sensomotoric function could be improved in all test persons no matter which group they belonged to. The assumption that stability could be improved could not be confirmed. The influence of the treatment on the symmetry was not discussed further because in general it deteriorated.

List of abbreviations

Cf.	confer
CNS	Central nervous system
D.O.	In Austria: Diplom OsteopathIn (certified osteopath), In the United States: Doctor of Osteopathy
Dr.	Doctor degree in German speaking countries
EFDMA	European Fascia Distortion Model Association
e.g.	For example (Latin: exempli gratia)
etc.	et cetera
FDM	Fascia Distortion Model
GLT	Global Listening Test
GTO	Golgi tendon organ
Lig.	Ligament (Latin: ligamentum)
M.	Muscle (Latin: musculus)
MFT	Multifunktionale Trainingsgeräte (Multifunctional Training Equipment)
mm	millimeter
Ph.D.	Doctor of Philosophy (Latin: Philosophiae Doctor)
SMI	Sensomotoric index
SPSS	Statistical Package for the Social Sciences
STI	Stability index
SR	Symmetry ratio
WSO	Wiener Schule für Osteopathie (Vienna School of Osteopathy)

Gender-specific terms will be used when appropriate to comply with the rules on gender and diversity.

The fascia, the framework of life, the dwelling-place in which life sojourns.

(Still, A.T.)[1]

[1] cf Stark, J.: p 126

1 Introduction

1.1 Choice of topic

Within the framework of the osteopathic training at the Wiener Schule für Osteopathie (WSO - Vienna School of Osteopathy) also the fascia distortion model of Dr. Stephen Typaldos, D.O. was presented. Since Typaldos builds a bridge between osteopathy and orthopaedics[2] with this approach and since Dr. Georg Harrer, who presented the approach at the WSO, could wake my enthusiasm with his profound knowledge of the subject, I chose to write my thesis on a topic in this field.

Thus the present paper looks at the effects of fascial treatment on the body and in how far it can influence symmetry, stability and sensomotoric function of a person in upright stance.

The aim of the study is to find out how orthopathic treatment according to the fascia distortion model (FDM) affects stability sensomotoric function and symmetry.

1.2 Hypotheses of the study

A distortion within the fascial system, which according to the FDM has the effect that the system is no longer able to completely fulfil its function in its continuity, leads to changes in the connecting structures of the locomotor system.[3] Dr. Georg Harrer, who is the President of the European FDM Association (EFDMA) and a certified FDM instructor[4] usually asks the patients to stand on one leg (both sides) and treats the side where the patients seems to have a more insecure stance. When the test is carried out again after the treatment the patients display more stability.[5] It seems that treatment according to the FDM can improve the stability,

[2] cf. Typaldos, S.: p 11
[3] cf. Typaldos, S.: p 15
[4] cf. http://www.orthopathy.com/gpage3.html
[5] Dr. Harrer teaches this in his courses and it could also be observed in practical demonstrations on patients.

sensomotoric function and symmetry in a patient population without symptoms. Therefore the following hypotheses have been formulated:

Hypothesis 1: The treatment of the lateral triggerband of the thigh according to the principles of the fascia distortion model of Dr. Stephen Typaldos D.O. will significantly improve the stability in the upright stance on both legs.
Hypothesis 2: The treatment of the lateral triggerband of the thigh according to the principles of the fascia distortion model of Dr. Stephen Typaldos D.O. will significantly improve the sensomotoric function in the upright stance on both legs.
Hypothesis 3: The treatment of the lateral triggerband of the thigh according to the principles of the fascia distortion model of Dr. Stephen Typaldos D.O. will significantly improve the symmetry in the upright stance on both legs.

The hypotheses were formulated with regard to stability, sensomotoric function and symmetry because all three parameters can be measured with the S3-Check-Systems by MFT (Multifunktionale Trainingsgeräte, cf 3.4) and results can be calculated with the related software.

1.3 Objectives of the work

The objective of this study is to show that orthopathic treatment has an effect on the parameters symmetry, stability and sensomotoric function and to inform authorized practitioners like doctors and osteopaths[6] about the effectiveness of the evaluated technique.

[6] cf. http://fdm-europe.com/ziele-efdma.html

2 Theoretical underpinnings

2.1 Anatomical underpinnings

2.1.1 Embryologic development

In the third week of embryologic development cells of the ectoderm migrate medially towards the primitive streak. An invagination is formed and the cells start to spread laterally again. This is how the mesoderm[7] is formed, which represents the third or medial germ layer. During gastrulation a thickened mass of tissue, called paraxial mesoderm, forms parallel to the neural crest.[8] It is also called segmental plate or unsegmented mesoderm. It is connected with the lateral mesoderm (lateral plate mesoderm) via the intermedial mesoderm.[9] The immature connective tissue of the paraxial mesoderm has a high differentiation potential so it can develop into e.g. fibroblasts, which form reticular, collagen or elastic fibres.[10] In the context of this paper it has to be pointed out that the connective tissue of the fascia derives from the mesoderm.[11]

2.1.2 Biodynamic forces

Among the eight metabolic fields defined by Dr. Erich Blechschmidt[12] the retention fields are responsible for the formation of the fascia. This means that an accumulation of undifferentiated tissue cells grow more slowly in one direction than the surrounding tissues. This causes a greater dilatation of the cells, which is responsible for their conversion into fibrous connective tissue during development. The tension produced through these fields has the effect that the peripheral parts grow faster. The result is the form of the human being.[13]

[7] cf. Paoletti, S.: p 3+4
[8] cf. Benninghoff, A.: p 105
[9] cf. Benninghoff, A.: p 199
[10] cf. Paoletti, S.: p 4 ff
[11] cf. Paoletti, S.: p 9
[12] cf. http://de.wikipedia.org/wiki/Erich_Blechschmidt
[13] cf. Paoletti, S.: p 19

2.1.3 Structure of the connective and supporting tissues

Basically, cellular and extra-cellular components can be differentiated in the connective tissue. Due to the localization of the cells in the connective tissue they are also referred to as fixed and mobile cells.[15] Fibroblasts and fibrocytes, chondroblasts and chondrocytes, osteoblasts and osteocytes, as well as mast cells and adipocytes belong to the fixed cells.[16] Macrophages, leucocytes, granulocytes and agranulocytes are counted towards the mobile cells.[17] The totality of all extra-cellular components is called extra-cellular or amorphous matrix. It includes collagen and elastic fibres as well as ground substance, water and non-collagenous proteins.[18] Representing 60-70% of the overall mass of connective tissue collagens are the most important protein components of the human body.[19] Seventeen different types of collagen can be differentiated. 95% are made up by the types I to IV. Collagen type I represents the larges share (approximately 80%). It can be found in tissues that have to tolerate traction forces, among them: tendons, ligaments and fascias.[20] The amino acids glycin, prolin and hydroxyprolin play an important role for collagen. A lack of glycin entails a disturbance of the triple helix structure which can be the cause for a congenital connective tissue disease.[21] Collagen consists of three polypeptide chains arranged in a left-handed spiral. This arrangement is also called alpha-

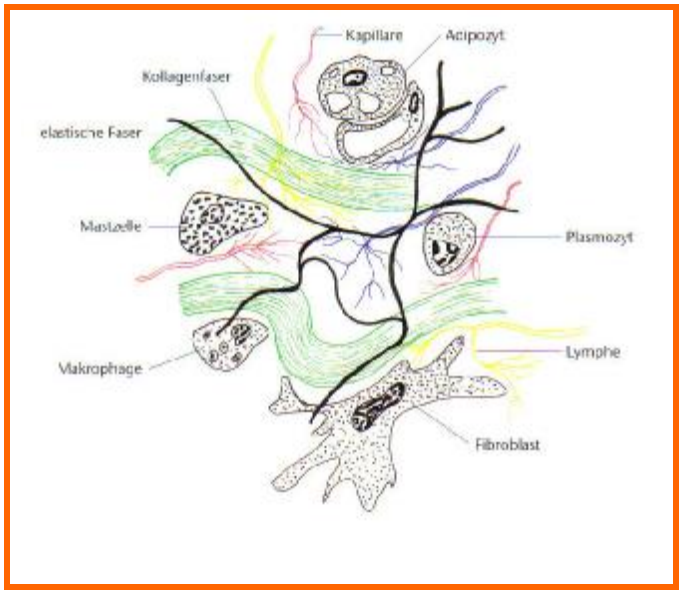


Figure 1: Components of fascia[14]

Glossar: Kollagenfaser = Collagen fibre, Kapillare = Capillary, Adipozyt = Adipocyte, Plasmozyt = Plasmocyte, Lymphe = Lymph vessel, Fibroblast = Fibroblast, Makrophage = Macrophage, Mastzelle = Mast cell, Elastische Faser = Elastic fibre

[14] cf. Paoletti, S.: 131
[15] cf. van den Berg, F.: p 3
[16] cf. van den Berg, F.: p 5
[17] cf. van den Berg, F.: p 11 ff
[18] cf. van den Berg, F.: p 3
[19] cf. Paoletti, S.: p 129
[20] cf. van den Berg, F.: p 18
[21] cf. Benninghoff, A.: p 132

helix. Three of these spiralling protein chains form a right-handed triple helix: the tropocollagen molecule or the proper collagen molecule. The molecules combine to form collagen micro-fibrils; several micro-fibrils build a collagen fibril. Many fibrils form a collagen fibre.[22] Fibres that are arranged parallel and in layers that are perpendicular to each other form aponeuroses. The product that results from their fusion is called fascia.[23] Elastic fibres are composed of the structural protein elastin. It has the same amino acid content like collagen, but it does not contain hydroxylysin and methionin. The collagen also contains a much larger amount of the amino acids valin, leuzin, isoleuzin and alanin. There are two types of elastin: alpha- and beta-elastin. Only 10% of these protein chains form a helix.[24] The long and elastic fibres have the ability to stretch and take on more than double their length. Besides the collagen and elastic fibres reticulin fibres represent the third type of fibres of the connective tissue. They are small-diameter collagen fibres that are rich in filaments and form a widely ramified network. They differ from collagen through their content of aspargin acid, hydroxamino acid and a small amount of prolin. These fibres are mainly found in the basal membranes.[25]

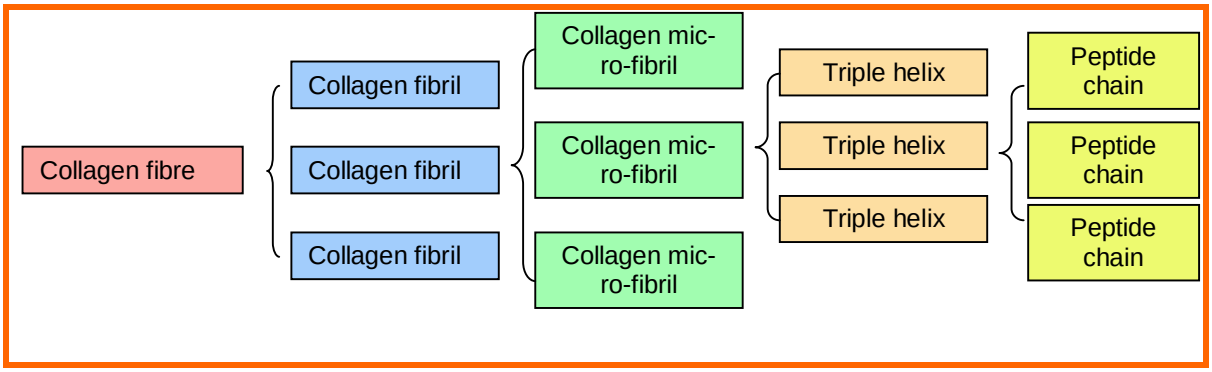


Figure 2: Schematic representation of collagen structure[26]

The ground substance can be described as network of macro-molecules.[27] It is composed of various mucopolysaccharides and can have a more liquid or gel-like

[22] cf. van den Berg, F.: p 20
[23] cf. Paoletti, S.: p 137
[24] cf. van den Berg, F.: p 28
[25] cf. Paoletti, S.: p 133
[26] cf. van den Berg, F.: adapted from p 20
[27] cf. Benninghoff, A.: p 134

texture depending on the water content.[28] If calcium salts are incorporated, it can be quite hard, e.g. in the case of bone tissue or dentin.[29]

2.1.4 The fascia of the lower extremity

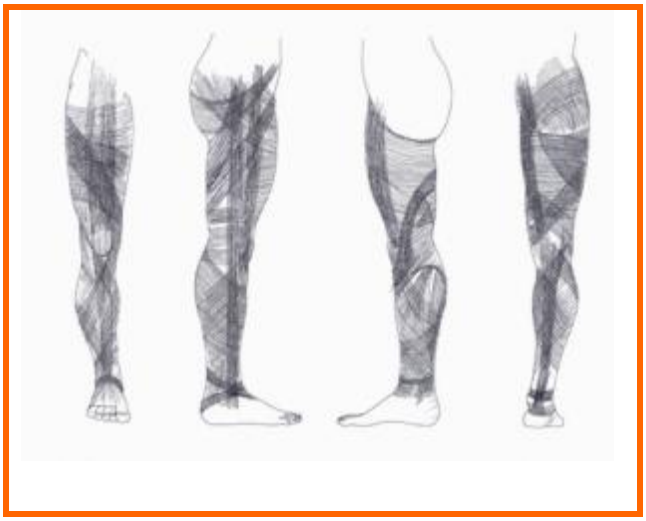


Figure 3: The fascias of the leg[30]

For this study the fascia in the region of the posterior and lateral thigh are those that are most important, therefore they will be discussed in detail. The fascial system must not be regarded as a uniform 'sleeve of tights' over the bones. Instead they form overlapping layers which differ in the direction of their fibres. This increases the stability and functionality of the tissue. At the posterior aspect of the leg strong vertical fibres can be found, horizontal fibres run distal to the gluteus maximus muscle and in the region of the popliteal fossa. The most inferior fibres run in an arching direction from proximal lateral to distal medial and continue in a vertical direction to merge with the leg's aponeurosis. At the lateral aspect of the leg the strong vertical fibres of the iliotibial tract can be found. Via the external obturator membrane it has a connection with the femor. In the middle of the leg it forms part of the patellar retinaculum and in the region of the lateral malleolus it participates in the ligamentous apparatus of the ankle. The arrangement of the fibres of the thigh continues unaltered in the lower leg and the foot.[31] The dense fasciculi of the connective tissue of the fascia are oriented in the direction of the strongest mechanical strain. This means that in the lower extremity the fascias in the region of the antero-lateral thigh are thicker and stronger than those in the region of the postero-medial thigh.

[28] cf. Paoletti, S.: p 132
[29] cf. Benninghoff, A.: p 134
[30] cf. Paoletti, S.: p 170
[31] cf. Paoletti, S.: p 169 ff

In the lower leg the fascia are strongest in the region antero-medially above the tibia.[33] The fascia can be differentiated in superficial and deep fascial chains which have a connection with each other because they form a continuous system. Without disruption they segue into each other and run vertically or diagonally. Attachments to the bones provide better coherence and efficacy of the system.[34] The fascia can be divided into the fascia superficialis, fasciae externae and the fasciae internae. The fascia superficialis is the superficial fascia which lies between the subcutaneous fatty tissue, dermis and subcutaneous cellular tissue.[35] In his dissection courses Gil Hedley, Ph.D., shows that after the skin is removed from a body the specific form of the individual is maintained by this layer.[36]

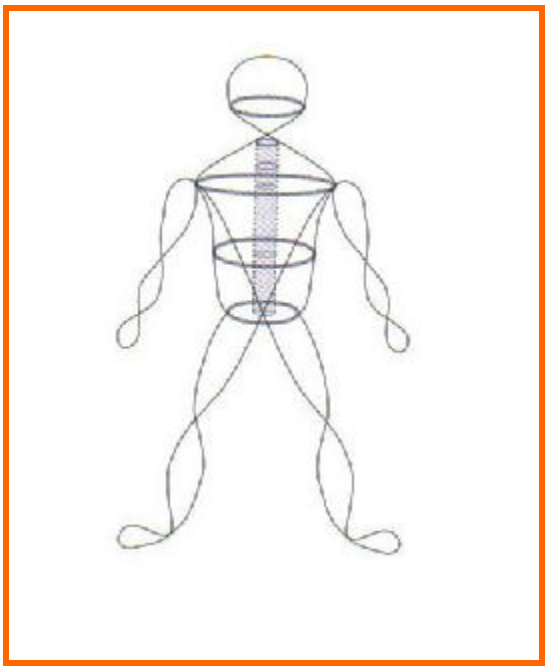


Figure 4:Representation of the fascial chains[32]

If the superficial fascia and the underlying tissues down to the fasciae externae are removed, the body immediately looses most of its characteristic form and appearance.

