Effects of Osteopathic work to Mother and Child regarding Foetal heart rate, Uterine contractions, Lumbosacral mobility, and objective Parameters of Delivery

Master Thesis zur Erlangung des Grades

Master of Science in Osteopathie

an der **Donau Universität Krems**

niedergelegt

an der **Wiener Schule für Osteopathie**

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Wien, Dezember 2006

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ACKNOWLEDGMENTS TO

Prim. Univ.-Doz. Dr. Günter Tews, head of the department for gynaecology of the Landes-Frauen und Kinderklinik Linz, who made it possible to do the study at the Landesfrauenklinik Linz.

Dipl. Hebamme Mrs. Marianne Weinberger, midwife at the Landes-Frauen und Kinderklinik Linz, who supported me in the practical work at the 'Schwangeren Ambulanz' and who helped me to get all the information from the medical records of the women.

Mrs. Barbara Walchshofer and Mrs. Birgit Breitschopf, midwife and student of midwifery at the Landes-Frauen und Kinderklinik Linz, who helped me with all the measurements in the ambulance room of the clinic.

Mrs. Christina Stephan, 2nd year student of osteopathy, who helped me with translation.

Mrs. Mag[a] Kathie Musil, who helped me with her focused advices to stay on track with the study.

Terence Dowling, M.A. PhB. B.A. for supporting me, and for answering a lot of questions.

Dr. Herwig Hampel, my husband, who never got tired to motivate me, and who helped me with the statistics.

I thank you all sincerely!

ABSTRACT

The purpose of this study was to find out if there is a measurable effect in pregnant women during and after Osteopathic Manipulative Treatment. 60 late pregnant women were included in the study. In addition to the routine check of late pregnant women (from their 36th week of pregnancy on) the mobility of the Michaelis rhombus (Diamond Test) was examined and a CTG was recorded. Under the CTG Control 30 women were treated with Myofascial Release Techniques in the lumbosacral area. The other 30 women only had their routine CTG control, without a treatment. (They were the control group.) The CTG´s of both groups were analyzed, and the lumbosacral mobility (Michaelis rhombus) was measured again.

As birth parameters the duration of pregnancy, duration of stage 1 and 2 of delivery, any additional help (caesarean section, vacuum extraction), the pH of the umbilical blood and the APGAR-Score of the newborn child were noted and compared.

One important finding was that the mobility in the lumbosacral area of the treated women increased significantly compared to the control group. The second outstanding result was that the basal frequency of the fetal heart decreased significantly but stayed in normal limits in the treated group while applying the Myofascial Release Technique. This might show a relaxing effect of this technique to the unborn child.

No significant differences in the birth parameters were noted.

Based on the data of this study, Myofascial Release Technique in late pregnant women had a positive effect to the mother and the unborn child, but did not create any negative side effects to the pregnant women nor to the baby nor to birth.

1. Preface

“Der Friede der Welt beginnt im Mutterleib“
“The peace of the world starts in the mother’s womb” – I once read this statement in a folder of two midwives (the author is unknown). It immediately touched my heart. I could feel the power of these words. Knowing my own story very well, I began to understand what influenced the development of my character the most.

There has been lots of research work done to prove this sentence in all its consequences. For example it is proven that peaceful people grew up in harmony from their very beginning on, whereas people with thoughts of fight, murdering and anxiety must have had some kind of disharmony at some point in their childhood or even back at the time when they had developed from egg and sperm. (DOWLING, 2006; LEINWEBER, 2004)
Where these very first stages of life peaceful? Where they desired and expected for a long time, or did they “happen” by accident? Thus was the mother’s whole body and mind already fighting their existence? Or did their parents even wish that the baby would not make it, or even think about abortion? (JANUS, 1989)
It is a fact that the whole pregnancy itself is a very important time for each human being because it builds the ground on which the character starts to grow. (DOWLING, 1987)
Starting at the time of fertilization the baby gets all impressions from the mother (her thoughts, her sorrows, her fears, her happiness…) through hormonal transmitters which can have a positive or negative effect to the foetus. With the sum of this information the new human being creates its own new world. (DOWLING, 1989)
Beside this also the surrounding of a pregnant woman is very important: Can she feel save and protected? Does a loving man stand beside her? Is there a family who will care for her? Does she have enough to eat? Does she have to work very hard to survive? Does she live in times of war? Do other circumstances threaten her live? Does she live in harmony or stress? Does the pregnant woman drink alcohol, smoke, or use other kinds of drugs? (KONCHAK, 2001)
And finally: Is birth a wonderful experience for both, mother and child, or is it a big trauma for each of them? (LEBOYER, 1981; DAHLKE et al. 2001; CARREIRO, 2004)

