OSTEOPATHIC PREVENTION STUDY IN ACHIEVEMENT-ORIENTED YOUNG SOCCER PLAYERS

FROM
CHRISTIAN ANGLEITNER

NOTE OF THANKS

At the beginning of my master thesis, I would like to say ’thank you’ to just a few people who are largely responsible for the circumstances that have allowed me to write it.

To my mother who created the preconditions for my medical studies – both financially and personally.
To my first teacher in osteopathy – Peter Adler-Michaelson, medical doctor – who opened the door to the ideology and understanding of osteopathic thinking for me.

To Raphael van Assche who offered me the chance to study and comprehend many further aspects of osteopathic thinking by entering another field of work at the Wiener Schule fü'9fr Osteopathie (Vienna School of Osteopathy).

Last, but not least, to all soccer players and training colleagues, of course, who assisted me during the research and medical examinations undertaken for my master thesis at the training centres of the National Associations in Ried and Steyr.

CONTENTS

INTRODUCTION:

With my master thesis, I would like to examine, whether one-sided sportive training leads to dysfunctions of joints and muscles typical of specific kinds of sports and whether it is possible to eliminate them in the long run through regular exercises adapted to the reversible functional disorders.

During more than 10 years of experience as a sports physician and osteopath I noticed the following phenomenon when carrying out sport medical examinations of athletes that were actively doing different kinds of sports (soccer, tennis, rowing, sailing, athletics, gymnastics): Each kind of sport has a certain pattern of typical dysfunctions and muscle shortenings. Searching for literature (both in the osteopathic field and in conventional medicine) by entering terms like "sport specific dysfunction", "sport specific patterns of dysfunctions", and "sport specific pattern of muscle shortening" on the Internet (e.g.www.cochraine.com, www.springer-link.com, www.spine-line.com, www.jaoa.org and www.medline.com), I was not successful. Nor could I find entries in various specialised literature ("*The Journal of the American Osteopathic Association*", "*DO – Deutsche Zeitschrift fü'9fr Osteopathie*" Hippokrates Verlag, "*Manuelle Therapie*" Georg Thieme Verlag, "*Manuelle Medizin*" Springer Verlag, "*Deutsche Zeitschrift für Sportmedizin*", Thieme Verlag, "*American Journal of Sportsmedicine*", Sage Publications Ltd, "*Deutsche Zeitschrift für Sportmedizin*", WWF Verlagsgesellschaft, "*Sportmedizin und Sporttraumatologie*", Paul Haupt Verlag, "*Sportverletzung – Sportschaden*", Thieme Verlag), or in the books recommended by the Wiener Schule für Osteopathie (Vienna School of Osteopathy) and the Philadelphia College of Osteopathic Medicine in the United States of America.

This is why I cannot refer to similar examinations in my master thesis. I cannot quote any studies or base my examinations on a sufficiently well-founded scientific background – and I regret this.

The interrelation of joint dysfunctions and muscle shortenings is an essential subject taught at the Vienna School of Osteopathy and the Philadelphia College of Osteopathic Medicine, USA. Many renowned professors in these schools (Adler-Michaelson 1999 and 2000, Nicholas 2000 and 2001, Craw 2000, Ligner 2003, van Assche 2002, Marcer 2004, Wallace 2003) teach these interrelations in their jobs. Authors pointing the way (Mitchell "*Handbuch der MuskelEnergieTechniken*" 2005 p.9 and Jones "*Strain-Counterstrain*" 2001 p. 6) write about the interrelation of muscle shortenings with dysfunctions of joints. It is important to say that these are generally accepted models, yet "only" explanatory models.

According to fundamental osteopathic thinking and doctrines pursued by the above mentioned osteopathic training centres, dysfunctions of the joints exert influence on the organs allotted to the segments concerned in the sense of visceral functional disorders (Ligner 2002, 2003, 2004 and 2005, Sandler 2003, Buset 2004, Duby 2004, Barral 2005). There is internationally recognised literature available representing this school of thought: Barral "*Visceralmanipulation*" 2001 p. 9, Helsmoortel "*Lehrbuch der viszeralen Osteopathie*" 2002 p. 7 and de Costa "*Viszerale Osteopatie*" 2001 p. 10 .

In addition, the influence of dysfunctions of the joints by way of the dura mater respectively the liquor cerebrospinalis on the craniosacral system belongs to the subjects taught at the Vienna School of Osteopathy and the Philadelphia College of Osteopathic Medicine USA (Arlot 2002 and 2003, Crow 2000, 2001 and 2002). Well-known osteopathic textbooks ("*Kraniosakrale Osteopathie*" Liem 2001 p.19 , "*Lehrbuch der CranioSacralen Therapie*" Upledger 2000 p. 27) also use explanatory models to describe the functional relationship between arthrogenic dysfunction, dura mater, liquor cerebrospinalis and craniosacral rhythm.

According to Finet (lectures at the Vienna School of Osteopathy 2004) due to one-sided mechanical strain and due to the subsequent structural adjustment of the complete mechanism it is most likely that asymmetries and decentralisation from "Midline" (model) influencing the fascial system are the consequences to be expected.

The purpose of the empirical research is to recognise the relations between one-sided sport-related strain and resulting osteopathic dysfunctions both arthrogenically and myogenically, and then to eliminate them in the long run by having the athletes perform a training programme that is based on osteopathic principles without a trainer. Further consequences on the visceral system, the craniosacral system and/or the "Midline" model could or should be the subject of secondary osteopathic studies.

PERSONAL APPROACH

From thirteen to thirty-two, I actively engaged in competitive sports, doing apparatus gymnastics, volleyball and athletics at the regional league and national league level. In these nineteen years, I saw many different trainers, many different training methods and I also suffered various injuries which healed to a greater or lesser extent. Even then, it struck me that every kind of sport has its typical injuries and its typical stress patterns (confirmed by Klü'9fmper "*Sporttraumatologie*" 1999 p. 1). Since I engaged in sports activities that were so diverse, I clearly suffered from fewer injuries and stress patterns than others. Though I did not have an explanation why this was the case, there was an obvious advantage in avoiding one-sided training.

As a young sports physician, I was lucky in immediately becoming physiotherapist to a professional soccer team in my region. "A chain is only as strong as its weakest link", as the saying goes, and so I set out full of ambition to examine all the factors that determined the performance of my pros, like strength, endurance, flexibility and coordination, in order to foster primary prevention and to develop a training programme based on my findings. Since the biggest shortcoming of the team was the low number of players, it was then the top priority for the highly successful trainer that injuries must be kept to an absolute minimum.

In the framework of my examinations, I also made an osteopathic diagnosis with a view to dysfunctions and muscle shortenings, as this had been part of my previous training. I was surprised to find a higher-than-average incidence of dysfunctions of the sacroiliac joint and muscle shortenings of the lower limbs.

On the basis of these findings, the players received regular osteopathic treatment together with a programme of stretching and strengthening exercises that I compiled.

Without knowing the immediate cause, we soon found that the number of injuries went back significantly and the team was highly successful due to generally favourable surrounding conditions.

Changes in my career then took me 100 km away and so I could not continue my work with the professional soccer team.

It did not take long, however, until I was offered an even more interesting work. I got the chance of working with professional juvenile soccer players, aged between 11 and 13 years.

Apart from the joy of working with young people, I also took on a high responsibility. A responsibility not only with regard to sporting achievements, but for me as a medical doctor even more so with regard to the health of the players. Therefore it was self-evident for me that I had to coach the team in a way that would not entail any health risks for the young kickers. So I included osteopathic principles in the regular pre-admission sports medical examination by doing function diagnosis tests of the joints and muscles.

For a function diagnosis of the joints, the sacroiliac joint seemed the most important one to me, since here it was logical to expect the strongest shear forces under a mechanical stress as in playing soccer. Appropriate muscle function tests of the lower limbs must be carried out.

If my theory and my empirical findings are correct, although the latter have not yet been scientifically evaluated, it should be possible to diagnose a typical dysfunction chain which can be lateralised to the standing and the free leg with typical muscle shortening also in the standing and the free leg.

With regard to primary prevention, a therapy of the joint to treat these dysfunctions cannot be enough. It is also important to develop methods to prevent these dysfunctions through specific exercise.

In this case, a specific stretching and strengthening programme must be compiled which, when carried through regularly, will prevent dysfunctions as well as muscle shortenings.

If this proves possible, it will be a giant step ahead not only from an osteopathic point of view, but also for socioeconomics. In this case, such training programmes would have to find their way into other kinds of sports, too.

OSTEOPATHIC RELEVANCE

“A sacral lesion is an obstacle to the permanent correction of an atlanto-occipital lesion and vice versa. There is definitely a correlation between these two regions" (Magoun 1951).

Assuming that Magoun’s conception is correct, although to date not scientifically proven, it would be of considerable osteopathic relevance to find proof that performing a certain type of sport leads to one-sided biomechanical overstrain and as a consequence to typical arthrogenic dysfunctions and typical secondary muscular dysfunctions in the form of functional shortening of the muscles.

If, in addition, it can be proved that a regular training programme based on osteopathic, biomechanical findings can lead to a permanent recovery from these pathologies, an important milestone will be set in terms of primary prevention.

Following the doctrines (explanatory models) of the osteopathic schools (Vienna School of Osteopathy, Philadelphia College of Osteopathic Medicine, USA), it can be assumed that an arthrogenic function disorder causes dysfunctions in other joints as well, leading to interrelated syndromes (Adler-Michaelson 1999 and 2000, Nicholas 2000 and 2001, Ligner 2003 and 2004, Wallace 2002 and 2003).
In the case of sacral torsion, it may lead to a dysfunction in the segment L5 and in the articulatio coxae. Typically, there will be a contra-rotation to it as well as a lateral flexion of the opposite side in the segment L5 or a defective position of the articulatio coxae caused by exterior rotation to the opposite side (Mitchell 2005 p. 172).