The fascias of the lower extremity represent a continuation of the fascia abdominalis and the fascia thoracolumbalis and terminate in the foot. They share deep and superficial layers. The deep portion forms the septum intermusculare and septum mediale and laterale in the thigh and the septum intermusculare cruris posterius and anterius in the lower leg. The superficial portion serves as “route” for lymphatic vessels, nerves and veins.[37] The fascias of the lower extremities can be divided in the Fascia glutea, femoris, cruris and pedis.

[32] cf. Paoletti, S.: p 177
[33] cf. Paoletti, S.: p 174
[34] cf. Paoletti, S.: p 176
[35] cf. Paoletti, S.: p 22
[36] cf. Hedley, G.: p 26
[37] cf. Paoletti, S.: p 42 f

The fascia glutea starts at the iliac crest, the sacrum, coccyx and the sacrotuberal ligament. It continues distally and ventrally as fascia femoris[39], which attaches to the inguinal ligament, the pubic bone and the ramus inferior ossis pubis. Further it attaches to the patella, the tibial tuberosity and the fibular head before it merges with the fascia cruris.[40] The fascia cruris is a posterior continuation of the fascia femoris and has the same antero-lateral points of attachment. In this region it incorporates fibres of some fascias enveloping the muscles of the thigh.[41]

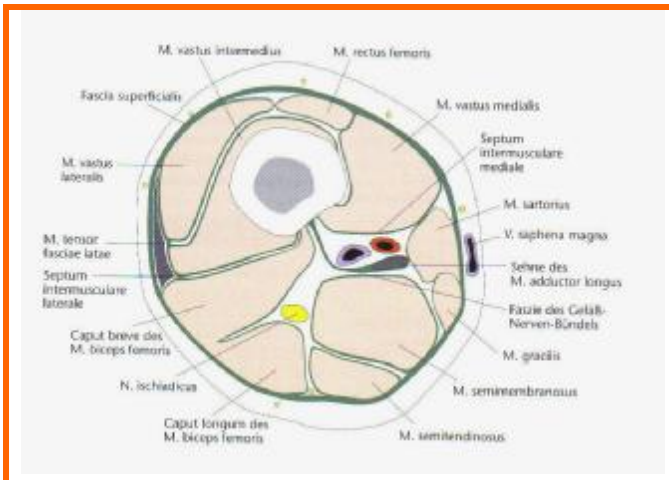


Figure 5: Cross-section of the thigh[38]

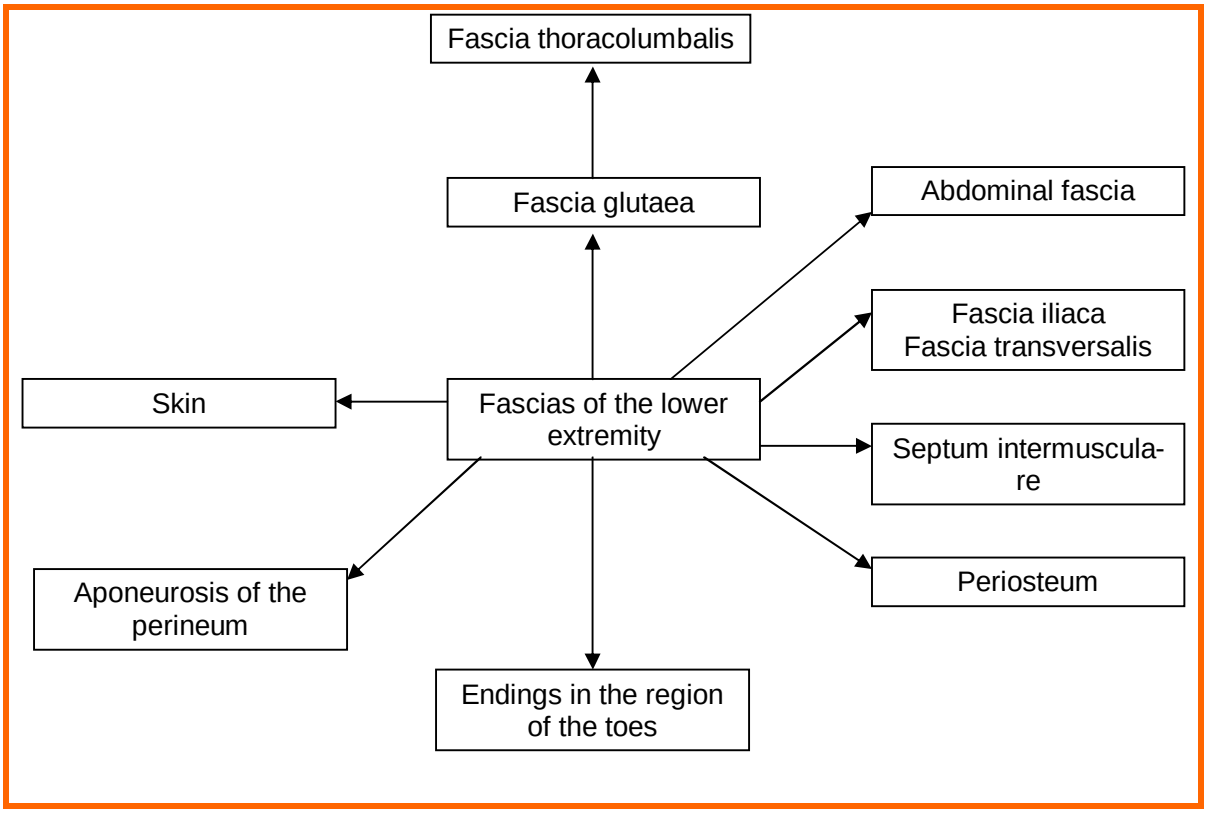


Figure 6: Schematic representation of the fascial connections in the lower extremity[42]

[38] cf. Paoletti, S.: p 43
[39] cf. Paoletti, S.: p 44
[40] cf. Paoletti, S.: p 45
[41] cf. Paoletti, S.: p 46
[42] cf. Paoletti, S.: adapted from p 49

The Fascia pedis is a continuation of the Fascia cruris and represents the most distal portion of the fascial system. It ends in the dorsal and plantar aponeurosis.[43]

The complexity of the fascial system shows that there is seamless continuity between the individual portions. The fascial ramifications, e.g. muscle septums, connect the superficial with the deep layers.

2.2 Physiological underpinnings

2.2.1 Function of the fascias

Fascias and thus the connective tissue are present in the whole body. They are responsible for a number of things and fulfil the most various functions:

- Supporting function
- Bearing function
- Protecting function
- Shock-absorber function
- Haemodynamic function
- Defense function
- Communication and exchange function
- Biochemical function.[45]

Figure 7: Schematic representation of the fascias' supporting function[44]

Each of these listed functions is important for the body but in this context only those will be described in more detail that can be regarded as relevant for the topic of this paper.

The fascias have a supporting function which guarantees that the muscle system can work properly, that the joints remain stable and the nerves and vessels have a guiding structure. The fascias make sure that the internal organs keep their anatomical shape, they provide a suspension system for them and thus guarantee

[43] cf. Paoletti, S.: p 48
[44] cf. Paoletti, S.: p 147
[45] cf. Paoletti, S.: p 146-156

that the organs can fulfil their function[46]. The fascias provide an important contribution for the maintenance of the body's posture. Some fascias are more important than others.[47] In particular the thoracolumbar fascia, the iliotibial tract, the gluteal fascia and the cervical fascia play an important role in stabilizing the upright posture.[48] The fascias' protective function is also essential because it ensures the physical and physiological integrity of the body. Since the fascias are everywhere in the body they protect the anatomical structures from changes in tension, stress and the impact of forces. To be able to fulfil this function the fascias can appear as different types depending on where they are located and which kind of strain they have to resist. One example for this would be the iliotibial tract with its very strong fascial structure. Structures of vital importance are often situated at the level of the deep fascias and are comfortably embedded in them, e.g. the radix mesenterii. As regards the brain and spinal cord the fascial system has the function to protect the structures from changes in pressure and to work as a shock-absorber.[49]

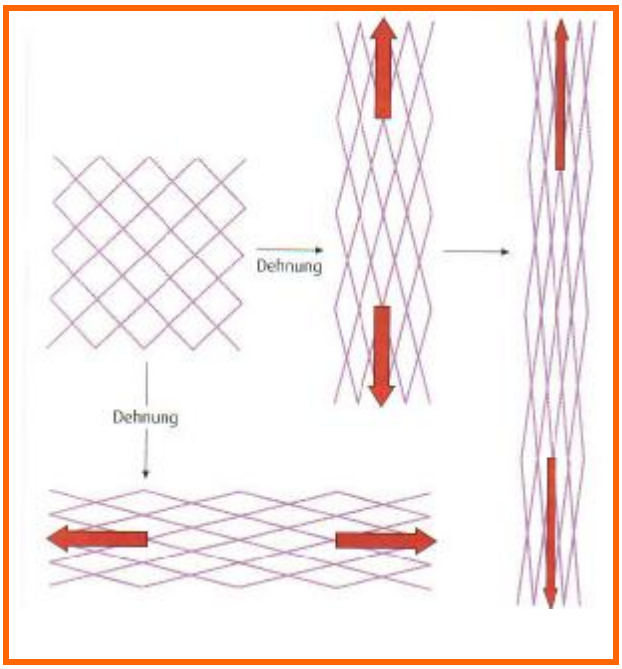


Figure 8: Connective tissue subject to traction[50]

Glossar:
Dehnung = stretch

[46] cf. Paoletti, S.: p 146
[47] cf. Paoletti, S.: p 176
[48] cf. Debroux, J.J: p 3
[49] cf. Paoletti, S.: p 148
[50] cf. van den Berg, F.: p 23

The fascias have a shock-absorber function thanks to their elasticity. The grid-like arrangement of the proteoglycans contributes to the cohesion. They also act like a lubricant because they change their state under strain. Their viscosity ensures that there is a cushioning effect for the cellular and tissue function. In particularly sensitive areas this cushioning effect is enhanced by fatty tissue, e.g. in the region of the kidneys.[51] The grid-like structure of the connective tissue adapts to the forces acting upon it and changes with traction.[52]

2.2.2 Nutrient supply of the connective tissue

The connective tissue usually has a good vascular and neural supply. Cartilaginous tissue represents an exception because according to most recent knowledge it is neither innervated nor supplied with blood. The transport of oxygen, nutrients and waste products is effected via the capillaries and interstitial fluid to the individual cells and from there via the interstitium to the venous and lymphatic system. For a good function of this system permeable and semi-permeable membranes are necessary.[53] The processes that are described are called diffusion and osmosis. Diffusion necessitates permeable membranes and osmosis requires semi-permeable membranes.[54] Besides a good supply of nutrients connective tissue also needs to be stimulated by regular physiological loading and unloading. The stimuli are different depending on the structure. If these stimuli are absent the connective tissue can degenerate .[55]

Structure	Stimulus
tendons	Contraction and stretching of muscles
capsule, ligaments	Use of the full range of movement of the joint
cartilage, discs, menisci	Compression due to the body weight and muscle contraction

Figure 9: List of stimuli[56]

[51] cf. Paoletti, S.: p 149
[52] cf. van den Berg, F.: p 23
[53] cf. van den Berg, F.: p 44
[54] cf. van den Berg, F.: p 45 f
[55] cf. van den Berg, F.: p 47
[56] cf. van den Berg, F.: adapted from p 47

2.2.3 Physiological mechanisms of wound-healing

The human body disposes of almost perfect self-regeneration powers. Thus it has the capability to react to injuries or tissue damage and often repair the damage completely.[57] The regeneration depends on the behaviour of the individual person, the applied functional stimuli and external influences. Depending on these factors the organism reacts with 'restitutio ad integrum' or a mere defect healing with the formation of scar tissue. Knowledge of the processes involved in healing allows to influence the wound-healing in a targeted way and to reduce or even eliminate negative influences like immobilisation, administration of medication or unphysiological stimuli.[58]

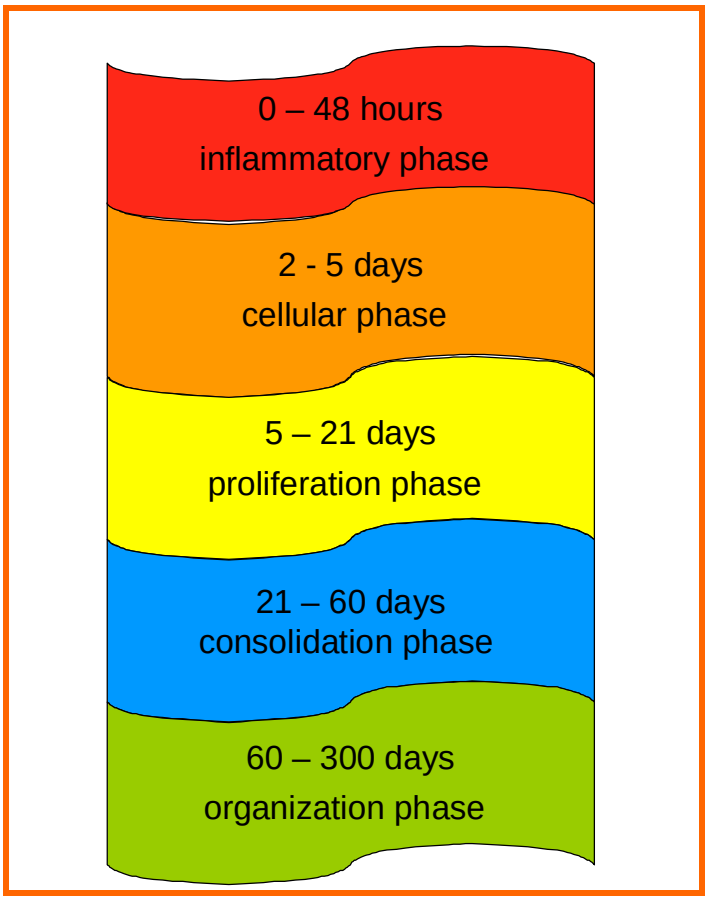


Figure 10: various phases of wound-healing[59]

[57] cf. van den Berg, F.3: p 131
[58] cf. van den Berg, F.3: p 132 and 133
[59] cf. van den Berg, F.3: adapted from p 132

2.2.4 Degeneration phenomena in the connective tissue

If a muscle is not adequately used, i.e. if it is not subject to maximum contraction and stretching, the relevant connective tissue is not efficiently stressed. The consequence is that the connective tissue atrophies, in particular regarding the amount of its ground substance and collagen fibres. The fact that the amount of ground substance is reduced results in an approximation of the collagen fibres which leads to the formation of pathological crosslinks, which prevent an expansion of the grid-like structure of the collagen network.

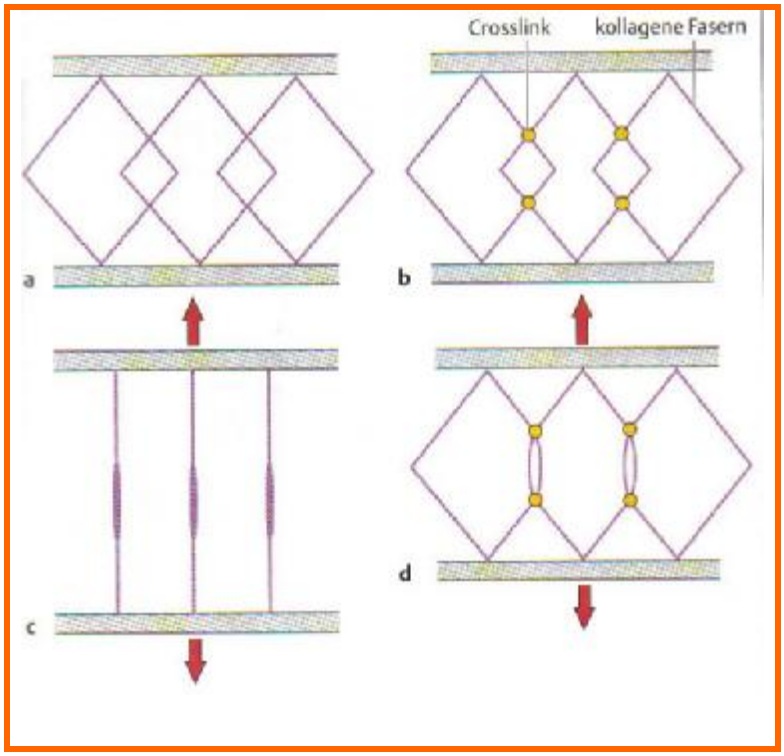


Figure 11: Formation of crosslinks in the grid-like collagen structure

a) relaxed normal state, b) relaxed state with pathological crosslinks, c) normal state under strain, d) strained with pathological crosslinks[60]

The result is a shortening of the muscle which in turn entails a hypomobility in the related joint. If this vicious circle is interrupted in time, the state is reversible. Regular stretching is an appropriate way to achieve this.[61]

[60] cf van den Berg, F.: p 179
[61] cf. van den Berg, F.: p 178

2.3 Fundamentals of training theory

2.3.1 Definition of terms

The definition of the 3 test parameters used in this study (stability, sensomotoric function and symmetry related to the human body in the upright stance) is not so easy. An online search of "Wikipedia" did not provide any results for stability and only technical descriptions for symmetry. Sensomotoric function is described as interaction of sensory and motor skills.[62]

Stability:

Biedert, R. and Meyer, St.[63] describe stability as functional stability, as a state in which a joint is stable. Stability is also explained as the result of the interaction of passive, active and controlling systems.[64] The term stability is also used in the context of analyses regarding exercise on uneven ground.[65]

Sensomotoric function:

In human beings the influence of peripheral information results in the perception of joint movements or altered joint positions. This perception is also referred to as proprioception.[66] The term proprioception is also used by Bizzini/Mathieu/Steens 1991[67], while Biedert, R. refers to the sensomotoric system in his dissertation.[68] In 2000 also Bizzini uses this term in his book "Sensomotorische Rehabilitation nach Beinverletzungen" ("Sensomotoric rehabilitation after leg injuries").[69]

Even though no explicit reference concerning the synonymous meaning of the terms proprioception and sensomotoric function can be found in the literature, today it can be assumed that the term sensomotoric function comprises the proprioceptive capabilities of a person.