All these impressions build the ground for the character of the baby. (DARSHAN SINGH, 1991)
This list can be continued even for the time after birth by taking a close look at the (loving?) care of the baby: Is the baby being breastfed? Does the mother always stay with the baby or a care giver? Or is the baby being left alone for longer periods of time? Does the baby get plenty of body contact? (ODENT, 2000) and so on…
Should we be critical to the new modern trend of "protecting mother and child" by doing a planned caesarean section? (RAMALIGNAM et al., 2005; KING, 2003)

You see, there is a lot to discuss, but these questions are very important to ask in the work with every pregnant woman who consults us. And I think our concern should be how to support every single women and baby at the best.
So, my question was and is: What can I do for a pregnant woman as an osteopath?
I was lucky to have some good teachers throughout my education who taught me a lot of knowledge and hand skills in this field, but my open eyes and ears are also a very important tool in the work with pregnant women.
As an osteopath I can help the women to relax, and I can help them to feel more comfortable in their very own special situation. Relaxation is a very important word in pregnancy. Too much tension of the mother, especially in the uterus, can lead to stress for the baby. MEERT (2006) writes that stress for the baby can be shown in a high heart rate. LEINWEBER (2004) did a big study on this issue, where she found out, that a high heart rate of the baby has some important effects in children at the age of 3 month. So she could prove that children with a higher heart rate in the 31st and in the 37th week of pregnancy are more likely to have a difficult temperament and to cry more and sleep less than a baby in average. To release stress to the mother and the unborn child is one of the aims in my work with pregnant women.

In this study, I have chosen Myofascial release techniques for the work with the women, because these techniques are a very mild, non-invasive way to relax all kinds of strain patterns.
The very intense work on this paper with the issue of pregnancy was a very interesting challenge for me, and I hope that this paper might help some more students to think scientifically about osteopathy during pregnancy.

2. Introduction

In my daily work as an osteopath, I recognize an increasing demand for osteopathic manipulative treatment during pregnancy. In my experience mother and child respond very positively to osteopathic manipulative treatment. This experience and many discussions with colleagues and physicians lead to the idea to do a study on this issue. On the one hand there are very view studies about osteopathy in pregnancy and if there is any effect of osteopathy to the pregnant women and the baby at all. On the other hand there are some concerns about possible side effects of some osteopathic techniques at this very vulnerable time of mother and child.

In this study I used one osteopathic approach (Myofascial Release) in late pregnant women. Through objective measurements I tried to observe any positive or negative effects to mother and child. A cardiotocogram was running during the treatment to show possible short term effects

In addition I noted objective birth-parameters like duration, indication of caesarean section, pH of the umbilical cord blood, and time of birth to examine any long term effects.

I also looked at the lumbosacral mobility, especially to the distance from L5 to S5 through the diamond test (measures the mobility of the Michaelis rhombus) before, and after doing the osteopathic manipulative treatment. I also looked at the correlation between this mobility and duration of birth. A theory of MOLINARI (2005) says that the mobility in the lumbosacral area is important in the first stage of delivery, when the head of the baby needs to pass the pelvic inlet.

In the beginning of the paper (Chapter 3) I give a brief overview about the anatomy and physiology of the uterus. Then I describe the physiology of uterine contraction and the birth.

Chapter 4 describes the changes in the maternal organism during pregnancy and possible problems and complaints that might be a reason for women to consult an osteopath.