Also, osteopathic schools (Vienna School of Osteopathy and Philadelphia College of Osteopathic Medicine, USA) and their lecturers (Adler-Michaelson 1999 and 2000, Nicholas 2000 and 2001, Ligner 2003 and 2004, Wallace 2002 and 2003) assume in their explanatory models that every arthrogenic dysfunction brings about at least one myogenic secondary lesion. This secondary muscular dysfunction more or less predisposes an entire chain of muscular dysfunctions (school of thought see above). This is particularly true if the dysfunctions persist over a longer period (in the sense of chronicity) and the body tries to compensate in its own way with a myogenic defensive reaction. Of course, this creates the basic conditions for pathologies of other muscles and muscle groups, which in turn can lead to further arthrogenic dysfunctions (according to Mitchell 2005 p. 173).

In relevance to our study, the example of sacral torsion and the interdependency (according to Mitchell p. 38) with musculus piriformis is shown:

The sacroiliac or the iliosacral joint (the same joint but with reference to different functions) are passive joints. The only muscle which entirely crosses the joint is the m. piriformis. The m. piriformis is described according to its various functions as follows: It acts as an exterior rotator and extensor in the hip joint and as an abductor of the femur when flexing the hip at an angle of at least 90 degrees. It acts on the sacrum by drawing it in an oblique direction towards the inferior pole of the sacroiliac joint. M. piriformis is therefore thought to have a stabilising function by anatomically creating a pivotal point at the inferior pole of the sacroiliac joint and thus enabling a sacral torsion motion. In addition, one would expect an accumulation of proprioceptors.

According to the doctrine of the above mentioned osteopathic schools and lecturers, put forward in their explanatory models and empirically confirmed (in my case by 15 years of relevant experience), it is assumed that additional muscles play an important role in dysfunctions of the sacroiliac joint. Some of them being m. iliopsoas, m. quadratum lumborum, m. tensor fasciae and subsequently m. rectus femoris, mm. adductores and mm. ischiocrurales (according to Mitchell 2005 p. 34 to 36).

To give an example, the direct muscular function chains at the sacroiliac joint are (according to Mitchell 2005 p. 34 to 36, Adler-Michaelson 1999 and 2000, Nicholas 2000 and 2001, Ligner 2003 and 2004, Wallace 2002 and 2003):
m. iliopsoas, m. quadratus lumborum, m. tensor fasciae latae, m. rectus femoris and mm. ischiocrurales.
Each of the muscles enumerated can become dysfunctional triggered by a sacroiliac dysfunction and in this way can cause further arthrogenic dysfunctions.

Due to its origin or attachment, musculus iliopsoas can cause direct dysfunctions in Th12/L1, L5/S1 as well as in the articulatio coxae (according to Mitchell 2005 p. 34, Adler-Michaelson 1999 and 2000, Nicholas 2000 and 2001, Ligner 2003 and 2004, Wallace 2002 and 2003).
Due to its origin or attachment, m. quadratum lumborum can cause direct dysfunctions of the 12th rib, Th12/L1 or L5/S1/ileum (according to Mitchell 2005 p. 34, Adler-Michaelson 1999 and 2000, Nicholas 2000 and 2001, Ligner 2003 and 2004, Wallace 2002 and 2003).
Due to its origin or attachment, m.tensor fasciae latae can cause direct dysfunctions in the articulatio coxae or at the art. genu (according to Mitchell 2005 p. 36, Adler-Michaelson 1999 and 2000, Nicholas 2000 and 2001, Ligner 2003 and 2004, Wallace 2002 and 2003).
Due to its origin or attachment, m.rectus femoris can cause direct dysfunctions at the symphysis pubica or at the articulatio genu (according to Mitchell 2005 p. 35 , Adler-Michaelson 1999 and 2000, Nicholas 2000 and 2001, Ligner 2003 and 2004, Wallace 2002 and 2003).
Mm. ischiocrurales can, due to their origin or attachment, cause direct dysfunctions at the articulatio iliosacralis or at the articulatio genu (according to Mitchell 2005 36, Adler-Michaelson 1999 and 2000, Nicholas 2000 and 2001, Ligner 2003 and 2004, Wallace 2002 and 2003).

In addition, every joint itself can cause and/or trigger further muscular dysfunctions via mono-segmental as well as poly-segmental muscles (Adler-Michaelson 1999 and 2000, Nicholas 2000 and 2001, Ligner 2003 and 2004, Wallace 2002 and 2003).
Ligner (2004 and 2005), Arlot (2003) and Crow (2001 and 2002) go so far as to say that from their point of view it is possible to reach more or less any point of the human body originating from the sacroiliac joint.
Based on the above mentioned concept, chronic and complex symptoms will give rise to the question: where is the so-called "key lesion“? After long-term unilateral overstraining when playing soccer, the condition might be caused by the sacroiliac joint.

Furthermore, osteopathic schools (Vienna School of Osteopathy and Philadelphia College of Osteopathic Medicine, USA), as well as their lecturers (Ligner 2002, 2003 and 2004, Craw 2000, 2001 and 2002, Buset 2004, Adler-Michaelson 1999, 2000 and 2001) and osteopathic textbooks (Barral

“*Visceral Manipulation”* 2001 p. 9, Helsmoortel “*Lehrbuch der viszeralen Osteopathie”* 2002 p.7 and de Coster “Viszerale Osteopathie” 2001 p. 10,) base their explanatory models on the assumption that visceral innervation and arthrogenic innervation essentially correlate like the hen and the egg. Every arthrogenic lesion sooner or later causes a lesion of the respective viscera and in turn every visceral lesion sooner or later causes an arthrogenic dysfunction.

The above mentioned osteopaths and lecturers even hold the opinion that every arthrogenic dysfunction must also be treated viscerally and vice versa with regard to preventing a relapse.

In the case of sacroiliac joint torsion, the organs of the pelvis minor are by all means to be considered (schools, lecturers and textbooks see above). According to the above mentioned concept, it is again possible to ask the question: Does many a visceral dysfunction possibly have its origin in a chronic arthrogenic dysfunction? In our case, might it not be due to long-term one-sided biomechanical stress caused by playing soccer?

In addition, the osteopathic schools (Vienna School of Osteopathy and Philadelphia College of Osteopathic Medicine, USA), as well as their lecturers (Ligner 2002, 2003 and 2004, Craw 2000, 2001 and 2002, Bisset 2004, Adler-Michaelson 1999, 2000 and 2001, Nicholas 2000 and 2001) and osteopathic textbooks (Paoletti “*Faszien, Anatomie, Strukturen, Techniken, Spezielle Osteopathie”* 2001 p. 146, Debroux “*Faszienbehandlung in der Osteopathie”* 2004 p. 47) base their explanatory models on functional correlations of the fascia which can be described as follows: Every muscle is enveloped by a fascia and every group of muscles is enveloped by a fascia. Then again, every region is enveloped by a fascia. Every single muscle when dysfunctional has a pathological effect on its fascia. This single fascia has an influence on the fascia of the muscle group which in turn influence the fascia of various regions and these in turn act on the overall fascia. By this mechanism, every single muscle fascia can cause disequilibrium in the whole system.

Furthermore, osteopathic schools (Vienna School of Osteopathy and Philadelphia College of Osteopathic Medicine, USA), as well as their lecturers (Craw 2000, 2001 and 2002, Bisset 2004, Adler-Michaelson 1999, 2000 and 2001, Nicholas 2000 and 2001, Arlot 2002 and 2003) and osteopathic textbooks (Liem “*Kraniosakrale Osteopathie”* 2001 p. 178, Geenman

”Lehrbuch der Osteopathischen Medizin” 1998 and Upledger “*Lehrbuch der CranioSacralen Therapie”* 2000 p. 95) base their explanatory models on the assumption that the sacrum, Th 6, C2, the foramen magnum and the tentoria are interconnected via the dura mater. Assuming that these statements are correct, there are implications not only for the above mentioned structures but also for the entire craniosacral rhythm.
At this level, all dysfunctions of the human body might more or less be traced back to single dysfunctions in the sacroiliac joint which have persisted for years or even decades.

According to Finet (lectures at the Vienna School of Osteopathy 2004), the entire human body must be seen in reference to the so-called “Midline” (model). Based on his concept, one-sided sports training leads to imbalances caused by disalignment of the “midline” originating in the arthrogenic, myogenic, fascial, visceral and craniosacral adjustment mechanisms.

In conclusion it can be said that assuming that the teachings of the osteopathic schools (Vienna School of Osteopathy, Philadelphia College of Osteopathic Medicine, USA) their lecturers (Adler-Michaelson, Nicholas, Craw, Ligner, van Assche, Arlot, Wallace, Bisset, Finet and others) and the relevant textbooks (Mitchell “*Handbuch der MuskelEnergieTechniken”* 2005, Jones “*Strain-Counterstrain”* 2001, Barral “*Visceral Manipulation”* 2001, Helsmoortel “*Lehrbuch der viszeralen Osteopathie”* 2002, de Coster “*Viszerale Osteopathie”* 2001, Liem “*Leitfaden Viszerale Osteopathie”* 2005, Barral “*Lehrbuch der Viszeralen Osteopathie”* 2005, Paoletti “*Faszien. Anatomie, Strukturen, Techniken, Spezielle Osteopathie”* 2001, Debroux “*Faszienbehandlung in der Osteopathie”* 2004, Liem “*Kraniosakrale Osteopathie”* 2001, Upledger “*Lehrbuch der CranioSacralen Therapie”* 2000) are correct, it is of prime importance for an osteopathic basic treatment but even more so for osteopathic primary prevention to prove the correlation between typical sports-specific dysfunctions and the subsequent function chains caused by one-sided sports training and to prevent them by developing a regular stretching and strengthening programme.