[62] cf. http://de.wikipedia.org/wiki/Sensomotorik
[63] cf. Biedert, R./ Meyer, St.
[64] cf. Panjabi, M.
[65] cf. Kremer, C./ Bös, K.
[66] cf. Grigg, P.
[67] cf. Bizzini, M./ Mathieu, N./Steens, J.-C.
[68] cf. Biedert, R.
[69] cf. Bizzini, M.: p 1

Symmetry:

In the context of anatomy the medial saggital plane which divides the body in two halves is also referred to as symmetry plane.[70] The balance ability describes the ability to keep the body in a state of balance, i.e. also after the body's position is changed the balance should be maintained or re-established.[71] Susanne Klein-Vogelbach argues that the position of the centre of gravity above the supporting surface is the decisive factor for the body's balanced position.[72]

If the balance ability is tested on an instable surface, which allows movement only in one plane, the balance ability in the frontal plane can also be referred to as symmetry. Thus the term symmetry is clearly defined for the present study.

2.3.2 Sensomotoric functions of the body

Due to the development of our motor skills many of our movement processes are highly automated (e.g. walking) and do not permanently require conscious control. Nevertheless, they are constantly adapted according to old and new experiences. The movements are the result of muscle activities, which are controlled via motor neurons in the spinal canal and brain stem and eventually by the cerebral cortex. Besides these connections also the neural interconnections of the cerebellum, inner ear and eyes play an important role for movement processes. All this does not depend on the surrounding or environment in which the person is moving. We can differentiate between a central and a peripheral system. In the central system the afferent proprioceptive signals go through the related regions of the cerebellum, thalamus and cortex, where they are analyzed, processed and coordinated.[73] The muscles represent the peripheral system. They do not only act as effectors but also complement the information flow from the peripheral exteroceptors with their proper receptors, muscle spindles, Golgi tendon organs (GTO) and the receptors of the joint capsule. In addition, also the information received by the receptors of the optic, acoustic and static-dynamic fields has to be considered. Therefore this whole system was termed sensomotoric system. The innervated muscles cause a change in the joint and thus provoke a change in

[70] cf. Platzer, W.: p 2
[71] cf. Weineck, J., Erlangen: p 540
[72] cf. Klein-Vogelbach, S.: p 39
[73] cf. Bizzini, M.: p 31

tension, which has an effect on tendons, ligaments and capsules. These changes are registered by the receptors and transmitted to the central system.[74] Every movement means that the soft tissues around the moved joint are strained and loaded differently. For structures like muscles, tendons, fascias and ligaments this load or strain has to be as economic as possible so that they are able to maintain their function. A load or strain stimulates the mechanoreceptors which innervate the above mentioned structures. Via afferent pathways the information is transmitted again to the central system. The result is the perception of a joint's altered position, which is also referred to as proprioception.[75] [76]. *"The integrative processing of proprioceptive information by the central nervous system has a crucial influence on the function and coordination of motor activities."*[77]

Figure 12 and 13 below (**Fehler! Verweisquelle konnte nicht gefunden werden.** and Figure 13: Controlling elements of proprioceptive signals) try to present the complex interconnections of the sensomotoric system and the controlling elements as concise as possible.

[74] cf. Bizzini, M.: p 32
[75] cf. Bizzini, M.: p 33
[76] cf. Grigg, P.
[77] cf Quante, M/ Hille, E.

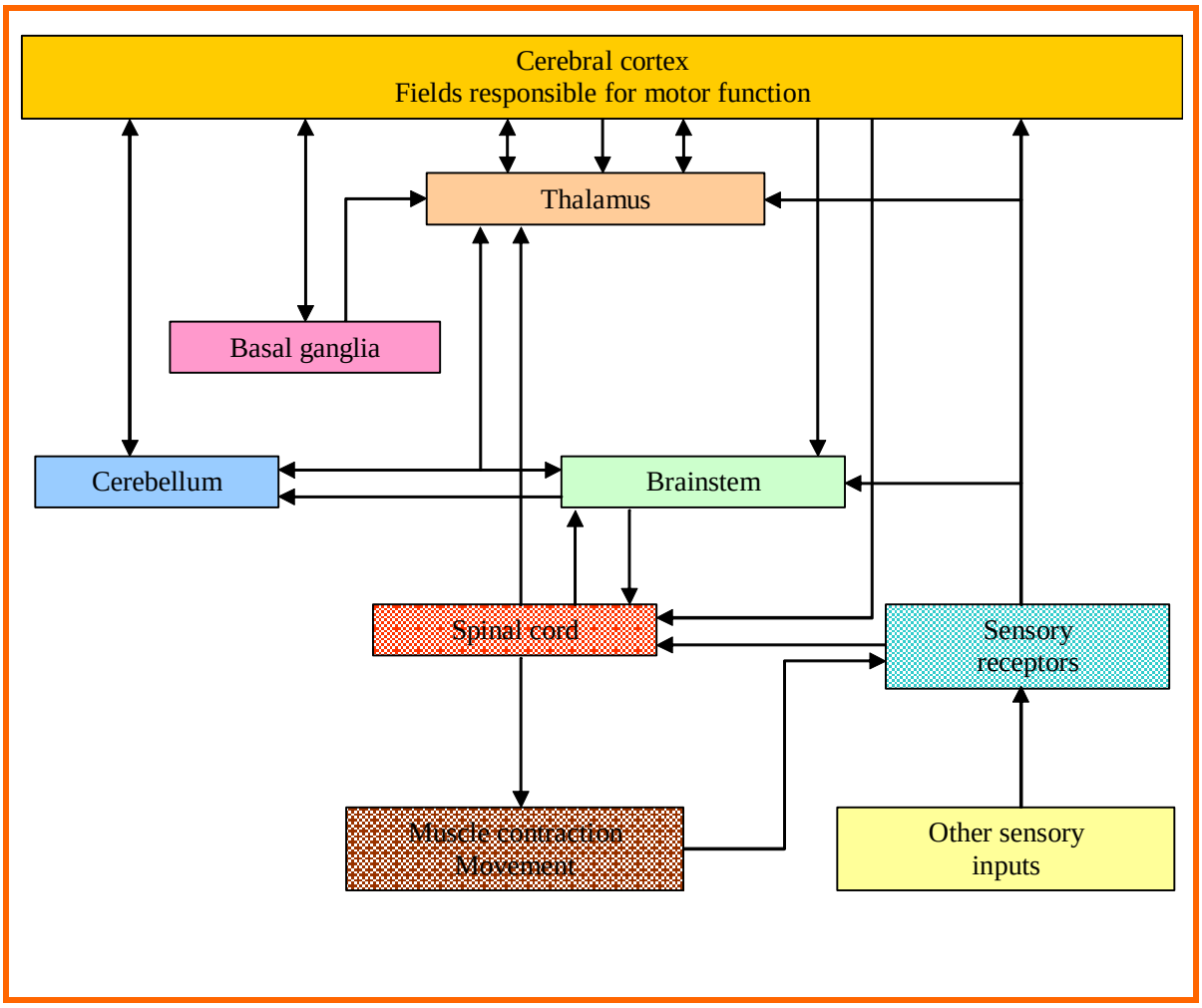


Figure 12: Overview of the sensomotoric system[78]

[78] cf. Kendel, E.R. et al

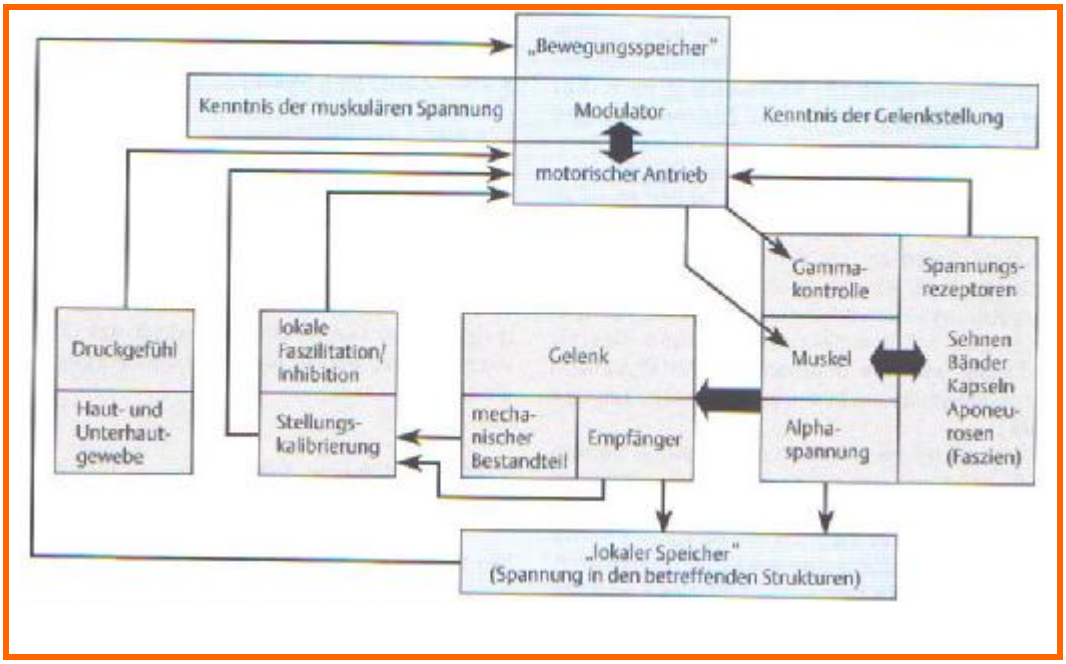


Figure 13: Controlling elements of proprioceptive signals[79]

Glossar:
Bewegungsspeicher = Movement memory, Modulator = Modulator, Motorischer Antrieb = Motor impetus, Kenntnis der muskulären Spannung = Perception of muscular tension, Kenntnis der Gelenkstellung = Perception of joint position, Spannungsrezeptoren = Tension receptors, Sehnen = Tendons, Bänder = Ligaments, Kapseln = Capsules, Aponeurosen (Faszien) = Aponeuroses (fascias), Gammakontrolle = Gamma control, Muskel = Muscle, Alphaspannung = Alpha tension, Lokaler Speicher (Spannung in den betreffenden Strukturen) = Local memory (tension in the affected structures), Gelenk = Joint, Empfänger = Receptor, Mechanischer Bestandteil = Mechanical component, Lokale Faszilitation / Inhibition = Local fascilitation / inhibition, Stellungskalibirierung = Calibration of position, Druckgefühl = Feeling of pressure, Haut- und Unterhautgewebe = Skin and subcutaneous tissue

Various studies have repeatedly evaluated the importance of the sensomotoric system in the human body. This made it possible to identify and provide evidence for a correlation between sensomotoric deficits and functional disturbances, muscular dysbalances or post-traumatic states.[80] [81] [82] [83]

[79] cf. Bizzini, M.: p 32
[80] cf. Quante, M./ Hille, E.
[81] cf. Lephart, p. M. et al
[82] cf. Machner, A./ Wissel, H./ Heitmann, D./ Pap, G.
[83] cf. Schlummberger, A./ Schmidtbleicher, D.

2.3.3 The kinaesthetic system

This system comprises the sum of the proprioceptors which are responsible for the deep sensibility in the body. The kinaesthetic system can be divided into the sense of position, sense of power and muscle-body sense. The sense of position is responsible for the perception of the position of joints in the various regions of the body. Information about pressure or traction is provided by the Vater-Pacini and Ruffini corpuscules and the free nerve endings (among other things). Also the Golgi tendon organs (GTO) and the muscle spindles contribute to the perception of this information. This kind of perception gives a person the possibility to know exactly in which position the joints are at the moment even though the visual system might not be working. The sense of power provides information on the quantity of muscle power that is necessary for an activity. The tendon spindles perceive the state of tension of the tendons and muscles. They react to the mechanical build up of tension in a tendon, which is the result of a muscle contraction or stretch, and they prevent a tearing of the tendon because they effect a reflex-like interruption of the contraction if the tension becomes too much.[84]

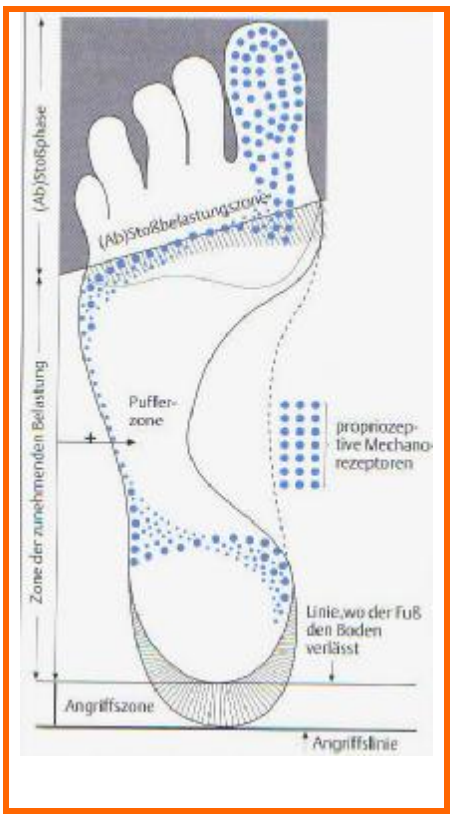


Figure 14: Distribution of the mechanoreceptors in the sole of the foot[85]

Glossar:
Zohne der zunehmenden Belastung = Zone of increasing load, (Ab)Stoßphase = Push-off phase, (Ab)Stoßbelastungszone = Push-off zone, Pufferzone = Cushioning zone, Propriozeptive Mechanorezeptoren = Proprioceptive mechanoreceptors, Linie, wo der Fuß den Boden verlässt = Line where the foot leaves the ground, Angriffszone = Zone of impact, Angriffslinie = Line of impact

[84] cf. Weineck, J.: p 117
[85] cf. Bizzini, M.: p 34

The muscle spindles are stretch receptors. They are important for the regulation of movements and are responsible for the muscle-body sense.[86] *"The muscle spindles play an important role for both the postural motor function and directed motility."*[87] The Golgi tendon organs complement the function of the muscles in a sensible way because they are tension receptors.[88]

Fehler! Verweisquelle konnte nicht gefunden werden. illustrates that it was a good decision to carry out the tests in this study without shoes and socks (cf 3.5) because mechanoreceptors are also present in the sole of the foot.