Chapter 5 contains the osteopathic approach to pregnancy and birth. I try to explain the role of the different structures in connection with the whole body and their meaning for pregnancy and birth.

Chapter 6 lists osteopathic manipulative treatment for pregnant women found in literature and in connection with the facts described in Chapter 5.

Chapter 7 describes the structure of the study and the methods used.
The results of the study, described in Chapter 8, are discussed in Chapter 9.
Chapter 10 is a short summary of the results and the discussion.
At the end of the paper there is the handout for the pregnant women taking part in the study and the form for commitment to take part in the study.

3. General overview of anatomy and physiology

3.1 Anatomy with focus on osteopathic relevant structures

3.1.1 Anatomy of the uterus

The uterus consists of smooth muscle. The arrangement of the fibers are in different layers, with an inner longitudinal layer, fibers running in all directions in the middle and circular and longitudinal bundles in the outer layer (STEER,1998). The inner surface is covered by endothelium, the outer surface is covered with a layer of serosa (perimetrium).

The biggest part of the uterus is the corpus, distally to the vagina is the cervix. We can describe the fundus uteri, facies intestinalis, facies vesicalis, margo uteri dexter and sinister (FENEIS, 1993).

Fig 3.1 (STEER, 1998, p 309)

Ventral to the uterus is the urinary bladder. The peritoneal excavation between the urinary bladder and the uterus is called excavatio vesicouterina (SOBOTTA, 2000)

During the last third of the pregnancy the anatomy of the uterus is mainly dominated by the increase of the size of the uterus (SOBOTTA, 2000) and by displacing other organs. Until the 9th month of pregnancy the cranial extension of the uterus is increasing as far up as to the caudal rim of the last rib, while in the 10th month the fundus is found at the same height as in the 8th month (SOBOTTA, 2000).

During pregnancy the wall of the uterus increases by hypertrophy of the myocytes (WILLIAMS, 1995). Due to the expansion of the foetus, the wall becomes progressively thin.

In 90% of the women, the uterus is in anteflexion, meaning that the fundus is pointing ventrally and the cranial end of the cervix more caudally. In 10% of the women the uterus is in retroflexion (BALTZER and MICKAN, 2002)

3.1.2 Nerval innervation of the uterus

The nerval innervation of the uterus is coming from the ovarian and hypogastric plexus (WILLIAMS, 1995). The sympathetic fibers origin from T12 and L1. The Parasympathetic innervation comes from S2-S4.

3.1.3 Blood supply of the uterus

The A. overica dext. and sin. are direct branches of the Aorta. They run in the Lig. suspensiorium ovarii and continue in the Lig. latum uteri on the left and right side of the uterus.

The A. uterine comes from the A. iliaca interna. It is the main artery for the blood supply of the uterus. The left and the right A. uterina have anastomoses with each other as well as with the ovarican and vaginal arteries.

The venous systems is constructed in the same way as the system of the arteries (WILLIAMS, 1995).

3.1.4 Ligaments of the uterus

The anterior ligament is the uterovesical fold. The posterior ligament is the rectovaginal fold (WILLIAMS, 1995). They consist of a layer of peritoneum that covers the anterior and posterior surface of the uterus and the dorsal aspect of the bladder (uterovesical fold) and the ventral aspect of the rectum (rectovaginal fold). Lateral is the fold build by a double layer of peritoneum that reaches from the lateral side of the cervix to the posterior pelvic wall. They form the uterosacral lilgament.