RESEARCH QUESTION:

Is it possible to take soccer as an example of the kind of sport to assess typical patterns of dysfunctions at the lumbosacral transition including functional muscle shortenings of the lower limbs with osteopathic examinations?

If so, is it possible to eliminate these dysfunctions in the long run by a specifically designed stretching and strengthening programme which is based on osteopathic biomechanical principles?

HYPOTHESIS:

Regularly performed exercises within a stretching and strengthening programme based on osteopathic biomechanical considerations can prevent sport specific dysfunctions and functional muscle shortenings in the long term.

BASICS:

The chapter Basics deals with the special demands you are confronted with when working with young athletes. I am going to describe the biomechanical explanatory model "*Axes of sacral motion*" by Mitchell (2005, page 39) that is relevant for my master thesis; in addition, the clinical functional examinations which were done on the lumbosacral transition and why and how which muscle tests were done.

Explanations will be given on the nature of my master thesis and why it includes a particular osteopathic aspect. As a conclusion, the training programme performed is illustrated both theoretically and with pictures.

1. Why young athletes in particular?

During 15 years of my experience as a doctor in sports medicine, osteopath, trainer and coach I have always noted that young people, contrary to older sportsmen, can be described as "raw diamonds". Young people almost never have a physical history. Therefore, the results of examinations and the consequences after different training-related therapeutical measures allow for a much better judgement.

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Furthermore, I know from my experience that young athletes are still more idealistic and that due to their natural confidence they implement everything you show and teach them one hundred per cent. Hence, the check-up results are much more convincing than with most of the adults.

1. Biomechanical principles:

2.1. General information:

The biomechanical principles I chose for examination, diagnostics and therapy are based on Mitchell's model *"Axes of sacral motion"* (2005, page 39). This model is taught at the Vienna School of Osteopathy and at the Philadelphia College of Osteopathic Medicine, USA. It is a model of ideas for diagnostics and therapy. There are no clinical-scientific studies on it. The advantage with this model is its recognition worldwide. A disadvantage is the fact that it underlies manual testing and evaluation by an individual person without being supported by objective equipment-based measuring techniques.

2.2. The model:

According to the model "*Axes of sacral motion*" for sacral dysfunctions by Mitchell (2005, page 53) we distinguish 5 axes in total:

2.2.1. A vertical axis responsible for dysfunction of rotation.
2.2.2. Three oblique axes responsible for torsion dysfunctions,

2.2.2.1. A transversely situated superior axis (= respiratory axis): It is situated in the basic zone and relates to thoracic respiration. Due to its connection to the dura mater in the superior section, it is linked with the diaphragm, as well as the C2 and the tentorium.

2.2.2. 2. A transversely situated middle axis = flexion/extension axis: It is situated at S2 in the area of the L-shaped joint area of the sacrum where the joint surfaces meet.

2.2.2.3. A transversely situated inferior axis = ilium: dysfunctions with flexion/anterior or extension/posterior. It refers to dysfunctions of the ilium in relation to the sacrum.

2.2.3. and 2.2.4. Two oblique axes from one side on top to the opposite site at the bottom. These axes are responsible for torsion dysfunctions.

2.2.5. An anteroposterior axis going through S2 is responsible for lateral dysfunctions.

2.3. Nomenclature of dysfunctions

Following the model "*Axes of sacral motion*" by Mitchell (2005, page 157) the nomenclature of dysfunctions mentioned below is applied for diagnostics. We distinguish unilateral and bilateral dysfunctions.

2.3.1. Bilateral dysfunctions:

The basic bilateral dysfunctions are:
2.3.1.1. Bilateral flexion/extension dysfunction of the sacrum
2.3.1. 2. Sacrum dysfunction - anterior or posterior translation

2.3.1.1. The most important bilateral dysfunction is the bilateral flexion/extension of the sacrum. It is at S2 along a horizontal axis.
With a bilateral flexion dysfunction both sulci are deep, the basis of the sacrum is anterior, the anguli inferiores are posterior and the lumbar spine is extended. The sphinx test is negative, the sacral rock test is positive.

2.3.1.2. Further bilateral dysfunctions of the sacrum are anterior or posterior translation:
With an anterior translated sacrum the sacral rock test is positive, the sphinx test is not usable, both sulci are deep and both anguli inferiores are anterior.
With a posterior translated sacrum dysfunction the sacral rock test is positive, the sphinx test is not usable, both sulci are high and both anguli inferiores are posterior.

2.3.2. The basic unilateral dysfunctions:

2.3.2.1. Unilateral flexion of the sacrum right/left
2.3.2.2. Unilateral extension of the sacrum right/left
2.3.2.3. Anterior torsion left on left/ right on right
2.3.2.4. Posterior torsion right on left/left on right
2.3.2.5. Unilateral lateral flexion dysfunction
2.3.2.6. Unilateral rotation dysfunction

2.3.2.1. Unilateral flexion of the sacrum right/left:
With unilateral flexion of the sacrum to the right the sphinx test is negative; the right sulcus is deep, left high, and the anguli inferiores right posterior, left anterior. With unilateral flexion of the sacrum to the left it is vice versa.

2.3.2.2. Unilateral extension of the sacrum right/left:
With unilateral extension of the sacrum to the right, the sphinx test is positive; the sulci right are deep, left high, and the anguli inferiores right anterior and left posterior.
With unilateral extension of the sacrum to the left it is vice versa.

2.3.2.3. Anterior torsion left on left/right on right:
With anterior torsion left on left around an oblique axis the sphinx test is negative; the posterior processus transversus of L5 right, the sulci right are

deep, left high, and the anguli inferiores right anterior and left posterior. With anterior torsion right on right around an oblique axis it is vice versa.

2.3.2.4. Posterior torsion right on left/left on right:

With posterior torsion right on left around an oblique axis the sphinx test is positive, the posterior processus transversus of L5 left, the sulci left are deep, right high and the anguli left anterior and right posterior. With posterior torsion left on right around an oblique axis it is vice versa.

2.3.2.5. Unilateral lateral flexion dysfunction

With a unilateral lateral flexion lesion right around an anterior/posterior axis, a superior displacement of the sacrum to the right cranially is encountered. The angulus inferior and the sacral base on the right are cranial. The angulus inferior on the left are not anterior or posterior; the sulci of the sacrum are not deep or low.

With a unilateral lateral flexion dysfunction left around an anterior/posterior axis it is vice versa.

2.3.2.6. Unilateral rotation dysfunction:

With a unilateral rotation dysfunction around a craniocaudal axis to the right, there is a rotation displacement of the right sacrum to ventral. The right angulus inferior is anterior and the right sulcus is deep.

With a unilateral rotational dysfunction to the left around a craniocaudal axis it is vice versa.

2.4. Characteristics of sacral dysfunctions:

A further important milestone for biomechanics, diagnostics and therapy in my study are the "*Charakteristika der Sakrumsdysfunktionen*" according to Mitchell p. 53:

2.4.1. *Characteristics of sacral torsion*; acc. to Mitchell 2005, p. 53

- The sacrum rotates at one point on the os ilium on which, in a locked position, the weight is transmitted from bone to bone.

• At the sacral base, the rotation is linked with a contralateral lateral inclination. In addition, with forward and backward motions of the sacral base on the os ilium, the angulus lateralis inferior on the opposite side of the sacrum moves forward and backward in relation to the ipsilateral os ilium. Torsion motions of the sacrum around an oblique axis (Mitchell model) are a reaction to the balanced lateral inclination of the torso: The vector of the

• sacral base moves to the opposite side of the lumbar inclination, which enforces the torsion motion.

• The main motion of the sacral base is the rotation with contralateral lateral inclination as a secondary coupled motion.

2.4.2. *Characteristics of unilateral sacrum flexion*:

• The weight is transmitted by the ligamentum sacroiliacum posterius. It is a swinging motion of the suspended sacrum.

• A unilateral anterior motion of the sacral base is caused by an inferior/posterior motion of the angulus lateralis inferior on the same side.

• The unilateral sacrum flexion is a reaction to the strained unbalanced lateral inclination of the torso, which can lead to the lateral inclination of the sacrum around a non-oblique axis in the direction of the lateral inclination of the torso.

• The main motion is the lateral inclination with contralateral rotation as a secondary motion.

3. Clinical tests for the evaluation of dysfunctions:

Clinical tests were performed for the accurate evaluation of dysfunctions. Tests by Mitchell 2005, Janda 2002, Buckup 2005, Bischoff 2007 and Neumann 1999 were used as a basis. These standardised tests are internationally renowned clinical functional tests and are applied in clinics in German- and English speaking countries. They are taught at the Vienna School of Osteophathy and at the Philadelphia College of Osteopathy, USA. One should consider that these are subjective tests which depend on the

3.1. Derbolowsky signs (advancement phenomenon supine): (acc. to Buckup 2005 p. 41, Neumann 1999 p. 197, Bischoff 2007 p. 85)

assessment of the examiner.

Assessment of variable leg length difference – advancement phenomenon supine.

Procedure: Patient is supine. The examiner grasps both ankles distal , palpates the medial malleoli with each thumb, and evaluates the relative level and rotation of the medial malleoli according to the position of the thumbs. The patient is asked to sit up. The examiner may either help the patient do so, or the patient may use his hands for support.