2.3.4 Significance of the Golgi tendon organs for the fascias

The receptors located in the proximal transition regions between tendons and muscles perceive changes in the tension of the muscle due to stretch or contraction. There are two kinds of receptors: one can be found directly at the transition between muscle and tendon, the other is located about 10 mm away from the transition in the tendon. Via muscle fibres a GTO has contact with about 10-15 motoric units, but only one muscle fibre per motoric unit reacts to a GTO. The perceived information is transmitted to the central system via afferent pathways. The GTOs are supposed to contribute to the modulation and fine-tuning of muscle contractions. They control the efficacy of muscle contractions and the state of tension of the fascias surrounding the tendons and muscles.[89]

Dexterity is another term used to describe a person's coordinative capabilities. The word 'coordinative' means that processes of movement control and regulation are concerned. Due to these capabilities the person can control his/her movements in predictable and unpredictable situations. They also facilitate the learning of new movement patterns. The coordinative capabilities are the basis of a good sensomotoric learning aptitude. They also guarantee that movements are carried out as economic as possible thus the degree of efficiency is increased with regard to a person's physical condition. Dexterity is mainly developed between the age of seven and the beginning of puberty. During this period the central nervous system

[86] cf. Weineck, J.: p 118
[87] cf. Weineck, J.: p 118
[88] cf. Weineck, J.: p 73
[89] cf. Bizzini, M.: p 41

matures more rapidly and the abilities of acoustic and optic analysis increase. The afferent information can be processed better by the CNS. This means that complicated movement patterns can be learned more easily.[90] The coordinative capabilities comprise: coupling abilities, differentiation abilities, orientation abilities, balance abilities, rhythm abilities, reaction abilities and adaptation abilities.[91] Complex neurophysiological mechanisms enable the body to maintain its balance when confronted with external forces.[92]

In the context of this study and the chosen test system a person's balance ability and reaction ability are of particular significance. Thus they will be explained in more detail below.

The balance ability has already been defined (cf. 2.3.1). The motoric balance can be divided into the balance of one's own body and in the balance of objects. The balance of one's own body can again be divided into static and dynamic balance. In the context of dynamic balance two aspects have to be considered: translatory and rotatory challanges.[93] *"For Meinel/Schnabel (1987, 251) the reaction ability is the ability to rapidly initiate and carry out short motoric actions responding to a signal. The decisive factor is to be able to respond with an adequate speed at the appropriate moment, with a reaction of maximum speed usually being the optimum."*[94] The muscle powers usually need a certain time to build up after the signal.[95] This time is called reaction time and it is dependent on certain sensory and physiological laws. The reaction time and its latency are based on five elements:

- Stimulation of the receptor
- Afferent input from the periphery to the CNS
- Processing and formulation of a response for the effector
- Efferent signal from the CNS to the effector
- Stimulation of the effector with the result of mechanical activity

[90] cf. Weineck, J., Erlangen: p 537 and 538
[91] cf. Weineck, J., Erlangen: p 539 and 543
[92] cf. Bizzini, M./ Mathieu, N./Steens, J.-C.
[93] cf. Weineck, J., Erlangen: p 542
[94] cf. Weineck, J., Erlangen: p 543
[95] cf. Weineck, J., Erlangen: p 418

Depending on the different stages of development the reaction time of a person is differently long. Also the type of sensory system which is addressed by the stimulus has a decisive influence on the time that elapses before the response.[96] The reaction time to an acoustic stimulus is shorter than to an optic stimulus. This is due to the fact that more time is necessary for converting light energy into neuronal impulses than for processing sound waves.[97]

2.4 Osteopathic underpinnings

Andrew Taylor Still, the founder of osteopathy, wrote: *"The soul of man, with all the streams of pure living water, seems to dwell in the fascia of his body."*[98]

Considering the philosophy of osteopathy one realizes that it is based on five biological principles:

- structure and function
- self-healing powers
- the body as entity
- the circulation as the supreme element
- the patient, not the disease.

The first principle makes clear that structure and function necessitate each other to the same extent. One cannot perform as best as possible without the other. If a dysfunction is present, no matter whether it is silent or symptomatic, the result is a change in the body's homeostasis.[99] This also includes changes in the postural balance. The body tries to compensate as far as possible. To do so it needs to recruit other structures (articulatory structures in the vicinity e.g. bones, muscles, joint capsule etc.) for self-protection and self-regulation. Due the incorporation in this stabilizing mechanism the structures' tension increases so they try in turn to change their situation to find the best possible position. In the long run this can lead to a change in morphology. This matter of fact closes the cycle and illustrates

[96] cf. Weineck, J., Erlangen: p 419
[97] cf. Weineck, J., Erlangen: p 420
[98] cf. Stark, J.: p 16
[99] cf. Liem, T/Dobler, T.K.: p 35

that structure and function are mutually related[100]. An osteopath uses observation and a number of tests to examine and evaluate the patient's upright stance. When the patients' statics are assessed, the practitioner mainly considers the vertical integration of the body when looking at them in the profile and the horizontal integration when looking at them from the front. The posture provides hints towards regions of increased tension in the body.[101] The global listening test (GLT) in standing (also know as 'ecoute' test) draws the osteopath's attention to the point of greatest tension and provides information on the postural pattern and the body's vertical and horizontal integration.[102] A detailed description of how the test is carried out can be found in chapter 3.4. The test can also be used as control of the treatment's progress.[103] But it has to be pointed out that this test alone is not sufficient to obtain a thorough diagnosis.[104] A study on the static examination by means of the 'ecoute' test (in the region of the abdomen) did not provide significant results.[105]

A.T. Still always attributed great importance to anatomy. The first system he considered in his original ideas was the circulatory system; then he integrated the nervous system and finally the fascial system.[106] These three aspects are also referred to as the three holistic networks of the body.[107] The importance of the vascular component is illustrated by the fourth biological principle: the rule of the artery. *"According to osteopathic philosophy the encounter of blood and fascias takes place under the control of the nervous system."*[108] In the principle according to which the body has to be regarded as an entity the importance of the connective tissue is emphasized: it envelops every cell and thus guarantees cohesion. *"It is a linking element which significantly multiplies the number of possible connections."*[109] There is no region in the body which is not enveloped by a fascia. Besides this "enveloping function" the fascial system also supports the structure of

[100] cf. Liem, T/Dobler, T.K.: p 37
[101] cf. Liem, T/Dobler, T.K.: p 79
[102] cf. Liem, T/Dobler, T.K.: p 81 f
[103] cf. Liem, T/Dobler, T.K.: p 79
[104] cf. Paoletti, S.: p 198
[105] http://www.osteopathicresearch.com/paper-pdf/Podlesnic_engl.pdf.
[106] cf. Liem, T/Dobler, T.K.: p 29
[107] cf. Myers, T.W.: p 24
[108] cf. Liem, T/Dobler, T.K.: p 41
[109] cf. Liem, T/Dobler, T.K.: p 41

the soft tissues: "*It is an integral part of them, serving as framework and support."*[110]

2.5 Orthopathic underpinnings

Orthopathy is an independent system of diagnosis and treatment.[111] Stephen Typaldos describes the bundle of parallel running fascial fibres (cf. 2.1) as fascial band.[112] "Normal" fascial bands play a role in proprioception, coordination of motor activities and muscle contraction. "Altered" fascial bands or fascial distortions thus cause restrictions of movements, altered proprioception and altered muscle function.[113]

This perspective of the fascial system was developed by Dr. Stephen Typaldos, D.O. Fascias and their structure and direction of fibres are known from an anatomical perspective, but the great importance of fascial bands and their distortion as well as the adequate treatment of these distortions goes directly back to the American author and his Fascia Distortion Model (FDM).

2.5.1 The Fascia Distortion Model

According to the FDM six fascial distortion types can be differentiated:

- Triggerband
- Herniated Triggerpoints
- Continuum distortions
- Folding distortions
- Cylinder distortions
- Tectonic fixations[114]

Since the treatment in the context of this study focuses on the triggerband, it will be described in more detail.

[110] cf. Paoletti, S.: p 162
[111] cf. Typaldos, S.: p 9
[112] cf. Typaldos, S.: p 234
[113] cf. Typaldos, S.: p 20 and 21
[114] cf. Typaldos, S.: p 23

2.5.2 The triggerband of the thigh

The course of the lateral triggerband of the thigh comprises parts of the lateral and posterior fascial chain. It starts in the lateral fascial chain at the lateral aspect of the knee joint and the fibular head and runs cranially via the iliotibial tract and the fascia lata. It then continues more posterior in the region of the thoracolumbar fascia. Here it passes over into the posterior fascial chain.[115] At the level of the gluteal region points of contact with the posterior chain are located; they comprise the ischial tuberosity, the sacrum, coccyx, sacrotuberal ligament and iliac crest.[116]

2.5.3 The treatment of the fascial triggerband

The triggerband is the most common fascial distortion. The image of a contorted seatbelt might help to better understand this distortion. Since the fascias are present in the whole body, distortions can occur anywhere in the body.[117]

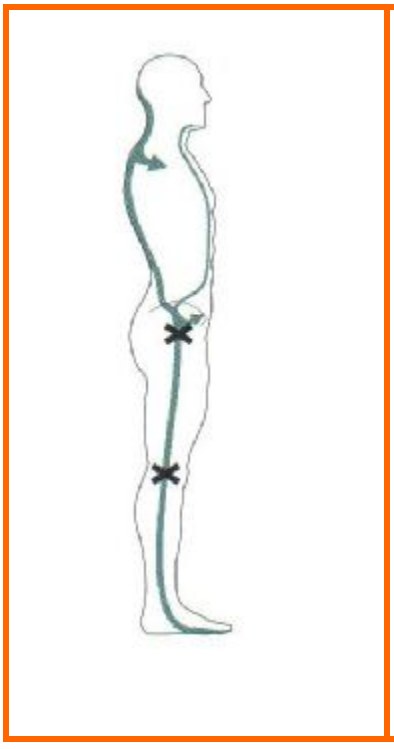


Figure 15: lateral fascial chain[118]

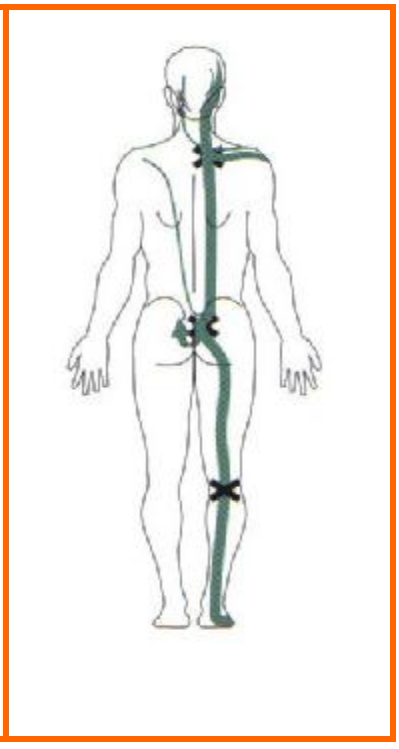


Figure 16: posterior fascial chain[119]

[115] cf. Paoletti, S.: p 180
[116] cf. Paoletti, S.: p 181
[117] cf. Typaldos, S.: p 25
[118] cf. Paoletti, S.: p 181
[119] cf. Paoletti, S.: p 182

From an anatomical point of view a triggerband is an altered arrangement of the band-like fascial tissue. The distortion provokes a contortion, separation, tear or folding of the fascial fibres. The treatment of a triggerband distortion consists in a special triggerband technique, by which the contorted fibres are manually corrected. Before the actual treatment the practitioner first has to determine the course and the beginning of the triggerband.[120] The correction involves that the contortion of the distorted fascial band and its sub-bands (i.e. individual fibres) is resolved and their ends approximated.[121] In the case of chronic triggerbands also adhesions in the fascias are removed by breaking pathological crosslinks. In order to remove adhesions completely several treatment sessions might be necessary.[122] The treatment is effected with the pad of the practitioner's thumb.[123] To do so the practitioner flexes the interphalangeal joint of his/her thumb approximately 90° and places the pad of the thumb at the beginning of the triggerband. Then the practitioner glides the thumb with a consistently strong pressure along the triggerband until its end.[124]

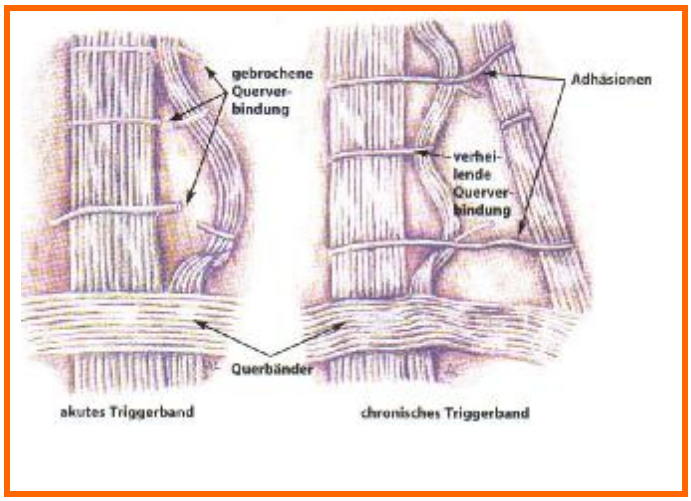


Figure 17: Acute and chronic triggerbands[125]

Glossar:
Akutes Triggerband = Acute triggerband, Chronisches Triggerband = Chronic triggerband, Gebrochene Querverbindung = Broken cross-fibre connection, Querbänder = Cross-fibre connection, Verheilende Querverbindung = Healing cross-fibre connection, Adhäsionen = Adhesion

[120] cf. Typaldos, S.: p 34
[121] cf. Typaldos, S.: p 29
[122] cf. Typaldos, S.: p 35
[123] cf. Typaldos, S.: p 29
[124] cf. Typaldos, S.: p 34
[125] cf. Typaldos, S.: p 33

It is important that the thumb stays on the triggerband throughout the whole treatment because otherwise it cannot be completely closed.[126] The triggerband is regarded as corrected or healed when all fibres are reconnected.[127] The fibres of the band are held together by connections that have a cross-fibre direction. These connections can be effected by retinacula, fascial bands, band-like fascial structures or bones. They prevent an endless tearing of the fascial band. Only very massive impacts of force or targeted cutting (e.g. during an operation) can sever the cross-fibre bands.[128]

Regarding the current research on the FDM it has to be pointed out that there are next to no studies available on this topic. The author of this study knows of two papers, which are both diploma theses within the framework of osteopathic training. Both papers evaluate the FDM in the context of treating pain patterns in the human body.

The search of the international online databases “pubmed” and “EBSCO” did not provide any results with the key word “fascial distortion model”. Also the search of the “osteopathic research web” did not provide any results with the same key word.

2.6 Fundamentals of massage therapy

Since the control group in this study was treated with a technique derived from traditional therapeutic massage, the most important characteristics of this kind of therapy will be described in this chapter.

2.6.1 Effects and principles of massage

According to their therapeutic principles the different processes that take place in a massage treatment can have the following effects:

- Mechanical effects
- Biochemical effects

[126] cf. Typaldos, S.: p 35
[127] cf. Typaldos, S.: p 32
[128] cf. Typaldos, S.: p 33

- Reflex-like effects
- Psychological effects
- Immune-modulating effects[129]

The smoothing out effect and the mobilizing effect of massage can be counted towards the mechanical effects, those that are produced by the movements of the hands. The mobilizing aspect can be divided into the loosening of adhesions between the different layers of tissue and the dissolving of pathological crosslinks in the connective tissue.[130] The biochemical effects include the release of various substances like serotonin, endorphins and inflammation mediators and their effect on the tissues. In this context the type of massage, its intensity and duration are decisive.[131] Effects like the reduction of pain, the reduction of sympathetic tone and the regulation of the muscle tone are reflex-like effects.[132] The psychological and immune-modulating effects will not be explained in more detail.