The mesometrium is a part of the broad ligament and runs from the lateral side of the uterus to the lateral side of the pelvis. Within this double layer of peritoneum runs the uterine artery and its branches (WILLIAMS, 1995). The uterine round ligaments run diagonally and down in the mesometrium to the pelvic floor. (WILLIAMS, 1995)

The round ligament has an influence on the position of the uterus. As the uterus gets taller in pregnancy or through hyperplasia because of a tumor, the length of this symmetric ligament changes. Thus it can lead to pain in the inguinal area. (BALTZER and MICKAN, 2002)

3.2 Physiology of the pregnant uterus

During pregnancy the uterus develops to an organ that protects, feeds and gives birth to the baby. Compared to the non-pregnant uterus, the muscle mass of the uterus increases mainly by growing of the cells (hypertrophy) (WILLIAMS, 1995), and only very few by multiplying the number of cells (hyperplasia). Muscle fibers become more compliant and uncoil there spiraling bundles (STEER, 1998). The muscles develop the ability not to contract in early pregnancy, but to be able to produce very intense contraction for the birth. The question is, how does the uterus know not to contract in early pregnancy but to produce labor contractions at the end of pregnancy?

The uterus contains smooth muscles that have the ability for spontaneous contractions (STEER, 1998; SILBERNAGEL and DESPOPOULOS, 1991). The contraction itself is the reaction of actin and myosin like in all other muscles. For the contraction essential factors are the presence of ATP and Ca^{2+} in the cell. During the time with no contraction, there exists a resting membrane potential. This is provided by higher sodium and calcium concentrations outside the cell and higher potassium concentration in the cell. During an action potential sodium and calcium gets in the cell. Repolarization happens by the efflux of potassium and calcium to the outside.

Until the end of pregnancy the resting membrane potential of the myometrium falls. Thus a contraction can happen more easily (STEER, 1998). A very high and a very low concentration of calcium in the serum can inhibit a sufficient contraction (STEER, 1998). The optimal extra cellular concentration of calcium is 2.5 mmol/l (STEER, 1998).

Second messengers also play an important part in controlling the contraction of myometrium cells. Second messengers have the ability to bind to specific receptors on the outside of the cell membrane and cause (or inhibit) an action in the cytoplasm.

For effective coordination of contraction, the cells are linked with gap junctions. They can be understood as tunnels between two cells, connecting the cytoplasm. They allow an easy propagation of electrical activity. They can be found at the end of pregnancy. The building is inhibited by progesterone and enhanced by estrogen and prostaglandins (STEER, 1998). This makes sense, as the concentration of progesterone falls and the concentration of estrogen increases during progress of pregnancy (STEER, 1998)

Table 3.1: The factors with influence on myometrial contractility during pregnancy in the human. All of these hormones act through second messengers which after the ion balance across the membrane and hence it's resting potential (STEER, 1998)

negative (relaxation of myometrium)	positive (produce contraction)	variable
- Progesterone - Relaxin - ß2-adrenergic stimulants - Nitric oxide - Adrenalin	- Estrogen - Oxytocin - PGF2-alpha - Endothelin - Noradrenalin	- PGE - Relaxin/PG interaction - Corticotrophin releasing hormone (CRH) - Catecholamine

3.3 Regulation of the fetal heart frequency

The fetal heart frequency is regulated by the sympathicus and parasympathicus. The sympathicus is increasing the frequency be the effect or adrenalin in the blood. The parasympathicus is acting via the Vagus nerve, causing a slower heart rate (GOESCHEN, 1997).

In the fetal circulation increased pressure to the head, compression of the umbilical cord and decreased perfusion of the placenta can cause significant alteration of the heart rate. (GOESCHEN, 1997)

As in the adult person, the frequency of the heart of the unborn child depends on many parameters detected by baro- and chemoreceptors that detect the blood pressure and content of the blood. The fetal heart frequency can be influenced by different components:

Maternal:

Body position

Physical activity

Fever

Activity of the uterus

Situation of the circulation

Fetoplazentar

- Insufficiency of the placenta
- Compression of the umbilical cord
- Chorioamnionitis
- Age of the foetus

Fetal

- Movement
- Behavior
- Attempts of waking up the baby
- Disease of the fetal conduction system in the heart

Exogen

- Medication
- Drugs (abuse, smoking)

(GOESCHEN, 1997; PARER, 1994; SCHNEIDER et al., 2004)

The main goal for the fetal circulation is to provide enough oxygen for the fetal body. Changes in the normal cardiotocogram are mainly seen by changes in the fetal oxygen support.