Assessment: Where there is motion restriction in the sacroiliac joint without any play between the sacrum and the ilium, the restricted leg will be longer when the patient sits up, and apparently shorter or the same length as the other leg when the patient is supine (relative leg length difference). The differential diagnosis should consider whether something other than a motion restriction in the sacroiliac joint may be causing the variable leg length difference, e.g. shortening of the hamstrings or genuine leg shortening or leg lengthening.

3.2. Advancement phenomenon (Standing flexion test):

(acc. to Buckup 2005 p. 39, Bischoff 2007 p. 93, Neumann 1999 p. 70)

Examination of the sacroiliac joint function.

Procedure: The patient stands with his back to the examiner. The examiner uses both thumbs to palpate both spinae iliacae posteriores superiores The patient is asked to keep both feet on the floor, to stretch knees and lean forward slowly. The position and the motion of both spinae is observed during flexion of the torso. Pelvic obliquity caused by leg length difference should be balanced out beforehand by placing a shim underneath the shorter leg.

Assessment: The sacrum rotates around a horizontal axis in relation to the ilia in the sacroilicac joints. For this rotating motion of the sacrum the term nudation is used.

With a normal finding, i.e. free mobility in the sacroiliac joints, the spinae iliacae posteriores are equally high at the end of the torsion flexion like at the beginning of the motion.

If there is no nudation of the sacroiliac joint on one side, the spina iliaca posterior superior is stretched with the sacrum cranially in relation to the opposite side (advancement).

If there is no nudation or if an advancement phenomenon occurs, this is a first sign primarily for a restriction of the sacroiliac joint in question. A bilateral advancement phenomenon can be simulated by shortened ischiocrural musculature on both sides.

Note: When evaluating the advancement phenomenon, the examiner must consider or exclude possible asymmetry of the pelvis and hip joints. Pelvic obliquity due to a difference in leg length should be compensated for beforehand by placing shims under the shorter leg. The advancement phenomenon can also be tested with the patient in a supine position (alternating leg length).

3.3. Spine test (acc. to Buckup 2005 p. 38, Neumann 1999 p. 70, Bischoff 2007 p. 57)
Examination of sacroiliac joint function.
Procedure: The examiner stands behind the standing patient and locates the spina iliaca posterior superior with his thumbs and at the same level the crista sacralis mediana. The patient is asked to raise the ipsilateral leg and pull his knee upwards as far as possible.
Assessment: With a normal function, if the sacroiliac joint is not restricted, the ilium lowers on the examination side. To prove mobility, the spina iliaca posterior superior glides to caudal shifting 0.5 cm - 2 cm, resulting in a tilting motion caudoanterior. If the sacroiliac joint is restricted, there is no bending. Due to a restriction the spina iliaca posterior superior that is being palpated often even moves cranially.

3.4. Sacroiliac joint springing test (acc. to Buckup 2005 p. 40, Neumann 1999 p. 69, Bischoff 2007 p. 58)
Examination of the sacroiliac joint function.

Procedure: The patient is supine. For the direct assessment of the play in the sacroiliac joint the leg opposite the examiner is flexed at the knee and hip and adducted in the direction of the examiner until the pelvis starts to follow (the other leg remains extended). Next, the examiner takes the knee of the adducted side and palpates the sacroiliac joint with the other hand exerting a resilient axial pressure on the knee.
Assessment: This procedure normally produces a springy motion in the sacroiliac joint, which is palpable by the motion between the spina iliaca posterior superior and the os sacrum. Lack of joint play is typical of functional impairment. The springing test is based on the fact that with every intact joint – even in its extreme position – the extent of motion can be increased by exerting resilient pressure. Basically, manual interference allows diagnosis of a functional impairment in any joint. However, it is important to start the

test by applying initial pressure on the joint. This test procedure is recommended in addition to the springing test with the patient in a prone position.

3.5. Testing the depth of the sulcus sacralis (acc. to Mitchell 2005, p. 63)
Examination of the sacroiliac joint function.
Procedure: The patient is in a supine position, with head turned to the side to relieve the neck. The examiner stands sideward to the patient, locates the tubercula glutealis by circular stereognosis and places his thumb tip posteriorly in the direction of medial. The examiner bends his thumb medially to the cristae iliacae and anteriorly in the direction of the sacrum, keeping contact with the cristae iliacae

Constant pressure is exerted with the thumb tips to anterior. The thumb tip contact on the crista iliaca defines the sulcus depth palpated.
Assessment: A unilaterally deeper sulcus is encountered with a unlilaterally flexed ipsilateral sacrum or with a torqued sacrum contralaterally. For further assessment of the sacroiliac dysfunction an ALI position test in prone and sphinx position or a sacral rock test must be performed.

3.6. Sacral rock test (acc. to Mitchell 2005, p. 166)
Examination of the sacroiliac joint function.
Procedure: The examiner stands to the side of the patient lying in a prone position. The examiner uses both palms placed on one another to model the whole sacrum. The whole sacrum is tested for mobility as for flexion and extension to both sides.
Assessment: The test is positive, if mobility is significantly low. A positive test suggests bilateral flexion or extension dysfunction of the sacrum.

3.7. ALI position test in prone and sphinx position (acc. to Mitchell 2005, p.160). Examination of the sacroiliac joint function
Procedure: The patient is in a prone position. If possible the examination table should not allow rotation in the cervical spine. The examiner stands to the side of the examination table so that his dominant eye is next to the patient’s feet. The examiner locates the posterior anguli laterales inferiores by following the crista mediana of the sacrum up to its bifurcation at the hiatus sacralis. Then he moves up to behind the cornua, palpating with both thumbs. The examiner bends forward to have his dominant eye directed on

the central line of the patient. To align his line of sight with his thumb nails, he lowers his head to get a more horizontal perspective. The examiner compares both ALIs which should be found at the same level with the cornuae. Every anterior/posterior asymmetry is significant; there are AP asymmetries of up to more than 5mm. Now the examiner raises his head and lets his thumb glide downwards to the inferior edges of the sacrum, where he directs both thumbs cranially, looking directly over his thumbs considering a superior inferior asymmetry. An inferior superior asymmetry can be as high as 20mm.

Then the examiner asks the patient to raise his shoulders from the examination table and support his chin with his hands. The examiner observes the ALIs closely as described above. If the ALI position has not changed, the patient is asked to hyperextend his back, which is called hyper sphinx position. Assessment: In most cases, this method allows the examiner to get enough information on torsion and flexion dysfunctions. With a torsion which is more like a rotation of the sacrum the ALI is dislocated mainly posteriorly and only slightly inferiorly. With a flexion which is more like a lateral inclination of the sacrum, the ALI is dislocated mainly inferiorly and only slightly posteriorly. With a sacrum torqued backward, the asymmetry remains in the sphinx position, with the sacrum torqued forward the asymmetry disappears. If the comparison between posterior and inferior positions yields ambiguous results, other points of reference and other tests are used (see above).

4. Why manual muscle tests?

According to many scholars (explanatory models) of the Vienna School of Osteopathy and the Philadelphia College of Osteopathic Medicine, USA, opinions of lecturers (Adler-Michaelson 1999 and 2000, Nicholas 2000 and 2001, Ligner 2003 and 2004, Wallace 2002 and 2003, Marcer 2003) and the books/textbooks by Jones " *Strain-Counterstrain*" 2001 p. 6 and Mitchell "*Handbuch der MuskelEnergieTechniken*" 2005 p. 9, muscle techniques are being used to treat arthrogenic dysfunctions, as functional muscle shortenings are caused by arthrogenic dysfunctions or functional muscle shortenings can cause arthrogenic dysfunctions. Therefore, treatments according to the school of thought of the above mentioned schools and professors should always be of an arthrogenic and myogenic nature. Please note that this is an explanatory model and the tests performed need to be done and assessed subjectively.

According to fundamental research in sports medicine (Janda 2002 p. 5, Frisch 2001 p. 42, Spring et alii 1997 p. 11 and 1990 p. 139) the human muscle groups are divided into tonic and phasic muscular systems. According to this school of thought phasic muscles tend to weaken, tonic muscles tend to shorten. As nearly every joint is moved by tonic and phasic muscles in the sense of agonists and antagonists, it is assumed that muscle groups may become imbalanced when doing one-sided or unbalanced sports without adequate keep-fit or balancing exercises.

5. Which muscles were tested in which way?

All muscle function tests were performed in accordance with the handbook "*Manuelle Muskelfunktionsdiagnostik*" by Janda 2002. Please note that these are subjective tests.

5.1. Musculus piriformis (modified acc. to Janda 2002, p. 265, Adler-Michaelson 1999)

Initial position: Patient in prone, arms stretched beneath the body. The examiner stands at the end of the examination table. Both knee joints are bent at 90°'a1 and kept as close together as possible. The patient's hips should be lying relaxed on the examination table.
Procedure: With the hip joints stabilised and the knee joints adducted, an inner rotation is performed in the hips bilaterally. The divergence of the planta pedis from the median sagittal plane needs to be assessed. MInd the free motion of the hip joint.
Assessment:
Step 0: no shortening, adduction and inner rotation is totally possible, smooth final sensation.
Step 1: slight shortening, inner rotation during adduction in relation to the other side is restricted.
Step 2: significant shortening, inner rotation during adduction almost impossible or painful.

Osteopathic relevance:
The musculus piriformis holds the contralateral sacrum in torsion (acc. to Mitchell 2005, Adler-Michaelson 1999, Nicholas 2000).