2.6.2 The technique of friction

The friction massage is also called ‘circling massage’. It is applied to treat broad-scale or local hardness in the muscles or to work directly on the transition regions between muscles and tendons. The friction can be applied cross-fibre, circular or in a rather global way as long as the focus lies on the region of the lesion. The practitioner first makes sure that the tissues to be treated are in a relaxed position; then he/she takes up contact with his/her hands. Depending on the size and localization of the region the friction massage can be applied with the fingers or with the heel of the hand. The tissue in question is massaged with an appropriate amount of pressure with circular or cross-fibre movements. To reach differently deep layers of tissues the “touching hand” (the hand that has the contact with the tissue) can be reinforced with the “controlling hand” (the second hand is put on the touching hand to increase the pressure). The actual friction movements are small movements that go into depth. The practitioner does not glide or stoke over the skin he/she wants to reach deep tissue levels with the friction.[133]

[129] cf Kolster, B.C.: p 22
[130] cf. Kolster, B.C.: p 22
[131] cf. Kolster, B.C.: S 25
[132] cf. Kolster, B.C.: p 26-32
[133] cf. Kolster, B.C.: p 98

It is interesting that in the notes of A.T. Still, which he wrote at the end of the 19th century, the term massage therapy can be found for the scientific aspect of the method, and the term massage for the non-scientific aspect of the treatment. Still strongly argued against massage and this treatment method did not have any influence on the osteopathic training. Nevertheless, it is remarkable, that the available literature on massage therapy emphasizes in particular the treatment of the fascias:[134] *"The pressure applied in deep massage has a simultaneous effect: on the skin, the fascias, the muscles within its range,…..The normal function of the superficial fascias is influenced in a positive way because the skin can move more easily over the deeper layers of tissue due to the massage……Besides its direct effect on the superficial nerves and vessels which are embedded in the fascia it simultaneously removes the obstacle of pressure acting upon it ….."*[135]

2.7 Physical underpinnings and mathematical considerations

The test system used in this study assesses the body's stability while the patient is standing on an instable disc. At the same time also the body symmetry and ability of sensomotoric regulation of the test person is evaluated. The disc has a diameter of 530 mm and is linked with a baseplate through a horizontal axis. It has a 12° angle of inclination to both sides. A constant inclination resistance is provided through an elastomer.[136]

Figure 18: S3 measuring disc

Elastomers are plastic materials that are characterized by the property of elasticity; they can be deformed through compression or traction and return to their original

[134] cf. Stark, J.: p 118
[135] cf Stark, J.: p 118
[136] cf. Gruber, D./ Hilden, T./ Lutz, M.: p. 4

shape once the force acting upon them is removed.[137] A sensor on the under-surface of the instable disc measures the inclination and forwards the data to the software. The test persons were instructed to try to keep the instable disc in a horizontal position during the test phase. To do so the test persons had to make certain balancing movements causing the disc to tilt. These inclinations were registered and transmitted by the sensor. On the basis of the number and amplitude of the balancing movements the software calculated the sensomotoric index (SMI). This index thus is the result of the deviations from the central balanced position of the disc. These values are crucial for the stability index (STI) which is also calculated.[138] *"The stability index provides information on the active body stability."*[139] The sensomotoric index describes the coordination of the movements by the muscles.[140]

Since the measurement looks at the right/left deviations, the symmetry ratio (SR) can be determined as well. The symmetry ratio describes the deviations from the symmetry plane. The body would be subject to a balanced strain if deviations would be equal to both sides.[141] To standardize the S3 checks a study was carried out to collect data and to obtain standard values and standard value diagrams on the basis of these data. They provide reference values for body stability and sensomotoric function. In a symmetry ratio of 50:50 percent the SMI corresponds to the STI.[142] *"The standard value/reference value for stability is an idealized value, while the standard value for sensomotoric function is a statistically calculated mean value."*[143] Since the analysis of the participants' results consists in comparing the measured values with the reference values of the corresponding age group and sex, the results are described by means of the "traffic light colour system". This means that dark green represents a very good result while red can be regarded as very bad. The classification categories in the evaluation of body symmetry are: no preference, slight preference and significant preference of one side of the body. The ideal value of symmetry is set at a ratio of 50:50 percent.[144]

[137] cf. http://de.wikipedia.org/wiki/Elastomer
[138] cf. Gruber, D./ Hilden, T./ Lutz, M., p. 4
[139] cf. Gruber, D./ Hilden, T./ Lutz, M., p. 5
[140] cf. Gruber, D./ Hilden, T./ Lutz, M., p. 5
[141] cf. Gruber, D./ Hilden, T./ Lutz, M., p. 6
[142] cf. Gruber, D./ Hilden, T./ Lutz, M., p. 7
[143] cf Gruber, D./ Hilden, T./ Lutz, M., p. 7
[144] cf. Gruber, D./ Hilden, T./ Lutz, M., p. 8

The software does not only register the results as values, it also provides a graphic illustration of the results. The measured data is represented in a diagram where the deviations to the left and right are represented on the x-axis, while the y-axis (bisecting the x-axis) is divided in five-second intervals from zero to 30 seconds (cf. Figure 19: S3 diagram).

The symmetry index results from the time that was spent to the left or right of the midline. The participants' performance is evaluated according to the following criteria:

- No preference of one side of the body with values between 40:60 and 50:50 percent
- Slight preference of one side with values between 25:75 and 39:61 percent
- Significant preference of one side of the body with values below 24:76 percent[145]

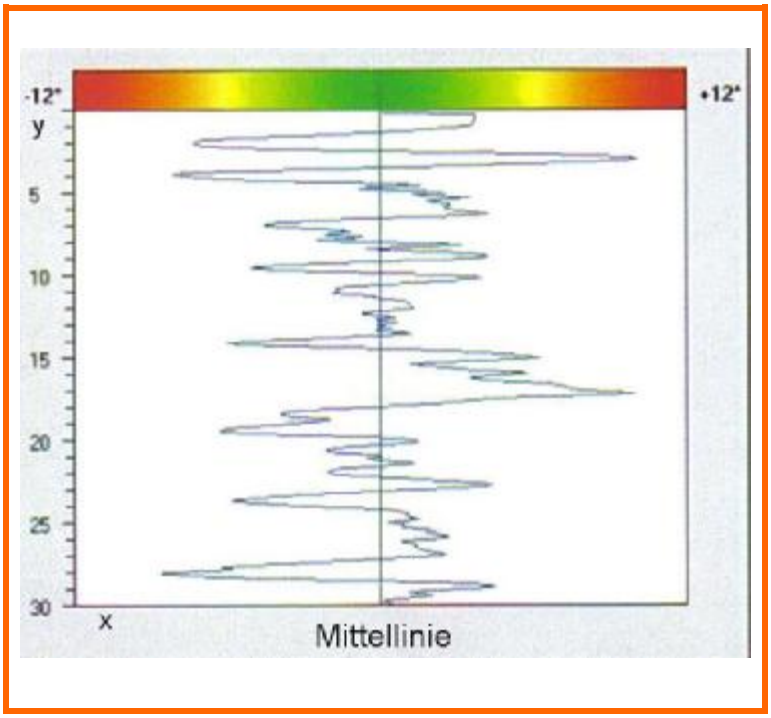


Figure 19: S3 diagram[146]

Glossar:
Mittellinie = midline

[145] cf. Gruber, D./ Hilden, T./ Lutz, M., p. 8
[146] From the MFT brochure

Unfortunately, the author was not able to obtain more detailed information on the calculation formulas of the three indices (SMI, STI and SR) from the manufacturer MFT, despite several requests. The formulas are regarded as corporate secrets and are thus not communicated.

3 Study design

3.1 Methodology

The study is a randomized controlled study. By means of three independent sample groups it is evaluated how different treatment methods influence the parameters symmetry, stability and sensomotoric function. In order to guarantee validity each sample group comprises 25 test persons. The third group serves as control group to take a possible learning effect into account.

3.2 The sample groups

The three groups are independent samples. By drawing of lots the test persons were randomly attributed to one of the three groups: experimental group, comparison group and control group. In order to be recruited for the study the participants had to have no symptoms and the following criteria were regarded as exclusion criteria. Each exclusion criterion is accompanied with an explanation:

a) Younger than 18 years of age – a declaration of consent by a parent or legal guardian would have been necessary
b) Older than 45 years of age – according to the WHO the transition or middle age starts at age 46[147]
c) At present physical complaints in the region of the pelvis or legs – because the patients cannot be regarded as “symptom-free”
d) At present undergoing medical, physical therapy or osteopathic treatment for these complaints – same reason as above

[147] cf. Weineck, J., Erlangen: p 428

e) Osteosynthetic material (e.g. nails, pins, plates) in the legs or in the pelvis – continuity of the structures is disturbed due to foreign bodies or operation
f) Presence of balance problems due to vertigo or dizziness – risk of falls because of instable test equipment
g) Haemorrhagic tendency – contradiction of orthopathic treament via trigger-bands because of the risk of severe bleeding
h) Administration of anticoagulants – same reason as above
i) Some sort of cerebral dysfunction – risk of falls on instable test equipment because the central component of the sensomotoric system is disturbed
j) Some sort of peripheral palsy – risk of falls on instable test equipment because the peripheral component of the sensomotoric system is disturbed
k) V Severe body asymmetry (e.g. scoliosis, missing body parts, etc.) – can impair the movement behaviour
l) Severe body asymmetry – contraindication for the treatment of the pelvis[148]
m) At present under the influence of alcohol – balance and coordination of movement are impaired. The reaction time is longer and responses are slower and more insecure[149]
n) Regular training (once per week or more often) using an MFT disc – corresponds to the test equipment

The test persons can be divided in the following categories:

- **ü** Physical therapy students
- **ü** Civil service clerks / persons with a mainly sitting profession
- **ü** Higher medical technicians and persons working in health care and nursing professions
- **ü** Retail sales persons / shop assistants – standing most of the time

[148] cf. Typaldos, S.: p 82
[149] http://www.schule-begleitet-fahren.de/alkohol.html

3.3 Scientific aspects

This fundamental study is based on a randomized controlled design. It was carried out with a total of 75 participants. This means that 25 test persons were attributed to each of the three groups (experimental group, comparison group and control group). The participants received five-pages of information on the study. By signing the included declaration of consent the test persons agreed to participate in the study (cf. annex **Fehler! Verweisquelle konnte nicht gefunden werden.**). The initial and final tests were carried out by instructed test supervisors in a different room than the treatment. This guaranteed a simple blinding of the study.[150] To guarantee randomization of the study each test person had to draw a piece of paper from a non-transparent bag. The pieces of paper were rolled up and fixed by rubber bands. Thus the patients could not read what was written on them. A letter indicating the respective group and a number could be found on each piece of paper. Each test person signed the piece of paper and put his/her name on the list of the respective group next to the number he/she found on the piece of paper. Since the patients signed their piece of paper the group lists could be controlled for correctness.

Figure 20: Pieces of paper for the drawing of lots

Figure 21: Pieces of paper rolled up for the drawing

[150] http://www.pflegewiki.de/wiki/Blinbedingung

3.4 Course of treatment

After the initial measurement the test persons proceeded into the treatment room. First they had to draw a piece of paper from the bag and the group attribution was documented. All the test persons were evaluated with a global listening test[151] in standing before and after the treatment or the period of rest. The test was carried out by the practitioner with the patient standing and not wearing shoes. The test persons stood with their backs to the practitioner who put her left hand on the head of the person and the right hand on the region of the thoracic spine. First, the test persons kept their eyes open. Once the position was assumed the test persons were asked to close their eyes and to keep them closed.[152] The practitioner took note of her impressions before asking the test person to open the eyes again. The practitioner then recorded the findings on a specific sheet for each patient (cf. 10.4). The participants of the experimental group and the comparison group were then asked to take off their long trousers. The patients were required to wear long comfortable trousers in order to allow for freedom of movement and to hide possible redness of the skin after the treatment. This guaranteed that the test supervisor did not have any information about the treatment and was unbiased during the second measurement. Adjustable treatment tables were used, which were covered with fitted sheets. The patients spent the 10-minute period of rest in supine position on the treatment table. To make sure that the patients could lie in a relaxed and comfortable position the head-rest of the table was raised if necessary. A digital alarm clock was placed in a well-visible location to ensure the correct duration of the resting phase.

3.4.1 Treatment of the experimental group

All patients of group A received a treatment of the lateral triggerband in the thigh on both sides. They had to lie prone on the treatment table while the practitioner carried out the treatment with her thumb. The treatment region extended from the lateral aspect of the knee joint to the coccyx. To protect the patients' privacy they could opt for a blanket cover. After the treatment the participants were asked to turn onto their back and to rate their feeling of comfort on the comfort scale (cf.

[151] also referred to as 'ecoute'
[152] cf. Liem, T. / Dobler, T.K.: p 82

10.3). The scale corresponds to the generally used visual analogue scale.[153] The patients spent 10 minutes resting in supine position. Afterwards they rated their feeling of comfort a second time before putting their trousers on again and proceeding to another room for the final measurement with the test supervisor.

3.4.2 Treatment of the comparison group

The participants in group B were treated with friction in the regions of the right and left lateral thigh according to the principles of traditional therapeutic massage.[154] The participants had to lie on their back and the head-rest of the treatment table was raised a little bit. The patients of group B were not positioned with a knee roll under their knees to increase tissue relaxation because also the patients of the other two groups were not positioned this way. A friction massage in four tracks was applied to the iliotibial tract with the heel of the proximal hand using a commercially available massage oil made of wheat germs (this kind of oil was chosen because of its neutral fragrance in order to prevent bias of the test supervisor through olfactory influences which could allow for conclusions regarding the applied treatment). The area to be treated extended from the lateral joint margin of the knee to the ilium. The distal hand on the medial aspect of the knee provided stability and prevented an internal rotation of the hip. Also the patients of group B assessed their feeling of comfort on the comfort scale after the treatment and after the 10-minute period of rest. After putting on their trousers and after the global listening test was carried out again the participants were sent to the second measurement.

3.4.3 Treatment of the control group

The participants in group C only spent 10 minutes resting in supine position on the treatment table, whose head rest was raised a little bit for reasons of comfort. The test persons did not assess their comfort on the comfort scale because they did not receive any treatment. After the period of rest the global listening test was carried out and the patients proceeded to the second measurement.

[153] cf. http://de.wikipedia.org./wiki/Visuelle_Analogskala
[154] cf. Kolster, p. 98 f

3.5 Test system

The test system is a computer-controlled measurement system developed by the company MFT, which evaluates the parameters body stability, movement symmetry and sensomotoric behaviour of the test person in the upright stance.[156] Besides the measurement disc the system requires a cable with USB plug to connect the disc with the notebook on which the software "MFT S3 Check", version 6.1.55, has been installed.[157] The disc needs to be placed on an even surface, which is controlled by means of a water-level, and connected with the notebook. On each test day the system is calibrated before the first test. The calibration is carried out for the respective test mode, i.e. in the context of this study for the disc's deviation to the left and right. In order to prevent slipping on sleek surfaces an anti-slip pad is placed between the floor and the baseplate of the measuring device (this was integrated by the author in the test design due to safety issues) because the patients could not hold on to any support. The test persons are asked to step on the disc with bare feet and to make sure that their feet are placed straight on the grey pads on the disc. They are instructed to maintain the disc in a horizontal position. The software has a pre-set and fixed test procedure which consists in:

Figure 22: Installed test system[155]

- 15 seconds warming up on the disc – to get a feeling for it
- 10 seconds rest – to relax (the test persons are allowed to step off the disc)
- 5 seconds preparation before the first measurement (test person steps on the disc again)
- 30 seconds for the first measurement

[155] Geiger, A.: photographed by the author
[156] cf. Gruber, D./ Hilden, T./ Lutz, M., p. 4f
[157] Current version at the moment of use (June 2007)

- 10 seconds rest – to relax and regenerate (test persons are allowed to step off the disc)
- 5 seconds preparation for the second measurement (test person steps on the disc again)
- 30 seconds for the second measurement

Not every participant took advantage of the possibility to step off the disc in the breaks (as described above). The test supervisor gave instructions to the participants by counting down the start of each test phase and by announcing the remaining time of each measurement after half of the time had elapsed. The system measured the results and saved the best valid result in a file. A result had to be regarded as not valid and deleted if the measurement was disturbed in one way or the other. Since the participants had to stand barefoot on the disc the disc was disinfected after each measurement by the test supervisor with the spray "EuroSept® Max Surface Lemon"[159] and dried with a paper towel to avoid the transmission of germs.

Figure 23: Test person on disc[158]

The successfully saved data are used to follow the progress in each participant's measurements. Besides basic data like name, first name, sex, date of birth, and name of test supervisor the software automatically saves the date of the test and the best result of one test unit.

Due to the fact that the test system comprises generally valid reference values for men and women between the ages of 7 and 70 years, the stability, sensomotoric behaviour and symmetry can be compared with certain categories. Thus the software can establish an interpretation in words of the test results of each

[158] Geiger, A.: photographed by the author 2007
[159] cf. Heiland Heilmittelkatalog, p. 85

participant (cf. annex 10.6). The test results are also graphically represented as coloured bars (colour range like in a traffic light: from green to red), with the reference value (standard value) indicated as blue triangle and the result of the test person marked by a black triangle (cf. annex 10.6).[160]

On the basis of the participant's results the software also calculates a training program tailored to the needs of the participant so he/she can improve his/her performance. Three different types of discs can be used for training purposes: Fit Disc, Trim Disc and Sport Disc. They differ from each other in the degree of difficulty. According to the availability of one of these discs the training program can be printed out for the participant in question (cf. annex 10.7).[161]

Figure 24: Fit Disc

Figure 25: Trim Disc

Figure 26: Sport Disc[162]

Each test person received a written analysis of the test results and his/her personal training program together with an accompanying letter (cf. annex 10.5).