3.3 Uterine activity during pregnancy

As already mentioned, the smooth muscle cells of the uterus have spontaneous activity. As early as 7 weeks, there can be detected some uterine activity (STEER, 1998). The contractions are of very high frequency but low intensity: about 2 contractions per minute. With the progress of pregnancy these activity becomes more coordinated by building gap junctions. The last 6-8 weeks of pregnancy the contraction are of lower frequency but higher intensity.

As long as the cervix is not dilated, the contraction may not be felt painful for the mother (STEER, 1998).

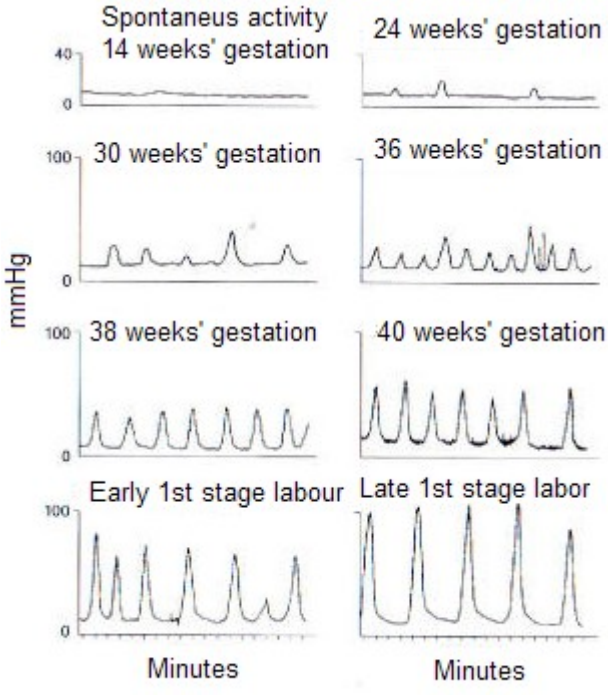

Fig. 3.2 spontaneous activity of the uterus during pregnancy and birth
(STEER, 1998, p 323)

3.4 Birth

The birth can be divided in 3 stages:
In the first stage labor contractions dilate the cervix, in the second stage the baby is pressed through the cervix and delivered. The third and last stage is the postpartal period when the placenta is delivered.

3.4.1 First stage

In the weeks before this first stage, coordinated uterine contractions occur. The tissue of the cervix becomes softer. With the start of coordinated contractions, the first stage begins. It ends, when the diameter of the cervix has reached 10 cm (LEE, 2000; FOURNIER, 1992) The duration of the first stage in women that have not had a birth before, lasts 8 hours in average, in women who have had a birth before, 3 hours in average (LEE, 2000). Duration longer than 18 hours is considered as abnormal (LEE, 2000).

Begin of the birth is the start of the labor to dilate the cervix. The contractions of the uterus are coordinated and produce a force against the cervix. Mostly the upper part of the uterus (fundus) takes part in the contractions while the lower part of the uterus and the cervix become a tunnel for the baby. With progress of birth, the fundus does not relax to its original length, decreasing the volume of the uterine cavity. (LEE, 2000)
The labor contractions are felt painful for the women. The cause of the pain is not clear. Hypoxia of the myometrium, pressure against the cervix or dilation of the peritoneum covering the fundus uteri are discussed (LEE, 2000). LEE (2000) also mentions, the psychological stress, such as fear and anxiety, can increase the pain.

3.4.2 Second stage

The start of the second stage is at the end of the first stage, when the cervix is fully dilated. The time between uterine contractions is 2 to 5 minutes. The normal time frame for this stage is about 30 minutes in women who give birth the first time and 20 minutes in women who have had a birth before. (FOURNIER, 1992)
Usually the fetal membranes rupture at this point of birth providing the baby to go a step deeper. Now the baby presses against the cervix, reflectively causing intense uterine contractions (FOURNIER, 1992). In this stage of birth the pressure in the abdomen is also increased by contractions of the abdominal wall muscles and the diaphragm (closed glottis of the mother). This stage ends, when the baby has passed the birth canal and is born.