5.2. Musculus iliopsoas (modified acc. to Janda 2002, p. 258, Nicholas 2000)

Initial position: Coccyx position on the edge of the examination table, the leg not being tested is held fully flexed by the patient with his hands. The person examined is brought in a supine position passively. The patient is supine and the pelvis remains lying on the examination table. The examiner stands to the side contralateral to the musculus iliopsoas to be examined. The patient raises the examiner's hand next to the examination table and smoothly flexes his top knee joint towards the thorax. The therapist's hand farthest to the bed also grasps the knee joint ventrally on the examination side. Procedure: The examiner stabilises the knee joint on top with his hip next to the examination table and with his hand farthest from the bed extends the hip over the knee joint.

Assessment:

Step 0: no shortening, thighs are horizontal without any deviation, the lower leg hanging vertically with muscles relaxed, the patella is only in a slightly lateral position. By exerting slight pressure against the distal third of the thigh it is possible to get the thigh slightly below the horizontal level and hyperextend it.

Step 1: slight shortening, slight flexion in the hip joint = musculus iliopsoas is shortened.

Lower leg obliquely extended forward = musculus rectus femoris is shortened. Thigh in slight abduction = musculus tensor fasciae latae is shortened. Step 2: significant shortening, with significant flexion in the hip; when exerting pressure on the distal third of the thigh towards hyperextension, it is impossible to get into a horizontal position = musculus iliopsoas is shortened. Osteopathic relevance: The shortened musculus iliopsoas creates a muscular imbalance of the pelvic region (acc. to Mitchell 2005, p. 105) and may produce or maintain a posterior pelvic dysfunction (Nicholas 2000 and Adler-Michaelson 1999).

5.3. Musculus rectus femoris (modified acc. to Janda 2002, p. 259, Adler-Michaelson 1999, Nicholas 2000)

Initial position: Patient is prone, arms straight alongside the body. The hip and knee joint of the leg not tested are extended in neutral O position. Procedure: The examiner stands to the side to be examined and moves the knee joint to be examined into flexion in the direction of the gluteal muscles

as far as possible. The hand next to the head stabilises the sacroiliac joint ipsilaterally in the direction of the examination table.
Assessment:

Step 0: no shortening, flexion is possible towards the gluteal muscles without an evasive motion.
Step 1: slight shortening, flexion possible only up to 80°'a1.
Step 2: significant shortening, flexion possible only up to about 80°'a1.
Osteopathic relevance:The musculus rectus femoris tips the pelvis forward (acc. to Mitchell 2005, p. 35) and may be responsible for a dysfunction of the ilium when in flexion (Nicholas 2000, Adler-Michaelson 1999).

5.4. Musculi ischiocrurales (modified acc. to Janda 2002, p. 261, Nicholas 2000)

Initial position: The patient is supine, arms straight alongside the body. The knee and hip joint of the leg not tested are flexed, with the foot on the table. The hip and knee joint of the leg examined are extended.
Procedure: The examiner stands to the side to be examined. The hand next to the head stabilises the spinae iliaca anterior superior ipsilaterally on the examination table. The examiner's hand next to the leg flexes the hip along the sagittal plane, while the knee joint is extended. The flexion in the hip is assessed. The test is finished once the examiner can feel the patient flexing the knee or the pelvis tips backward.
Assessment:
Step 0: no shortening, flexion at 90°'a1 possible.
Step 1: slight shortening, flexion possible only between 80°'a1 and 90°'a1
Step 2: significant shortening, flexion possible only up to 80°'a1
Osteopathic relevance: The musculi ischiocrurales can be responsible for a dysfunction of the os coxae in posterior rotation (acc. to Mitchell 2005, p.188, acc. to Nicholas 2000 and Adler-Michaelson 1999).

5.5. Musculi adductores (modified acc. to Janda 2002 p. 263, Nicholas 2000, Adler-Michaelson 1999)

Initial position: The patient is supine, with the side to be examined as close as possible to the edge of the examination table. The leg not examined is abducted by about 50°'a1 - 20°'a1 in the hip joint. The examiner stands to

the side to be examined. The hand next to the head palpates the trochanter major and the spinae iliaca anterior superior.
Procedure: The examiner clamps the heel of the leg to be examined inside his elbow to avoid possible external rotation. His palm rests on the tibia. The hip is fully abducted. Having reached its full extent, the knee joint is moved into flexion between 10°'a1 and 15°'a1, i.e. before the pelvis starts to move at an angle of less than 40°'a1.
Assessment: The aim is to assess the extent of abduction in the hip joint with extended and flexed knee. If they are equally restricted, the single-joint adductors are shortened. If the extent of motion with the flexing knee joint increases, the double-joint adductors are shortened.
Assessment:

Step 0: no shortening, abduction at 40°'a1 possible with extended knee joint
Step 1: slight shortening, abduction restricted to 30°'a1 - 40°'a1
Step 2: significant shortening, abduction below 30°'a1 possible.
Osteopathic relevance:
The musculi adductores may be responsible for a symphysis inferior shear (Nicholas 2000, Adler-Michaelson 1999)

5.6. Musculus triceps surae (modified acc. to Janda 2002, p. 254, Nicholas 2000, Adler-Michaelson 1999)

Initial position: Patient is supine, the leg not extended bent with the sole of the foot on the examination table; the examined leg is extended. The distal half of the lower leg projects beyond the table.
Procedure: The examiner stands to the examination side. The hand next to the head stabilises the distal lower leg with extended knee and ankle joint on the examination table. The hand next to the table grasps the planta pedis in the area of the heads of the metatarsalia I - V. With the knee joint and ankle joint extended, the hand next to the foot performs a dorsal flexion.
Assessment:
Step 0: no shortening, dorsal flexion is possible minimum up to neutral 0 position.
Step 1: slight shortening, neutral 0 position is not reached.
Step 2: significant shortening, dorsal flexion only possible up to 10°'a1 below the neutral 0 position.

Osteopathic relevance:
The musculus triceps surae can bring a distal femur posteriorly into dysfunction, and via an extending chain over the musculi ischiocrurales and the musculus rectus femuris cause a pelvic dysfunction (Nicholas 2000, Adler-Michaelson 1999).

6. Why osteopathic? Which peculiarities?

According to one of the first principles you are taught in osteopathy all structures (joints, muscles, fasciae, viscera and the craniosacral rhythm) are connected with each other. From every point of the body you can reach and influence every point and every dysfunction (Vienna School of Osteopathy 2002-2006, Philadelphia College of Osteopathic Medicine, USA 1999-2003). During 15 years of experience as a sports physician and osteopath I noticed that one-sided exercises cause one-sided structural and functional changes. This subject has never been scientifically tested according to my research (Internet and books, see page 3).
The arthrogenic and myogenic functional impairments, which are taught quite uniformly at schools of osteophathy (Vienna School of Osteopathy and Philadelphia College of Osteopathic Medicine, USA) and are well described in various handbooks (see above), seem to be the ideal basis for scientific studies after lengthy observation. However, it is important to point out that the models are explanatory models and idea models, and that the result of the examinations is a subjective testing procedure.

The special feature of this thesis is the fact that dysfunctions diagnosed on joints and muscle groups are not “only“ treated and eliminated by manual techniques by the osteopath. Moreover, a special stretching and strengthening programme followed by the athletes should prevent a new creation of dysfunctions in the sense of a secondary prophylactic measure. This is even more spectacular as the one-sided exercises can be continued at the same time.
The programme consists of nine stretching and strengthening exercises, which can be easily understood and performed by any athlete. Basically, this master thesis is to point out that an individual programme can be offered for every kind of sport that can prevent dysfunctions, thus resulting in long-lasting success regarding the athletes’ health and long-lasting success in their competitiveness.

7. The 9 stretching and strengthening exercises:

7.1. General information:

To eliminate the dysfunction chains and as a secondary prophylaxis, a complex stretching and strengthening programme was performed with young soccer players two times a week for 45 minutes each. The exercises were done in accordance with the agonist/antagonist rules (acc. to Frisch 2001 p. 42, Spring et alii1997 p. 11 and 1990 p. 139).

Within this programme, the exercises were directed at those muscle groups which had been assessed as shortened after the muscle tests and can cause dysfunctions in the area of the lumbosacral transition directly or indirectly in the sense of osteopathic biomechanical considerations (expert opinion of the Vienna School of Osteopathy 2002-2006 and the Philadelphia College of Osteopathic Medicine, USA, 1999-2003).

During the exercises, at first the agonists were stretched (30 seconds) and then the antagonists were strengthened (always in the endurance-strength phase). Every exercise was repeated three times (= three series). This procedure was chosen due to my long-term experience in this field and based on the above mentioned assumptions that the desired effect would take place.

7.2. The exercises:

Exercise no. 1: stretch m. rectus – strengthen mm. ischiocrurales – stretch m. rectus.

Exercise no. 2: stretch m. rectus abdominis– strengthen autochthonous back musculature – stretch m. rectus abdominis

Exercise no. 3: stretch m. iliopsoas – strengthen m. glutaeus maximus – stretch m. iliopsoas

Exercise no. 4: stretch mm. ischiocrurales – strengthen m. rectus femoris – stretch mm. ischiocrurales

Exercise no. 5: stretch m. triceps cruris – strengthen mm. tibiales anterior group – stretch m. triceps surae

Exercise no. 6: stretch mm. adductores – strengthen tractus iliotibialis – stretch mm. adductores

Exercise no. 7: stretch m. piriformis– strengthen mm. adductores – stretch m. piriformis

Exercise no. 8: stretch autochthonous muscles of the back – strengthen m. rectus abdominis – stretch autochthonous muscles of the back

Exercise no. 9: stretch mm. obliquii abdominis – strengthen mm. obliquii abdominis – stretch m. obliquii abdominis

SCIENTIFIC METHOD

The chapter Scientific method looks into the whole examination flow, the inclusion and exclusion criteria, the dependent and independent variables and it critically scrutinises my own scientific method.