Even though the company MFT asserted before lending the equipment to the author that the data collected by the software could be exported in an Excel file, this was not possible with the applied version of the test system and software. This problem could only be detected after all tests have been carried out because at that moment the data needed to be imported into SPSS for statistical analysis. Since no other possibility of electronic transfer could be found, the test supervisors and the author had to enter all data manually into an Excel file and double-check the entered data. Finally, the data were analysed by means of the SPSS software, version 12.0.

[160] cf. Gruber, D./ Hilden, T./ Lutz, M., p. 8
[161] cf. Gruber, D./ Hilden, T./ Lutz, M., p. 9
[162] Figures 4 to 6 were taken out of a brochure of the company MFT

4 Analysis and graphical representation of the collected data

4.1 Descriptive statistical analysis of the sample

The total number of 75 participants (N=75) in this study was divided into 53 women and 22 men. The gender distribution in the three groups is represented in the diagram below.

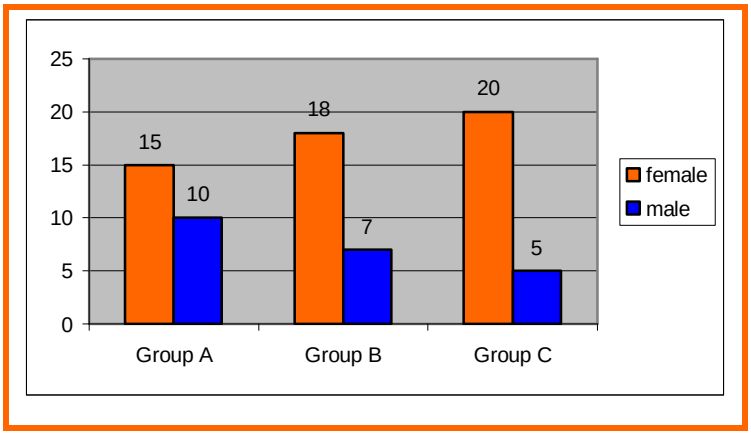


Diagram 1: Gender distribution by groups

Group A is the experimental group, group B the comparison group and group C the control group. Even though the patients were randomized into the three groups by drawing of lots the average gender distribution in the groups was 70.67 percent women and 29.33 percent men.

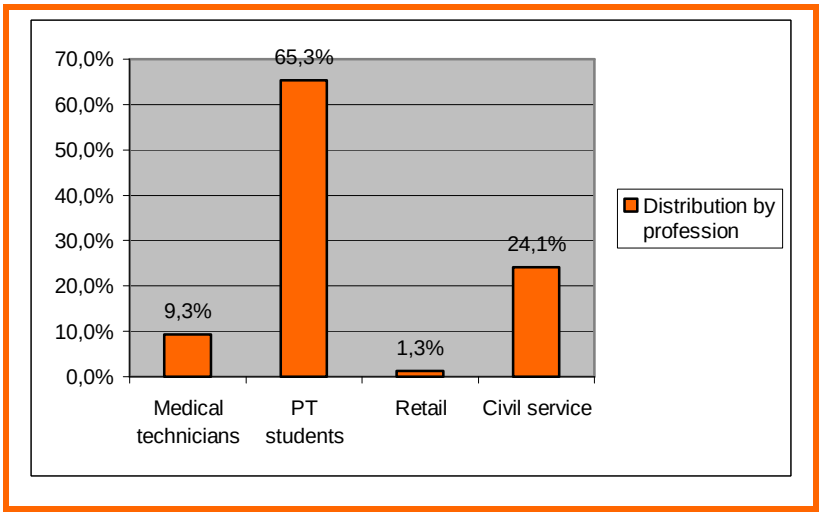


Diagram 2: Distribution by profession

The distribution among the various professional groups shows that 49 persons are students of physical therapy. Another large group (18 participants) are working in the field of civil service. 7 participants are medical technicians in a higher position or have a job in the fields of health care or nursing. 1 test person works in retailing. Since all participants had to answer additional questions for the statistical analysis (cf. annex 10.2), the results are presented below. 8 of the participants indicated fractures of the legs in the past. All fractures were treated conservatively by means of immobilization through casts.

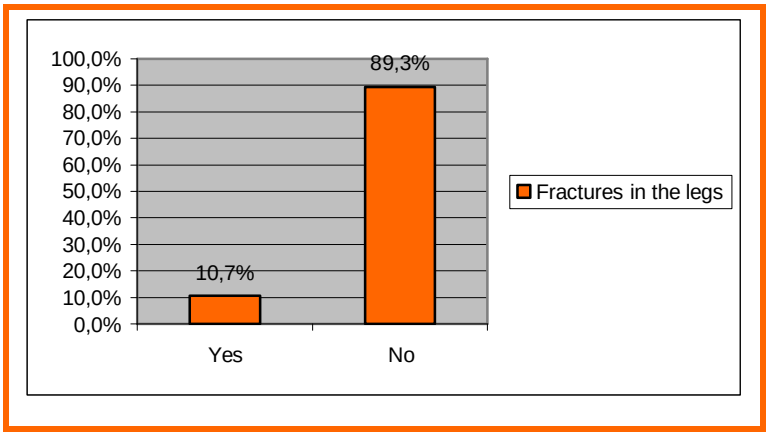


Diagram 3: Fractures in the legs

2 of the test persons indicated a fracture in the region of the pelvis, which was also treated conservatively.

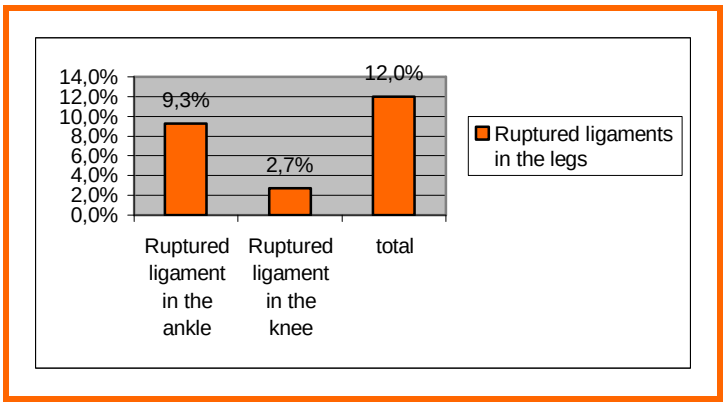


Diagram 4: Ruptured ligaments in the legs

9 test persons mentioned ligament tears in the lower extremity, 7 of them in the ankle joint and 2 in the knee joint. Thus 12 percent of the participants did experience a ligament tear of the lower extremity in the past. One participate said

that he had already 2 ruptured ligaments. 2 persons were operated and 7 were treated conservatively with immobilization (cast or air-cast splint).

One patient indicated a tear of the Achilles' tendon which was treated surgically.

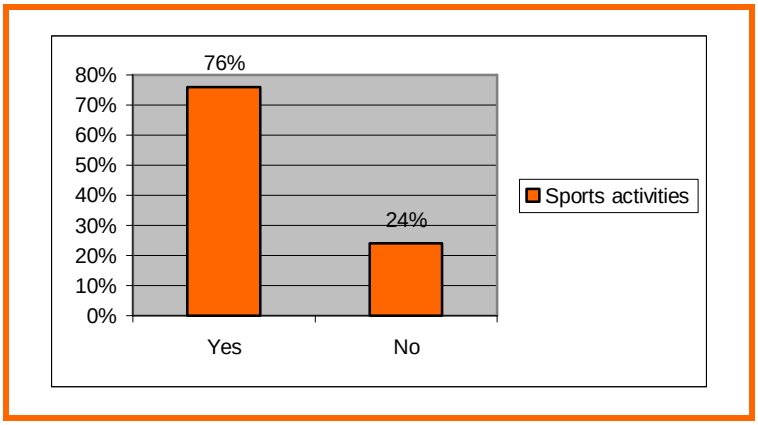


Diagram 5: Distribution of sports activities

57 participants declared to be active, which means that they practice sports once a week or more often. 18 test persons do not have time for regular exercise at the moment. 15 of the 57 active persons indicated that they regularly carry out balance exercises within the framework of their training.

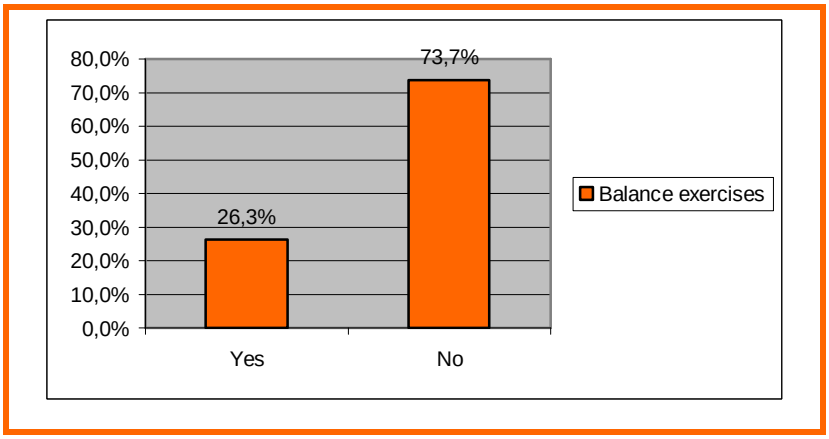


Diagram 6: Distribution of balance exercises

25 of the test persons that indicated to practice sports regularly, exercise once a week, while 19 participants do so twice a week, and 13 participants practice sports even more often.

4.2 Normal distribution of the data

All data was evaluated with regard to normal distribution by means of the Kolmogorov-Smirnov tests.[163] These tests were necessary because a theoretical normal distribution of the population (sample groups) is the prerequisite for the t-tests to evaluate the hypotheses.[164]

4.2.1 Normal distribution of “comfort” and “ecoute”

The test of normal distribution for the osteopathic examination method “ecoute” provided a negative result, i.e. both the data of the “ecoute” before and after the treatment do not correspond to normal distribution.

The test of normal distribution concerning the feeling of comfort immediately after the treatment provided a positive result, while that for the comfort rating after ten minutes rest was negative.

The standard deviation of the variable “comfort” in group A (experimental group) $\sigma \approx 2.7$ is bigger than the standard deviation in group B (comparison group) $\sigma \approx 1.9$. The calculations with the Levene test and t-test for independent samples did show a significant difference ($p=0.049$). This means that the subjective pain perception immediately after the treatment was significantly higher in group A than in group B. After the 10-minute period of rest no difference in the pain perception could be observed.

4.2.2 Normal distribution stability, sensomotoric function and symmetry

The tests to verify the normal distribution of the parameters stability, sensomotoric function and symmetry provided positive results in all cases, in the first and second measurement. Thus all parameters are normally distributed.

[163] cf. Weiß, Ch.: p 202
[164] cf. Weiß, Ch.: p 207

4.3 Evaluation of hypotheses

Since the data are normally distributed, the hypotheses can be evaluated with t-tests. These tests for the location parameter of one or several populations[165] provide p-values (calculated by the statistic program SPSS), which will be indicated below.

The original hypotheses were:

Hypothesis 1: The treatment of the lateral triggerband of the thigh according to the principles of the fascia distortion model of Dr. Stephen Typaldos D.O. will significantly improve the stability in the upright stance on both legs.

Hypothesis 2: The treatment of the lateral triggerband of the thigh according to the principles of the fascia distortion model of Dr. Stephen Typaldos D.O. will significantly improve the sensomotoric function in the upright stance on both legs.

Hypothesis 3: The treatment of the lateral triggerband of the thigh according to the principles of the fascia distortion model of Dr. Stephen Typaldos D.O. will significantly improve the symmetry in the upright stance on both legs.

4.3.1 Stability

In comparison with the initial measurement the second measurement showed an improvement in groups A, B and C. The statistical tests provided that the improvement was not significant in all three groups. The calculations showed the following p-values for the three groups: group A: p=0.941, group B: p=0.477 and group C: p=0.238.

Thus **hypothesis 1** could **not be confirmed**.

[165] cf. Trampisch, H.J. / Windeler, J.: p 210 - 223

4.3.2 Sensomotoric function

Compared with the initial measurement the second measurement indicated an improvement of sensomotoric function in all three groups. Statistical tests showed that the result was very significant in group A, while it was significant in groups B and C: group A: p=0.004, group B: p=0.034 and group C: p=0.040.

Hypothesis 2 could thus be **confirmed**.

4.3.3 Symmetry

With regard to the initial measurement the second measurement showed deterioration in the groups A, B and C.

Therefore **hypothesis 3** could **not be confirmed**.

4.3.4 Variance analysis of sensomotoric function

The variance analysis of groups A, B and C showed that the three groups did not differ significantly from each other at both measurements (1st measurement p=0.242, 2nd measurement p=0.307). This means that for the improvement of sensomotoric function it did not matter to which group the patients belonged.

4.3.5 Analysis regarding the additional questions

The data was analyzed by means of repeated measures analyses of variance. With the aid of the dialogue box "repeated measures" variance analyses can be carried out if several measurements are taken on the same subject or same case.[166]

[166] cf. Bühl, A. / Zöfel, P.: p 407 - 412

This kind of repeated measures analysis of variance was used after the evaluation of the hypotheses to examine the data regarding the additional questions. The results including the calculated p-values are presented below.

Sex (53 female, 22 male):

The variance analysis regarding the variables stability, sensomotoric function and symmetry did not show a significant difference in the groups A, B and C with regard to gender. The calculated p-values are: p=0.547 for stability, p=0.214 for sensomotoric function and p=0.327 for symmetry.

Fractures (8 persons with and 67 without fractures):

The variance analysis regarding the variables stability, sensomotoric function and symmetry did not show a significant difference in the groups A, B and C with regard to fractures. The calculated p-values are: p=0.330 for stability, p=0.394 for sensomotoric function and p=0.726 for symmetry.

Ligament tears (9 persons with and 66 without ligament tears):

The variance analysis regarding the variables stability, sensomotoric function and symmetry did not show a significant difference in the groups A, B and C with regard to ligament tears. The calculated p-values are: p=0.301 for stability, p=0.381 for sensomotoric function and p=0.776 for symmetry.

Tendon tears (1 person with a tendon tear):

The variance analysis was not carried out in this case because at least two cases are necessary for statistical calculation.

Sports activities (57 active and 18 not active):

The variance analysis regarding the variables stability, sensomotoric function and symmetry did not show a significant difference in the groups A, B and C with regard to sports activities. The calculated p-values are: p=0.353 for stability, p=0.566 for sensomotoric function and p=0.547 for symmetry.

Balance exercises (15 practice balance exercises and 42 not):

Among the participants indicating sports activities 15 persons also carry out balance exercises. The variance analysis regarding the variables stability, sensomotoric function and symmetry did not show a significant difference in the groups A, B and C with regard to balance exercises. The calculated p-values are: p=0.180 for stability, p=0.651 for sensomotoric function and p=0.247 for symmetry.

5 Discussion

The present study showed that not all of the original hypotheses concerning the effect of orthopathic treatment on the parameters stability, sensomotoric function and symmetry could be confirmed. The statistical analysis showed a significant improvement of the variable sensomotoric function in the second measurement in group A, but the variance analysis showed that no significant difference could be detected between the groups A, B and C at both measurements. This means that it did not matter to which group the participants belonged, no improvement could be observed with regard to sensomotoric function.

Since the test persons for the overall sample were recruited under the condition that they had “no symptoms” and since the age was set between 18 and 45 years, the search for appropriated participants was carried out in the immediate environment of the author. The result was a high number of physical therapy students (49 test persons), which comprised 65.3 percent of the overall sample. The students have to pass an entrance exam, which tests their intellectual capacities but also their physical aptitudes (including tests of their sensomotoric function), before they can undergo the physical therapy training. Thus it seems that this group of test persons clearly had an advantage with regard to the applied test system. The big influence of the group of “physical therapy students” among the test persons was underestimated and should be considered in further studies.

It would have been desirable to have an approximately equal number of male and femal participants. Unfortunately, the ratio in this study was 53 women to 22 men. This could also be ascribed to the large number of physical therapy students among the participants, because two thirds of the students in the physical therapy training are female. However, the repeated measures analysis of variance showed that the gender did not matter because the results for the variables stability, sensomotoric function and symmetry were not significant.

In the case history the participants had to answer additional questions regarding fractures, ligament or tendon tears and the data was also put in relation with the test results. The repeated measures analysis of variance did not show any significant difference for patients with fracture or ligament tears in the lower

extremities with regard to the three variables stability, sensomotoric function and symmetry. No calculation could be carried out for the test person with the Achilles' tendon tear because the statistical analysis requires at least two cases for calculation. This result is surprising because in particular the 7 participants with ligament tears in the ankle joint were expected to achieve different results than the other test persons. In particular because the tests were carried out with an instable MFT disc and for stabilization on such an instable surface also good sensomotoric function of the ankle joint is required. The same holds for the patient with the Achilles' tendon tear.