1. **Examination flow**

In the context of my work as a sports physician and coach with the training centres of the National Associations (LAZ, Landesverbandsausbildungszentren) in Steyr and Ried, I tested and examined the new generations of soccer players that were taken on.
Certainly, apart from tests specific to the kind of sport (technique, tactics, soccer brains and team spirit) and sports skills tests (strength, endurance, mobility and coordination), a detailed sports medical status had to be evaluated on admission to the training centre.
In the course of this sports medical examination an internal, gross neurological as well as orthopaedic and physical status were evaluated.
In view of my master thesis, I took the unique opportunity of structurally examining the osteopathic status and consequently treating a group of 33 players of absolutely equal rating.

1.1. What was investigated and how?

The soccer players were structurally examined with regard to arthrogenic dysfunction at the lumbosacral transition and functional shortening of the muscles of the lower limbs.

For an evaluation of the arthrogenic dysfunctions, the tests described in the chapter Basics, heading 3, were used.

The nomenclature of the dysfunctions is in conformity with the sacral dysfunctions by Mitchell (2005) as described in the chapter Basics, heading 2.3.

For an evaluation of the functional muscle shortenings, the tests according to Janda (2002) , Adler Michaelson (1999) and Nicholas (2000) described in the chapter Basics, heading 5, were used in a modified form.

1.2. Logistics of the examination flow:

The first examination was done on admission to the national association training centres.

Based on the results, a complex stretching and strengthening programme was worked out which was designed to eliminate or avoid dysfunction in the area of the sacroiliac joint.
This stretching and strengthening programme consists of 9 partial exercises which are described in the chapter Basics, heading 8, with illustrations included. According to the agonist/antagonist rule (Frisch 2001 p 42, Spring et alii 1997 p.11 and 1990 p. 139), at first the agonist is stretched and the antagonist strengthened. Every stretching lasts for 30 seconds, muscle toning in the form of an endurance strength exercise is repeated 20 to 40 times. Every practice session consists of 3 series.
This form of training programme is based on the assumptions described in the chapters Basics and Osteopathic relevance.

In the framework of the practice sessions at the national association training centres, I personally did the 9 stretching and strengthening exercises with the soccer players twice a week for 45 minutes each over a period of four months.

After four months, a control examination was done. In the control examination, the same tests were done as in the first examination on admission. Arthrogenic dysfunctions at the lumbosacral transition as well as functional shortenings of the muscles of the lower limbs were tested.

The test findings were compared and statistically evaluated.

2. **Inclusion criteria**

Admission of the sportsman to the national association training centre in Steyr or Ried.

Regular soccer training at least twice a week over a period of at least two years prior to admission to the national association training centres (only then a dysfunctional pattern typical of this sport can form).

Regular participation in the practice at the national association training centre.

Regular participation in the stretching and strengthening programme (twice a week, 45 minutes each session).

No absences due to injury of more than four weeks, a total injury period of no more than 6 weeks.

No problems passing the medical admission examination and the control examinations.

Aged between 11 and 13 years.

3. **Exclusion criteria**

Injury leading to an interruption of practice for more than 4 weeks running or total injury period of more than 6 weeks.

Regular non-attendance of the special training.

Departure from the training centre.

4. **Dependent variables**

The dependent variables in my master thesis are the functional tests at the lumbosacral transition like the Derbolowsky sign (advancement phenomenon when in a lying position) according to Buckup 2005 p. 41, Neumann 1999 p. 197 and Bischoff 2007 p. 85, the advancement phenomenon (standing flexion test) according to Buckup 2005 p. 39, Bischoff 2007 p. 93 and Neumann 1999 p. 70, the spine test according to Buckup 2005 p. 38 , Neumann 1999 p. 70 and Bischoff 2007 p. 57, the sacroiliac joint springing test according to Buckup 2005 p. 40, Neumann 1999 p. 69 and Bischoff 2007 p. 58, testing of the depth of the sulcus sacralis according to Mitchell 2005 p. 63, sacral rock test according to Mitchell 2005 p. 166 and the testing of sacroiliac dysfunction according to Mitchell 2005 p. 160 as well as the modified muscle function tests of m.piriformis, m.iliopsoas, m.rectus femoris, of the muscles mm. ischiocrurales, mm. adductores and of the m. triceps surae according to Janda 2002 p. 254, p. 265, p. 258, p. 259, p.261 and p. 263, Adler Michaelson 1999 and Nicholas 2000.

5. **Independent variable**

The independent variable is the complex stretching and strengthening programme which was carried out over a period of four months and which was based on the examination findings regarding arthogenic dysfunctions at the lumbosacral transition and functional shortening of the muscles of the lower limbs. It was developed on the basis of the explanatory models and doctrines of osteopathic schools as described in the chapter Osteopathic relevance and of my own long-time experience in this area.

6. **Planned magnitude of sample size**

In the framework of a sports medical examination on admission, 33 juvenile soccer players aged between 11 and 13 years were examined.
The examination looked at dysfunctions at the lumbosacral transition and at functional shortening of the muscles of the lower limbs. Based on the findings of the examination, a training programme in line with osteopathic and biomechanical principles was compiled.
This programme was carried out twice a week over a period of 4 months with each session lasting for 45 minutes.
After four months, a control examination directed at the above mentioned criteria was done.

7. **Critical reflection of scientific method**

Starting my critical reflections, I'd like to say that in spite of extensive search for basic literature on the Internet and in various medical journals (see chapter Introduction page three), it was not possible - neither in an osteopathic context nor in conventional medicine - to find scientific data on my object of research.

Therefore I used the doctrines and explanatory models of two renowned osteopathic training schools (Vienna School of Osteopathy, Philadelphia College of Osteopathic Medicine, USA) and of their approved teachers (Adler-Michaelson 1999 and 2000, Nicholas 2000 and 2001, Ligner 2003 and 2004, Wallace 2002 and 2003) and international specialist literature (Mitchell "*Handbuch der MuskelEnergieTechniken"* 2005, Jones "*Strain-Counterstrain"* 2001, Barral "*Viszeralmanipulation*" 2001, Helsmoortel "*Lehrbuch der viszeralen Osteopathie*" 2002 , de Costa "*Viszerale Osteopathie*" 2001, Liem "*Kraniosakrale Osteopathie*" 2001, Upledger "*Lehrbuch der CranioSacralen Therapie"* 2000, Geenman "*Lehrbuch der osteopathischen Medizin"* 1998) as a basis for my test procedure, evaluation and documentation.

A point of criticism of my master thesis is that I carry out both the first examination and the control examination myself. However, it was very difficult to find sufficiently qualified examiners in the region of Upper Austria who would have been able to carry out the examination for me. For colleagues who live farther away, the long journey and the time required for doing the examinations proved too great an obstacle.

Nor did I succeed in splitting the 33 soccer players into two groups to create a verum and falsum group. I had ethical and moral doubts about this procedure, because all team members are aspiring professional soccer players and I am convinced that the stretching and strengthening programme that I carried out not only offers advantages from an osteopathic point of view, but also forms the basis for a healthy and controlled improvement in performance. Therefore it would have been unethical to do two different training programmes with the members of one team. The group with the unspecific training programme would have considered the treatment unfair.
Since a great number of the players that I examined and trained have successfully pursued their sports career to this day, I feel that my ethical and moral concerns are justified.

Another criticism certainly is that I also evaluated the examination results myself. Considering the framework of the research, it was the best feasible way to carry out the study.

Furthermore the low number of test persons is undoubtedly a weak point of the study.

In short, it is obviously not a randomised double-blind study. My wish is that several osteopaths use the results of my study as a basis for examining a larger number of soccer players with the same preconditions and compare their findings with mine.

DATA PRESENTATION AND ASSESSMENT

The purpose of this chapter “Data presentation and assessment” is to submit the findings of the examinations as well as an interpretation.

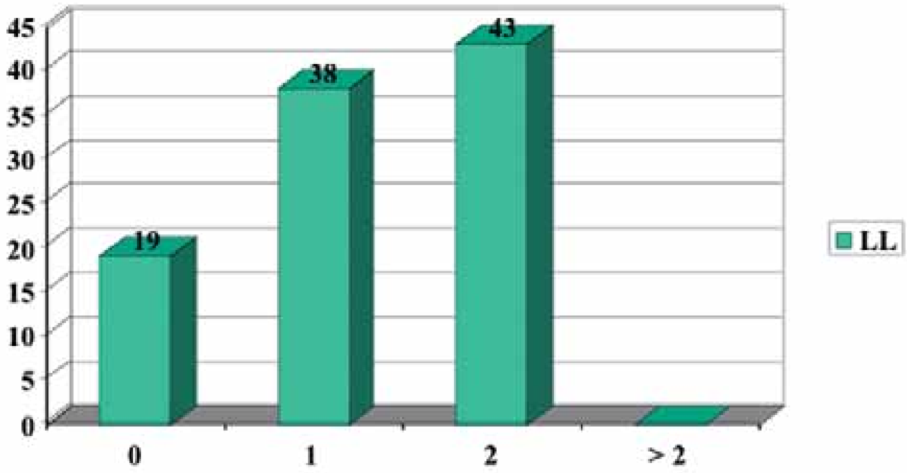
1. General information:

The first examinations for admission to the training centres of the national associations covered 33 boys aged between 11 and 13 years. Their average age was 12.5 years.
During the sports medical examinations I also included osteopathic examinations.
The osteopathic examinations involved structural clinical tests to evaluate dysfunctions at the lumbosacral transition and muscle tests of the lower limbs which are directly or indirectly associated with dysfunctions at the lumbosacral transition.

2. Muscle test – admission examination
For the first examinations on admission, standardised manual muscle function tests modified according to Janda (*“Manuelle Muskelfuntionsdiagnostik “*2002), Adler Michaelson (1999) and Nicholas (2000) were done on muscles of the lower limbs:
m. piriformis, m. rectus femoris, m. iliopsoas, mm. adductores, mm. ischiocrurales and m. triceps surae.
A precise description of the tests is given in chapter Basics, heading 5.

2.1. Muscle shortenings of lower limbs – admission examination

Diagram no. 1: Muscle shortenings of lower limbs – admission examination



The diagram on muscle shortenings of the lower limbs, admission examination, shows the subdivision of athletes that display no, one, two or more than two muscle shortenings of the lower limbs.

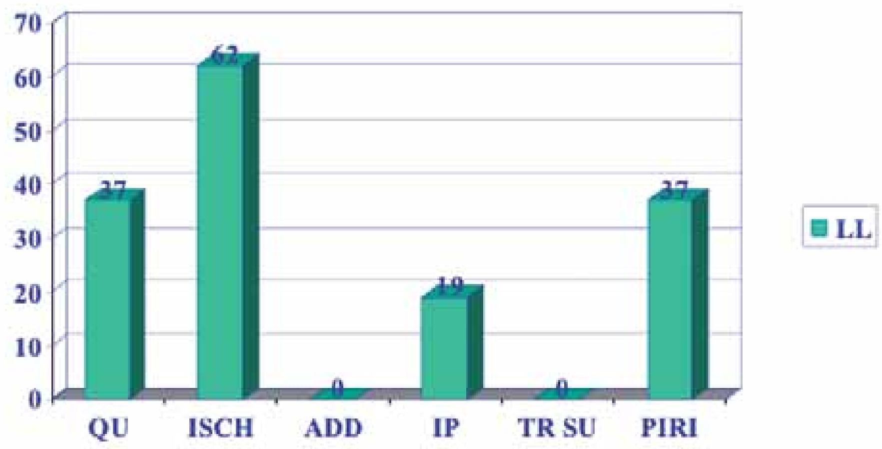
19 per cent showed no muscle shortenings, 38 per cent showed one and 43 per cent showed two muscle shortenings of the lower limbs. None of the athletes examined had more than two functional muscle shortenings of the lower limbs.

Interpretation: One-sided sportive activities lead to functional muscle shortenings of the lower limbs. Even more striking is the extraordinarily large extent, if we consider that the persons examined were athletes aged between 11 and 13 years. From the osteopathic point of view this is no marginal fact, as structure and motion directly correlate with each other, directly influence one another and motion impairment also has an effect on the structure in the long run (van Assche 2002).

According to the description in the chapters Osteopathic relevance and Basics, functional muscle shortenings exert influence on arthrogenic dysfunctions, and trigger or may cause functional muscle function chains. Subsequently, according to osteopathic explanatory models they can cause fasciae resulting in osteopathically relevant functional disorders like visceral mobility and even a craniosacral rhythm.

2.2. Muscle shortenings of the lower limbs – admission examination

Diagram no. 2: Muscle shortenings of lower limbs – admission examination



The diagram “Muscle shortenings of the lower limbs - admission examination” displays the breakdown of muscle shortenings of the lower limbs in per cent. The muscles mostly affected are mm. ischiocrurales (62 per cent), followed by m. piriformis and by m. rectus femoris (37 per cent each) and m. iliopsoas (19 per cent).

Most interestingly, no functional muscle shortenings could be made out with the adductors and m. triceps surae.

Interpretation: According to the hypothetical examples, patterns of dysfunctions related to specific kinds of sports do exist, as there is a disproportionately high share of individual functionally shortened muscle groups and there are muscle groups which are not affected at all.

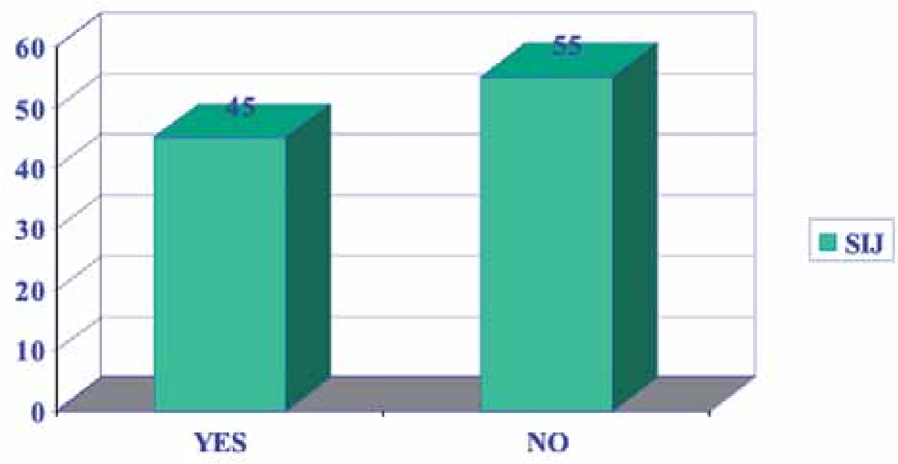
The mm. ischiocrurales, m. rectus femoris and m. piriformis play an extraordinarily important role.

3. Dysfunction of the SIJ (sacroiliac joint) – admission examination

Clinical tests were performed to establish an accurate evaluation of dysfunctions. Test methods according to Mitchell 2005, Janda 2002, Buckup 2005, Bischoff 2007 and Neumann 1999 were used. For a detailed description of the procedure see chapter Basics, heading 3.

3.1. Dysfunction of the SIJ – admission examination

Diagram no. 3: Dysfunction of the SIJ – admission examination



The diagram on SIJ dysfunctions, admission examination, demonstrates how many soccer players exhibit a dysfunction of the SIJ: 45 per cent of the test persons aged between 11 and 13 years had a dysfunction of the sacroiliac joint and 55 per cent had no dysfunction.
The dysfunctions of the sacroiliac joint were exclusively torqued sacrum dysfunctions. To be classified as such, the pre-conditions mentioned below had to prevail during the examinations (acc. to Mitchell, 2005, p. 86):

3.1.1. *Summary of the diagnostic criteria for a torqued sacrum:*
The diagnosis for sacrum torsion to the left across the left oblique axis comprises the following criteria:
Positive flexion test, seated (++) to the right
Positive flexion test, standing (++) to the right
The ALI left is posterior and slightly inferior.

The right sulcus sacralis is deeper.
In prone position the left leg is shorter (supposed L5 can freely rotate to the right and flex to the left).
The torsion disappears in sphinx position.

With the soccer players examined, the torqued sacrum was always on the standing leg and the m. piriformis was functionally shortened on the free leg.
Interpretation: Dysfunctions are revealed a disproportionally high rate (45 per cent) with one-sided sportive activities. Moreover, there is a type of person displaying a predisposition to a specific dysfunction (torqued sacrum) which is lateralisable due to strain.
The aforementioned dysfunctions of the sacroiliac joint occur in combination with functional muscle shortenings of the lower limbs – going with the osteopathic model (acc. to Mitchell, 2005).
Again, the typically osteopathic question arises – What came first? – The hen or the egg? What came first – the dysfunction or the muscle shortening?

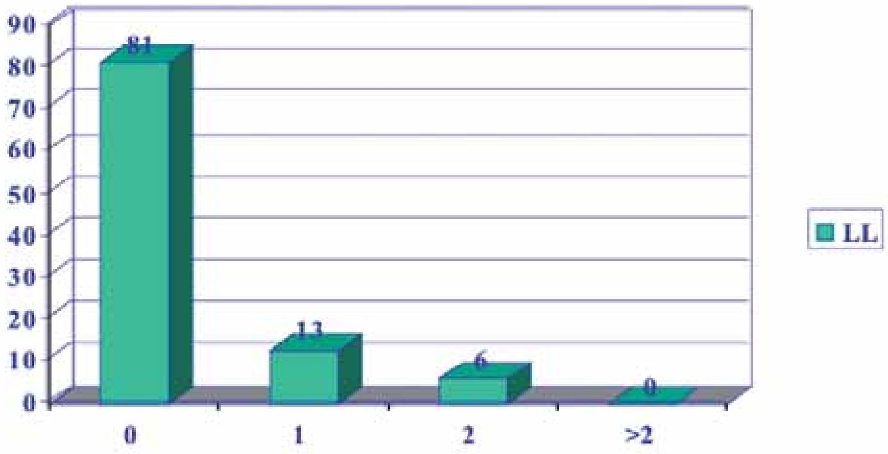
3. Procedure:

Based on the examination results, the athletes participated in a special stretching and strengthening programme over a period of 4 months. Considering a lasting elimination of the functional disorders, the exercises developed were of an arthrogenic and myogenic nature in the sense of secondary prevention and corresponded with the agonist/antagonist rule (acc. to Frisch 2001 p. 42, Spring et alii 1997 p.11 and 1990 p.139). After four months, a control examination was performed following the same criteria that were applied for the admission examination.