Sports activities did not have an effect on the evaluated parameters. The result of the statistical analysis was not significant.

Although the group of active participants and in particular those who also practiced balance exercises were suspected to deliver better results, the repeated measures analysis of variance showed no significant differences. This means that even the 15 participants who carried out balance exercises regularly did not show a change in the parameters stability, sensomotoric function and symmetry even though one might have thought that due to participants' experience (! learning effect in the test situation) with instable surfaces other than the test equipment a clear effect of the treatment could have been isolated and observed.

The significant result regarding the feeling of comfort immediately after the treatment can be explained by the fact that the orthopathic triggerband treatment is considerably more painful than friction massage. The reason for that is the considerable amplitude of the movement (pressure with the thumb and then "pulling" of the triggerband) with consistent pressure onto the connective tissue in the triggerband treatment, while friction massage applies a rather local force (increase and decrease of pressure in a circular movement). Since the comfort rating after ten minutes rest did not show a significant difference, it can be concluded that the discomfort is a temporary phenomenon.

Further studies on this topic should envisage a representative sample. The sample size could be larger and it can also be considered to include patients with actual problems in the fascias of the lower extremities rather than symptom-free test persons. In addition, the instruction for the patients on the disc could be more

explicit and restrictive. Concerning the test equipment it would be desirable to know the formulas for the calculation of the parameters stability, sensomotoric function and symmetry. It would be even better to have a valid device to test the sensomotoric function of the lower extremity in an isolated way, because with the MFT disc the sensomotoric function of the whole body is considered since the trunk of the person standing on the disc cannot be eliminated.

In any case the influence of the fascial system on the statics and dynamics of the whole body is obvious for me and my colleagues. Nevertheless, more scientific research and examinations would be desirable as in so many fields of osteopathy.

6 Summary

The choice of topic can be explained by the author's fascination of the fascia distortion model, which was presented during a course of her osteopathic training. In the context of this thesis three hypotheses were formulated and evaluated: the treatment of the lateral triggerband in the thigh according to the principles of the fascia distortion model developed by Dr. Stephen Typaldos, D.O. improves the stability, sensomotoric function and symmetry in the upright stance on both legs. Each of the mentioned parameters is considered in a separate hypothesis. The chapters on the theoretical underpinnings look at anatomy, physiology, training theory, osteopathy, massage and physical and mathematical considerations.

The anatomical considerations deal with the embryologic development of the connective tissue. The biodynamic aspect provides information on the kind of metabolic field that is responsible for the development of the connective tissue. The structure of the connective and supportive tissues comprises the cellular elements of the fascias. Also the anatomical pathways of the fascias in the lower extremity are explained in more detail.

The physiological underpinnings look at the different functions of the connective tissue and its supply with nutrients. Also the phases of wound healing and degeneration phenomena in this kind of tissue are explained.

The chapter training theory focuses on the sensomotoric functions of the body, the kinaesthetic system and the importance of the Golgi tendon organs for the fascia. These are important topics to establish a relationship with the selected test system.

The osteopathic chapter describes the importance of the fascial system for the whole organism and also integrates the original thoughts of A.T. Still regarding biologic principles. In addition the global listening test (or "ecoute") is described because it is applied in the evaluation of the patients.

The fundamentals on orthopathy explain the fascia distortion model, the different types of fascial distortions and their treatment. The fascial triggerband in the lateral

thigh is described in more detail because it is treated in the experimental group of this study. Further it is pointed out how difficult it is to find appropriate studies on the fascia distortion model.

Besides the action principles of friction massage, the technique is also described in detail in the chapter on massage treatments because the participants in the comparison group were treated with this technique in the region of the lateral thigh.

The physical and mathematical considerations refer to the selected test system. The chapter provides descriptions of how the hardware and software components work and how data is collected.

The study evaluated an overall sample of 75 persons who were randomized in three groups (experimental group, comparison group and control group) by drawing of lots. Since instructed test supervisors carried out the initial and second measurement in a different room than the treatment, the study can be considered as blind study. The participants were symptom-free and received comprehensive information (cf. annex 10.1) about the study and how it would be implemented. They agreed to participate in the study by signing a declaration of consent. The participants of the experimental group received a bilateral treatment of the lateral triggerband in the thigh according to the principles of orthopathic triggerband therapy. The test persons in the comparison group were treated with friction massage in the region of the lateral thigh on both sides. After the treatment the participants in both groups observed a 10-minute period of rest. Before and after the rest they had to rate their feeling of comfort on a comfort scale. The test persons in the control group also observed a 10-minute period of rest but they did not rate their feeling of comfort.

The test system comprised a disc for measurement and the related software that was installed on a laptop, which was connected to the disc with an appropriate cable. The collected data were imported into the statistic program SPSS by means of an Excel file to calculate the results.

The analysis of the data showed that only the hypothesis regarding the sensomotoric function could be confirmed. However, the variance analysis of

groups A, B and C demonstrated that the two groups did not differ significantly at both measurements. This means that sensomotoric function improved regardless to which group the test persons belonged. The hypothesis about a significant improvement of stability could not be confirmed. The influence of the treatment on symmetry was not analyzed further because a deterioration could be observed in all three groups.

7 Bibliography

Benninghoff, A.:
Anatomie, Bd. 1, München, Urban & Schwarzenberg, 1994

Biedert, R.:
Sensori-Motor Function of the Knee Joint, Histologic, anatomic and neurophysiologic investigations, Dissertation, Universität Basel, 1997

Biedert, R./ Meyer, St.:
Propriozeptives Training bei Spitzensportlern, Sportorthopädie-Sporttraumatologie, 12.2, 1996

Bizzini, M.:
Sensomotorische Rehabilitation nach Beinverletzungen, Stuttgart, Thieme, 2000

Bizzini, M./ Mathieu, N./Steens, J.-C.:
Proprozeptives Training der unteren Extremität auf instabilen Ebenen, Manuelle Medizin, 29: 14-20, 1991

Bühl, A./ Zöfel, P.:
SPSS 11. Einführung in die moderne Datenanalyse unter Windows, München, Pearson Studium, 2002

Debroux, J.J.:
Faszienbehandlung in der Osteopathie, Stuttgart, Hippokrates, 2004

Grigg, P.:
Peripheral Neural Mechanisms in Proprioception, Journal Sport Rehabilitation, 3:12-17, 1994

Gruber, D./ Hilden, T./ Lutz, M.:
S3 Testleitung, Guntramsdorf, 2007

Hedley, G.:
Handbuch über Human-Dissektion, 2001

Heiland
Heilmittelkatalog 07/08 – Heiland – Medical Vertriebs-GmbH , 2007

Kendel, E.R./ Schwartz, J.H./ Jessel, T.M.:
Neurowissenschaften, Heidelberg, Spectrum, 1996

Klein-Vogelbach, S.:
Funktionelle Bewegungslehre, Bewegung lehren und lernen, Berlin, Springer, 2001

Kolster, Bernhard C.:
Massage, Berlin, Springer, 2003

Kremer, C./ Bös, K.:
Training auf labilen Ebenen – eine vergleichende experimentelle Untersuchung mit Step und Aerostep, Zeitschrift für Physiotherapeuten, 57, 2005

Lephart, S. M. et al:
The role of proprioception in the management and rehabilitation of athlethic injuries, The American Joournal of Sports Medicine, 25: 130 – 137

Liem, T./ Dobler, T.K.:
Leitfaden Osteopathie, Parietale Techniken, München, Urban & Fischer, 2002

Machner, A./ Wissel, H./ Heitmann, D./ Pap, G.:
Veränderungen propriozeptiver Fähigkeiten am Schultergelenk bei ventraler Schulterinstabilität, Sportverletzung-Sportschaden, 12: 138 – 141

Myers, Thomas W.:
Anatomy Trains, München, Elsevier, 2004

Panjabi, M.:
The stabilizing system of the spine, Part I, Function, dysfunction, adaptation and enhancement, Journal of spinal disorders, 5 (4): 383 – 389

Paoletti, S.:
Faszien – Anatomie, Strukturen, Techniken, Spezielle Osteopathie, München, Urban & Fischer, 2001

Platzer, W.:
Taschenatlas der Anatomie, Bd. 1 Bewegungsapparat, Stuttgart, Thieme, 1986

Quante, M./ Hille, E.:
Propriozeption: eine kritische Analyse zum Stellenwert in der Sportmedizin, Deutsche Zeitschrift für Sportmedizin, Jhg. 50, Nr. 10, 1999

Schlummberger, A./ Schmidtbleicher, D.:
Effekte eines Krafttrainings mit explosiv-isometrischen Kontraktionen, Deutsche Zeitschrift für Sportmedizin, 51: 94 – 98

Stark, J.:
Stills Faszienkonzepte, Pfähl, Jolandos, 2006

Trampisch, H.J. / Windeler, J.:
Medizinische Statistik, Berlin, Springer, 2000

Typaldos, S.:
Orthopathische Medizin, Kötzing/Bayrischer Wald, Wühr, 1999

Van den Berg, F.:
Angewandte Physiologie 1,Stuttgart, Thieme, 1999

Van den Berg, F.:
Angewandte Physiologie 3,Stuttgart, Thieme, 2001

Weineck, J.- Erlangen:
Optimales Training, Balingen, Spitta, 2000

Weineck, J.:
Sportbiologie, Balingen, Spitta, 2000

Weiß, Ch.:
Basiswissen medizinische Statistik, Heidelberg, Springer, 2005

List of online references

http://fdm-europe.com/ziele-efdma.html
29.10.2007, 10:12

http://www.orthopathy.com/gpage3.html
26.10.2007, 19:14

http://de.wikipedia.org./wiki/Visuelle_Analogskala
28.10.2007, 19:57

http://de.wikipedia.org/wiki/Erich_Blechschmidt
03.11.2007, 14:52

http://www.pflegewiki.de/wiki/Blinbedingung
04.11.2007, 11:54

http://de.wikipedia.org/wiki/Elastomer
16.11.2007, 22:43

http://www.schule-begleitet-fahren.de/alkohol.html
19:11.2007, 09:00

http://www.osteopathicresearch.com/paper-pdf/Podlesnic.engl.pdf.
20.11.2007; 07:05

http://de.wikipedia.org/wiki/Sensomotorik
23.11.2007, 10:03

8 List of figures

9 List of diagrams

10 Annexes

10.1 Information for test persons and declaration of consent

Information for test persons and declaration of consent to the participation in this fundamental study

A randomized single-blind fundamental study on the effect of a specific fascial treatment according to Dr. Stephen Typaldos DO in comparison with a global fascial treatment with friction according to the principle of traditional therapeutic massage and their effect on stability, symmetry and sensomotoric function of the test persons, which are evaluated through computer-assisted measurements with the aid of an MFT disc.

Dear patient,

Practitioner:	Astrid GEIGER, PT
Address: Phone, Fax:	Ing. Ritzinger – Gasse 4, 3151 St. Georgen am Steinfeld 02742/86 1 77

I would like to invite you to participate in the above mentioned fundamental study. The study will be explained in detail below and additional questions will be answered by the practitioner.

The participation in this fundamental study is voluntary and can be ended by the participant at any moment without further explanation.

Scientific studies like this are necessary to collect new reliable therapeutic and medical research data. Before such a study is carried out it is indispensable that the participants declare their consent in written form. Please read the following text carefully and do not hesitate to ask further questions if necessary.

You must sign the declaration of consent only:

- **ü** if you have completely understood the design and procedure of the study,
- **ü** if you agree to participate in the study and
- **ü** if you are fully aware of your rights as participant in the study.

The following criteria have to be excluded, i.e. you should be able to answer the following questions with **NO**:

- I am younger than 18 years of age.
- I am older than 45 years of age.
- At the moment I have physical problems in the regions of the pelvis and legs.
- At the moment I receive treatment for these problems by a doctor, physical therapist or osteopath
- I have osteosynthetic material (e.g. nails, pins, plates) in my legs or in my pelvis.
- I suffer from balance problems due to dizziness/vertigo.
- I have a tendency to haemorrhage.
- I take anticoagulants.
- I have some sort of cerebral dysfunction (a dysfunction affecting the brain).
- I have a form of peripheral palsy (paralysis in the regions of the arms and/or legs).
- A severe asymmetry can be observed in my body (e.g. scoliosis, missing body parts, etc.) which impairs my motoric function.
- I am pregnant.
- At the moment I am under the influence of alcohol.
- I regularly (once a week) use an MFT disc for training.

1. What is the purpose of this study?

With this fundamental study we want to find out whether test persons who do not have any problems standing normally on both legs, who fulfil all inclusion criteria, and in whom the parameters stability, symmetry and sensomotoric function have been assessed through computer-assisted measurements by means of an MFT disc show any improvement in these parameters after a specific fascial treatment according to Dr. Stephan Typaldos DO.

2. What is the design of the study?

We plan to carry out this study with 75 test persons. The participants will be divided into three groups with 25 test persons each. A test supervisor will assess each participant‘s performance on an MFT disc after which the test persons will be allocated to one of the three groups by drawing of lots. Depending on the group the participants will receive different kinds of treatment. One group will be treated with the special fascial techniques on both legs in the region of the external lateral thigh. The effects of this treatment will be compared with those observed in the second group which will receive a global fascial treatment with friction according to the principles of traditional therapeutic massage also in the region of the external lateral thigh on both sides. In addition we want to observe the learning effect in group three which does not receive any treatment. It is necessary to work with a sample size of 25 test persons per group in order to obtain valid results. To make the study a blind study (i.e. the test supervisor does not know how the individual test persons were treated and the therapist does not know the test results of the test person) the initial tests and the tests at the end take place in a different room and are carried out by a test supervisor who is not informed about the kind of treatment the test persons receive. It is also necessary that the patients wear long

and comfortable trousers for the measurements on the MFT disc to avoid that the test supervisor can draw conclusions as to which treatment the individual test person received because of visible skin reactions. To guarantee a randomization of the study (i.e. the kind of treatment is allocated completely at random) each test person draws a piece of paper from a non-transparent bag. The pieces of paper are rolled up and fixed by rubber bands. Thus the patients cannot read what is written on them. A letter indicating the respective group can be found on each piece of paper (it defines the kind of treatment the patient will receive) as well as a number which guarantees the complete number of test persons in each group.

3. Assessment and treatment:

At first you will be assessed barefoot on the MFT disc by the test supervisor in a separate room. Please make sure to wear comfortable long trousers for this assessment.

Afterwards you go in another room where the treatment will take place. You will have to draw a piece of paper from a non-transparent bag which will determine to which group you will be allocated:
special fascial techniques,
global fascial techniques or
no treatment.

Before the start of the treatment the therapist will carry out a standing global listening test (an osteopathic means of diagnosis with both hands) – also called “ecôute test“ – to evaluate the whole body. After this evaluation you are asked to lie down on the treatment table.

If you are allocated to the special fascial techniques group you will have to take off your trousers (but leave on your underwear; upper body remains dressed, too) and lie in prone position for the duration of the treatment. If you want you can have a blanket to protect your privacy. The therapist will slide her thumb with powerful pressure along your external lateral thigh, over your behind to your tailbone (coccyx). This procedure is carried out on both sides. After that you are asked to turn onto your back. To assess how you feel immediately after the treatment you have to fill in a comfort scale. After 10 minutes rest in recumbent position you have to mark the scale again. Then you are asked to stand up and the therapist will again carry out the global listening test. After that and dressed again with your long trousers you may proceed to the other room where you are reassessed on the MFT disc by the test supervisor.

If you are allocated to the group intended for a global fascial treatment (friction) according to the principle of traditional therapeutic massage, you are asked to take off the long trousers (but leave on your underwear; upper body remains dressed, too) and lie down on the treatment table in supine position. If you want you can have a blanket to protect your privacy. The therapist will carry out the friction treatment along your external lateral thigh. This procedure is carried out on both sides. To assess how you feel immediately after the treatment you have to fill in a comfort scale. After 10 minutes rest in recumbent position you have to mark the scale again. Then you are asked to stand up and the therapist will again carry out the global listening test. After that and dressed again with your long trousers you

may proceed to the other room where you are reassessed on the MFT disc by the test supervisor.