4. Muscle tests – control examination:

4.1. Muscle shortenings of the lower limbs – control examination

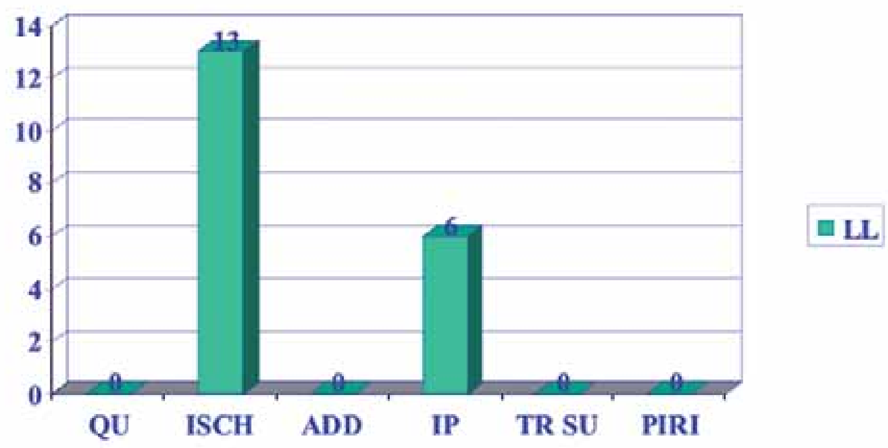
Diagram no. 4: Muscle shortenings of the lower limbs – control examination



According to the diagram, on the occasion of the control examination 81 per cent of the soccer players had no functional muscle shortening, 13 per cent of them had one and 6 per cent had two functional muscle shortenings. Statistically, the result is highly significant. P < 0,03.
Interpretation: By regularly participating in a properly performed stretching and strengthening programme over a period of four months it is possible to eliminate functional muscle shortenings.

4.2. Muscle shortening of the lower limbs – control examination

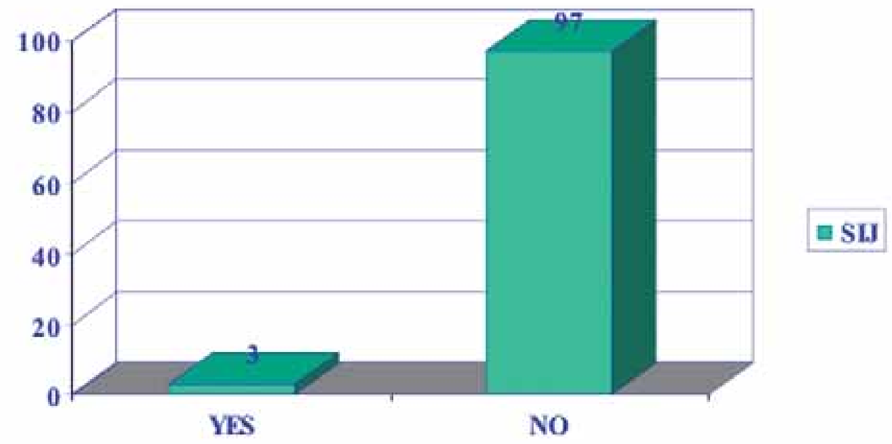
Diagram no. 5: Muscle shortenings of the lower limbs – control examination



According to the diagram, 13 per cent still exhibit one functional muscle shortening and 6 per cent respectively still exhibit two functional muscle shortenings of the lower limbs on the occasion of the control examination. Interpretation: The m. piriformis and m. iliopsoas are muscles particularly tending to shorten with persons playing soccer. In addition, from the close biomechanical relationship between the diagnosed dysfunctions of the lumbosacral transition and the m. piriformis lead me to conclude that mutual triggering can maintain the combined functional impairment. Not to ignore the considerations that there might be better exercises to stretch the m. iliopsoas and the m. piriformis.

5. Dysfunction of the SIJ – control examination:

Diagram no. 6: Dysfunction of the SIJ – control examination



According to this diagram, 97 per cent of the athletes had no dysfunction and only 3 per cent of them had one dysfunction on the occasion of the control examination.

Statistically, the result is highly significant . P < 0,03.

Interpretation: By doing regular exercises within a complex stretching and strengthening programme dysfunctions of the sacroiliac joint were successfully permanently eliminated. The hypothesis has been proven and the research question turned out to be justified.

CONCLUSIONS

The chapter Conclusions describes the history of the origin of my master thesis, my personal approach, the osteopathic relevance, the research question, the hypothesis, data presentation and a critical demonstration of the weak points, including deductions.

The starting point for my master thesis was the scientific examination and review of my 15 years of clinical experience and observations in the field of sport medicine in accordance with the doctrines of two recognised osteopathic schools (Vienna School of Osteopathy and Philadelphia College of Osteopathic Medicine, USA) , their teachers and lecturers (Adler-Michaelson 1999, Nicholas 2000, Craw 2000, Ligner 2003, van Assche 2002, Marcer 2004, Wallace 2003, Sandler 2003, Buset 2004, Duby 2004, Barral 2005, Arlot 2002, Finet 2004) and international specialist literature (Mitchell "*Handbuch der MuskelEnergieTechniken"* 2005, Jones "*Strain-Counterstrain"* 2001, Barral "*Viszeralmanipulation*" 2001, Helsmoortel "*Lehrbuch der viszeralen Osteopathie*" 2002 , de Costa "*Viszerale Osteopathie*" 2001, Liem "*Kraniosakrale Osteopathie*" 2001, Upledger "*Lehrbuch der CranioSacralen Therapie"* 2000, Greenman *"Lehrbuch der osteopathischen Medizin "* 1998*).*
The research question is:
Is it possible to take soccer as an example of the kind of sport to assess typical patterns of dysfunctions at the lumbosacral transition including functional muscle shortenings of the lower limbs with osteopathic examinations?

In the framework of the research, 33 soccer players aged between 11 and 13 years were examined according to standardised tests. As a pre-condition, they had to participate in regular soccer training over a period of two years at least twice a week.

The result was clear without ambiguity: 45 per cent of the athletes examined displayed a dysfunction of the sacroiliac joint and 81 per cent were diagnosed with having functional muscle shortenings on the lower limbs. The dysfunctions were exclusively torqued sacra on the standing leg. The functional muscle shortenings reflect a typical (sport specific) pattern: The muscles mostly affected were hamstrings (62 per cent), followed by m. piriformis (37 per cent) and m. quadriceps. It was striking to see that with all torqued sacrum dysfunctions, a functional muscle shortening of the contralateral m. piriformis was diagnosed.

The hypothesis is:
Regularly performed exercises within a stretching and strengthening programme based on osteopathic biomechanical considerations can prevent typically sport specific dysfunctions and functional muscle shortenings in the long run.
Soccer players took part in a complex stretching and strengthening programme which took place over a period of four months, twice a week for 45 minutes each. The exercises were chosen and compiled on the basis of the findings of the examinations in accordance with the biomechanical osteopathic considerations and the agonist/antagonist rules (Janda 2002 p. 5, Frisch 2001 p. 42 , Spring et alii 1997 p. 11 and 1990 p. 139).

The hypothesis was confirmed by the findings of the control examination. Through the control examination, only three per cent of the soccer players were diagnosed with a dysfunction of the sacroiliac joint. From the statistical point of view the result is highly significant. $P < 0,03$.
Only 19 per cent of the soccer players exhibited functional muscle shortenings on the lower limbs during the control examination. Here, too, the result is highly significant from the statistical point of view. $P < 0,03$. Assuming that the doctrines of osteopathic schools (see above), the idea models of the teachers and lecturers of those schools (see above) and the recommended specialist literature (see above) are right, the confirmation of the hypothesis is of outstanding relevance. Thus, the dysfunctions and functional muscle shortenings which are caused by one-sided sportive strain are remarkably important for primary and secondary prevention with respect to mobility (arthrogenic, myogenic, visceral, craniosacral, Midline-relevant). Furthermore, this means that in all probability every kind of sports has its typical pattern of dysfunctions with the relevant functional muscle shortenings. Accordingly, every kind of sport should be investigated for its typical dysfunctions and functional muscle shortenings. Then, an exercise programme should be undertaken which is specifically tailored to the osteopathic biomechanical demands in the sense of primary and secondary prevention.

In spite of the research question confirmed and the hypothesis proven, it is here that I would like to comment once more on the weak points of my master thesis.

A group of test persons comprising 33 athletes is a rather small group. Both the admission and control examinations were conducted by the same examiner. The soccer players were not divided in two groups (verum and falsum). The testing methods and its procedures and interpretation solely depend on one examiner. Therefore, the testing methods themselves are of limited reliability and validity only.
In particular, the interpretation with respect to osteopathic relevance reflects the doctrines of well-known schools (see above), their teachers and lecturers (see above) and internationally recognised literature (see above). Searching for various kinds of scientific literature (both in the osteopathic field and in conventional medicine) by entering terms like "sport specific dysfunction", "sport specific patterns of dysfunctions", and "sport specific pattern of muscle shortening" and on the Internet (see chapter Introduction), I was not successful nor could I find entries in special literature and in the books recommended by the Vienna School of Osteopathy and the Philadelphia College of Osteopathic Medicine, USA.

However, the result is clear without ambiguity and highly significant from the statistical point of view.

PERSPECTIVES

It was a courageous decision to choose a completely new subject for my master thesis, as up to this point there had been no scientific works or findings available on this subject in specialised literature – neither in osteopathy nor in school medicine. The only driving force for the definition of the research question and the verification of the hypothesis was my 15-year experience in the field of school medicine and osteopathy.

Though the osteopathic relevance reflects the school of thought of recognised osteopathic schools (see chapter Introduction), their teachers and lecturers (see chapter Introduction) and specialised international literature (see chapter Introduction), my master thesis basically deals with 'just' explanatory models. The reliability and validity of the clinical tests referred to in chapter Basics, is also rather restricted.

This is exactly the problem that osteopathy as a whole is confronted with (Barral 2005). Even more, my master thesis is a typical mirror image of osteopathy, and yet, the research question was justified and the result of the hypothesis is highly significant from the statistical point of view.

Therefore, I would like to express my wish that other colleagues from the field of osteopathy attend to the same research question and the same hypothesis, considering the same or another kind of sport with a larger number of participants divided up in a verum and falsum group, involving different examiners, and carried out in the form of a blind study.

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