If you are allocated to the group without treatment you are asked to lie down supine on the treatment table fully dressed. After 10 minutes the therapist will evaluate you again with the global listening test. After that you may proceed to the other room where you are reassessed on the MFT disc by the test supervisor.
In this study the

- initial assessment
- treatment and
- final assessment

are carried out only **once**. Therefore it will only require a total of 25 minutes of your time.

4. What is the special fascial technique according to Dr. Stephen Typaldos, DO?

The triggerband technique that is applied in this context has its origin in orthopathic medicine – it is a form of manipulative therapy which is based on the fascial distorsion model (FDM) and has been integrated in orthopaedic practice. In the triggerband technique distorted fascial bands are corrected manually through the thumb of the therapist. Adhesions between various layers of tissue are released.

5. What is the global fascial treatment (friction)?

Friction is a technique that is used in traditional therapeutic massage. Individual layers of tissue are manually shifted against each other, which helps to release fascial adhesions and hardness in the muscles.

6. What is the benefit of participating in a fundamental study?

It is possible that the participation in this fundamental study will grant you an efficient treatment of your fascial tissues. However, the success of the treatment cannot be guaranteed. Also the probability of how efficient the treatment method will be in the individual patient cannot be predicted. Since you fulfil all inclusion criteria, you do not have any complaints in the area that will be treated, but you can still have distorted fascial bands. Since after the evaluation of both tests you will receive an MFT disc training program that is especially adapted to your needs, you can use the program to work on your stability, symmetry and sensomotoric function if necessary. The results of this fundamental study are supposed to contribute to a scientific underpinning of a treatment method that is taught in osteopathic training.

7. Are there any risks, complaints or associated effects?

The most common complaint associated with the special fascial treatment is an uncomfortable burning sensation which the patients notice as more or less painful depending on their subjective perception. The friction between the tissue layers that is carried out in the global fascial treatment is also perceived differently depending on the patients' individual pain threshold.

An associated effect in both kinds of treatment is a red discolouration of the skin that can persist for a variable period of time. Depending on the state of the connective tissue also bruises may occur.

8. When will the study be terminated prematurely?

You can revoke your participation at any moment without further explanation and withdraw from the study.

It is also possible that the therapist or the test supervisor decide to terminate your participation in the study prematurely without your prior consent. The reasons for that could be:

- **ü** Your physical condition has deteriorated
- **ü** You do not follow the instructions of the staff involved in the study
- **ü** One or more exclusion criteria cannot be excluded

9. In what way will the data collected in the study be used?

The test supervisor and the therapist will collect your data and record it in a list. Some data is also needed for identification in the computer processing. All data collected in the study will be treated confidential. Only the test supervisor and the therapist will feed the data into the data base. The collected data will be analysed and evaluated in an anonymous way (i.e. without your name) and can thus also be used in the future for related studies or other research work. The data can also be referred to in publications concerning treatment techniques or the test method. But your name will not be mentioned in any test report or publication.

You have the right to look at your data and if required you can demand a review of the data according to the relevant legal dispositions and procedures. You can also discuss this question with your therapist.

10. Possibility to discuss further questions

Should you have further questions with regard to this fundamental study, you can contact your therapist any time. This also holds for questions concerning the rights of each test person within the framework of this study.

Name of the therapist: Astrid Geiger
Contact information:
Astrid Geiger – face-to-face conversation at FH St. Pölten or
Phone: 02742/313 228 -581 or
Mobile: 0650/970 63 70 or
astrid.geiger@fh-stpoelten.ac.at – please indicate: Re: your thesis

11. Declaration of consent

Name of test person in capital letters: _____

Date of birth: _____

Sex: O female O male

The therapist, Ms. Astrid Geiger, has informed me in detail and in a comprehensible way about this fundamental study, its possible associated effects as well as its relevance. In addition, I have thoroughly read the test person information and the declaration of consent, which comprise a total of 6 pages. All questions that have occurred have been answered by the therapist in a comprehensive and understandable way. I had enough time to take my decision and at the moment I do not have any further questions.

I will follow the instructions which are necessary for a good execution of the study, but I reserve the right to terminate my voluntary participation at any time without incurring any disadvantages.

I do agree that the personal data collected within the framework of this study will be recorded. In order to check whether the recorded data is correct agents authorized by the therapist and representatives of competent authorities may inspect my personal data.

The provisions of the data protection act will be respected in processing and dealing with the data.

I declare that it is my free will to participate in this fundamental study on fascial treatment.

_____ _____

Date (to be completed by the test person) | Signature of the test person

10.2 Additional questions for the analysis

Group & number:

Name:

First name:

Additional questions for the analysis

The following questions are necessary to better document the statistical analysis. Please answer the questions as faithful as possible.

1. **Fractures of lower extremities:**
   - ☐ YES, I already had a fracture of the lower extremities
   - ☐ NO, I never had a fracture of the lower extremities

If YES, please indicate:
- ☐ It was a normal fracture
- ☐ It was a comminuted fracture
- ☐ I had several fractures of the lower extremities
- ☐ The fracture was immobilized (cast, splint, etc.)
- ☐ The fracture had to be treated surgically (pins, nails, etc.)

2. **Fractures of pelvis**
   - ☐ YES, I already had a fracture of my pelvis
   - ☐ NO, I had no fracture of my pelvis

If YES, please indicate:
- ☐ I already had several pelvic fractures
- ☐ The fracture was treated surgically
- ☐ The fracture was not treated surgically

3. **Ligament tears in lower extremities**
   - ☐ YES, I already had a ligament tear in the lower extremities
   - ☐ NO, I never had a ligament tear in the lower extremities

If YES, please indicate:
- ☐ It was a ligament tear in the ankle joint
- ☐ It was a ligament tear in the knee joint
- ☐ I already had several ligament tears in the lower extremities
- ☐ The ligament tear was treated surgically
- ☐ The ligament tear was not treated surgically

4. **Tendon tears in lower extremities**
   - YES, I already had a tendon tear in the lower extremities
   - NO, I did not have a tendon tear in the lower extremities

If YES, please indicate:
   - It was a tendon tear in the ankle joint
   - It was a tendon tear in the knee joint
   - I already had several tendon tears in the lower extremities
   - The tendon tear was treated surgically
   - The tendon tear was not treated surgically

5. **Sports**
   - YES, I practice sports
   - NO, I do not practice sports

If YES, please indicate:
   - I practice sports regularly once a week
   - I practice sports regularly two times a week
   - I practice sports more often
   - The training includes balance exercises
   - The training does not include balance exercises

Thank you for your cooperation!

10.3 Comfort scale

Group & number:

Name:

First name:

COMFORT SCALE

Please indicate how you feel on the scale by marking it with an X on the line. The point of intersection of the X should be on the line like this:

—X—

Comfort scale immediately after the treatment

very comfortable / not painful

very uncomfortable / painful

Comfort scale after 10 minutes rest

very comfortable / not painful

very uncomfortable / painful

10.4 Global Listening Test

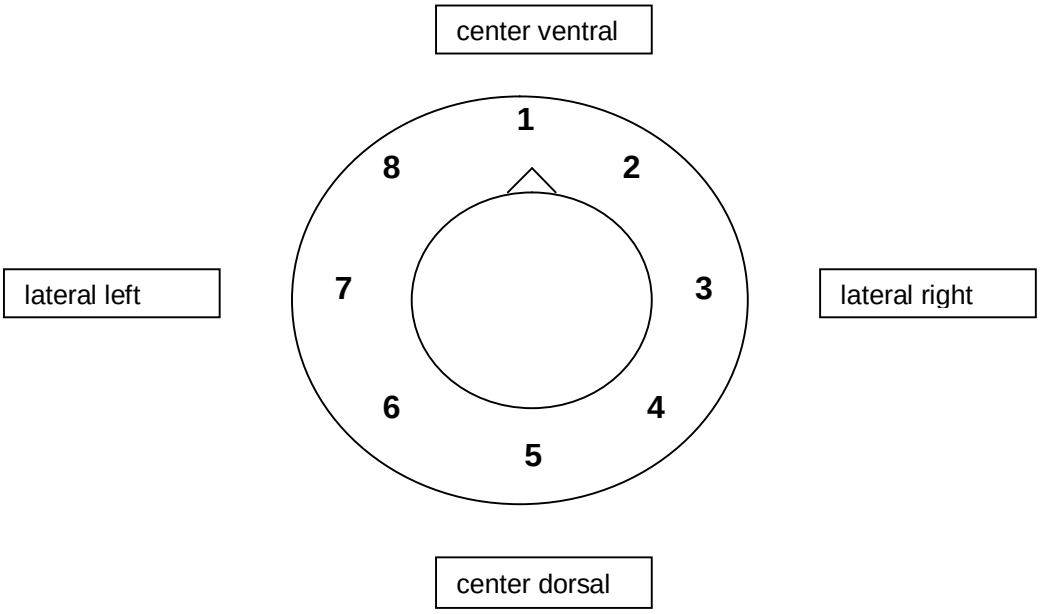
Group & number:

Name:

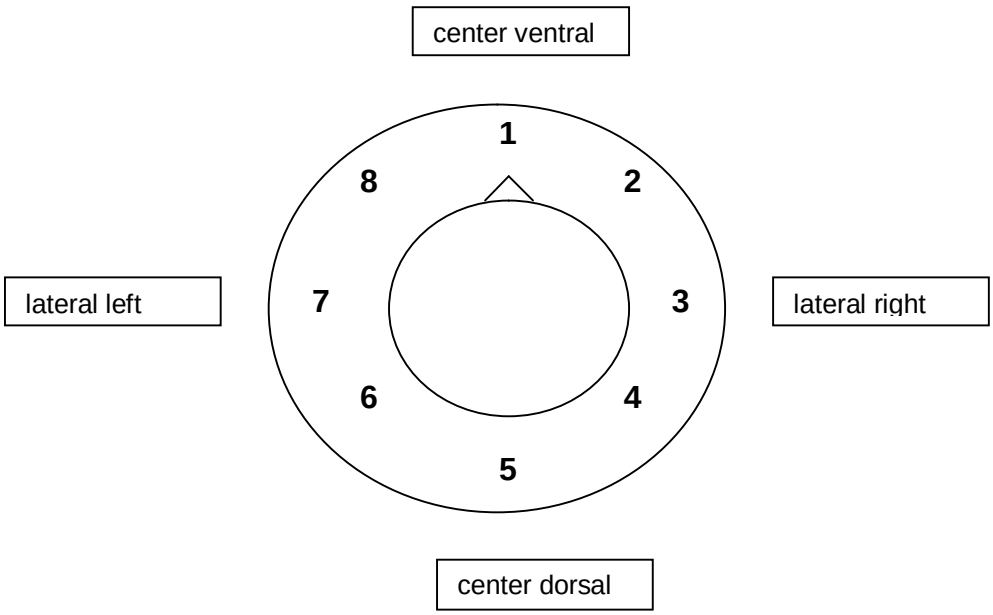
First name:

GLOBAL LISTENING TEST

Global Listening Test **BEFORE** the treatment



Global Listening Test **AFTER** the treatment



10.5 Accompanying letter to the test persons concerning the test analysis

St. Georgen, July 15, 2007

Enclosed please find the analysis of your tests and a training program for the Fit Disc. The disc was developed by the company MFT (Multifunktionale Trainingsgeräte – multifunctional trainings equipment) for the purpose of exercise and training. The company also offers a Trim Disc and a Sport Disc. In case you already own one of the latter discs and thus need exercise instructions for those and not the Fit Disc, please contact me and I will print the appropriate training program for you adapted to your test results.

The following things have to be considered in the interpretation of the test results:

The program has stored gender-specific reference values of stability and sensomotoric function for the specific age-groups. These values are indicated by an arrow. To differentiate between your own value and the reference value you find a description of where the reference value is located below:

Stability: the reference value can be found on the left side of the appropriate bar
Symmetry: the reference value is located on the superior border of the horizontal bar always in the middle at 50%:50%
Sensomotoric behavior: the reference value is indicated on the left side of the appropriate bar.

The relevant term and values are always indicated below the respective bar.

In case of further questions concerning the results or anything else, you can reach me anytime by phone 02742/86177 (practice phone with answering machine). Please leave your name, number and your question and I will call you back.

I would like to thank you very much for participating in my study and I wish you a lot of fun with the exercises.

10.6 Example of an S3 check analysis [167]

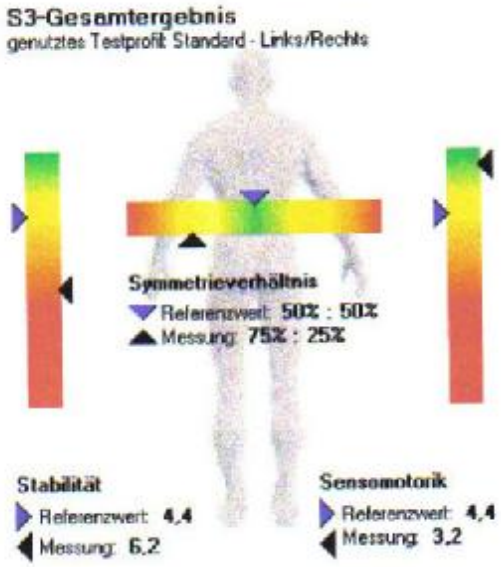
Multifunktionale Trainingsgeräte

MFT S3 - Körperstabilitätstest

MFT S3 – Body Stability Test

First Name:	**Last name:**
Sex: male	**Date of birth:**
Recorded by: MG	**Recorded on:** July 13, 2007

S3 overall result
applied test profile standard left/right



STABILITY

The MFT body stability test® evaluates the **stability of the body** while standing on an instable disc with regard to the body's symmetry and sensomotoric behaviour. Your test results show that with this diagnostic method your body stability has to be qualified as **insufficient**.

Among other things the body is stabilized by well-coordinated postural muscles. This stability protects your spine and your joints and counteracts forces that affect the body during movement. Repetitive strains will influence the body's stability in a negative way and impair your quality of life in the long term.

Advice: You will achieve an improvement of your body stability by observing a regular and mixed exercise regime of the whole body using the S3 concept training equipment.

DIAGRAMM

left bar = stability	blue arrow: reference value: 4.4 black arrow: measured value: 6.2
horizontal bar = symmetry	blue arrow: reference value: 50% : 50% black arrow: measured value: 75% : 25%
right bar = sensomotoric behaviour	blue arrow: reference value: 4.4 black arrow: measured value: 3.2

[167] Due to data protection the personal details have been removed.

SENSOMOTORIC BEHAVIOUR

The MFT S3 body stability test® analyses the amount and amplitude of balancing movements during the test. Your results show that during the measurement you proved that your **sensomotoric ability of regulation is above average**. It seems that due to a good interaction of your muscles your can coordinate your balance quite well.

A good coordination of movements will give you security in everyday life and in coping with unsuspected situations. Thus it represents a valuable contribution to avoid accidents. It does not only contribute to carrying out movements in a secure and precise way but also in an economic way. Thus you need less energy for the movements which will influence your performance in a positive way.

SYMMETRY

The MFT S3 body stability test® evaluates the deviation of movements from the symmetry plane (left/right and front/back). Your test results show that in this diagnostic method you clearly **prefer to use one side of your body** and thus **put more strain on this side**.

A balanced symmetry in the movements is the precondition for a healthy load on the spine and all joints and prevents an over-straining and unilateral wear of the locomotor system.

10.7 Example of a training program according to the S3 software[168]

S3 Training

Last name	**Sex:** male
First name	**Date of birth**

Date of issue: September 23, 2007

S3 Training objective

Among other things the body is stabilized by well-coordinated postural muscles. This **body stability** protects your spine and your joints and counteracts forces that affect the body during movement. Repetitive strains will influence the body's stability in a negative way and impair your quality of life in the long term.

A good **coordination of movements** will give you security in everyday life and in coping with unsuspected situations. Thus it represents a valuable contribution to avoid accidents. It does not only contribute to carrying out movements in a secure and precise way but also in an economic way. Thus you need less energy for the movements which will influence your performance in a positive way.

A **balanced symmetry** in the movements is the precondition for a healthy load on the spine and all joints and prevents an over-straining and unilateral wear of the locomotor system.

Name of exercise	Intensity and number of repetitions	Picture	Comment
Side rocking	For mobilization rock 10 times to the right and left, afterwards try to stabilize the board for 20 seconds 3 series		
Front rocking	For mobilization rock 10 times to the front and back, afterwards try to stabilize the board for 20 seconds 3 series		

[168] Due to data protection the personal details have been removed.

Turn around	For mobilization rotate 5 times to the right and left, afterwards try to stabilize the board for 20 seconds 3 series		
Diagonal rocking	For mobilization rotate 5 times to the right/front and left/back and left/front and right/back, afterwards try to stabilize the board for 20 seconds 3 series