Due to the very strong contractions, the blood flow through the uterus can be reduced as the vessels are compressed. Therefore, if this period lasts very long, there can be a problem with the oxygen supply for the baby. This might be seen in the CTG as decelerations.

3.4.3 Third stage

After the baby is born, the volume of the uterus is reduced. As soon as the uterus has adapted to the smaller volume, contractions start to remove the placenta. The placenta should be delivered within 30 min. (LEE, 2000).
The normal blood loss is about 300 ml (FOURNIER, 1992).

4. Changes of the maternal organism during pregnancy

Pregnancy causes some major changes in the female body. Despite of many of these changes occur in most women and are physiologic, they can be differently bothering for the becoming mother. Frequently some of the complaints caused by the physiologic changes make the women ask for professional help.

4.1 Abdomen

With progress of pregnancy the volume of the abdomen increases, the midline becomes pigmented und striae may develop. (FOURNIER, 1992) The increase of the volume of the uterus is a main cause of some changes and complaints of pregnant women.

4.2 Cardiovascular system

The heart becomes hypertrophic and changes the position, the heart rate is increased and the heart minute volume is increased. For the perfusion the intravenous pressure in the lower extremities is increased. Thus varicosis it is more likely to develop.
MOORE (1991) describes reversible ECG-changes due to the change in position of the heart.

The volume of the circulating blood is increased up to 7 liters. The components of the blood change: Leucocytosis (up to 15.000/µl), increase of plasma (Hydremia), decrease of the relative protein (albumin). This leads to a decreased oncotic pressure. Anemia in the last third of pregnancy is often found relative to an relative increased Plasma volume. (FOURNIER, 1992) The amount of red blood cells increases 25%, but the plasma volume increases for 35% (MARTIUS, 1980).
Frequently a low level of Magnesium is observed. This can cause muscular cramps. (FOURNIER, 1992)

4.3 Liver

Due to the increased metabolism the workload of the liver increases during pregnancy. But there are hardly signs of insufficiency. (FOURNIER, 1992)

4.4 Gastrointestinal tract

Do to the increased volume of the uterus, there are frequently malfunctions as secondary esophagitis, decreased peristalticactivity and constipations. (FOURNIER, 1992). According to MARTIUS (1980) 50% of the women have complaints of reflux esophagitis.

For LEE (2000) the decreased tonus of the smooth muscles during pregnancy is a major component of the gastrointestinal complaints as esophageal reflux or constipation.

MARTIUS (1980) mentions an increased vulnerability of the gingival tissue during pregnancy.

4.5 Urinary tract

During pregnancy, Glukosuria, increased excretion of Creatinin and BUN and decreased excretions of uric acid are frequent findings. (FOURNIER, 1992; MARTIUS, 1980)

The renal pelvis and ureters are dilated. (LEE, 2000) This might lead to an increased risk of urinary tract infections due to ascending bacteria. (FOURNIER, 1992; LEE, 2000)

4.6 Respiratory tract

Observed changes are decreased function of the whole system and increased ventilation (FOURNIER, 1992), 60-70% of pregnant women have dyspnea at some time during pregnancy. According to MARTIUS (1980) 30% of the women complain about dyspnea before the uterus extends and interferes with the diaphragm. Predisposing factors are the decreased pCO_2-level, hyperventilation and increased circulating blood colume (LEE, 2000; FOURNIER, 1992).

LEE (2000) describes a swelling of the mucosa of the nasal cavity due to mucous gland hypertrophy and vasodilation. This can lead to nasal stuffiness, altered voice or cough.

4.7 Metabolism

There are some remarkable changes in metabolism:

- Increased basic turnover
- Increased lipids in the blood (25-50% more)
- Increased retention of sodium
- Increased need of iron
- Increased production and excretion of steroids
- Increased production and excretion of aldosteron
- Hyperplasia of the thyroid gland.

(FOURNIER, 1992)

4.8 Musculoskelatal system

The changes are not only limited to the pelvic area, but also to all ligamentous structures in the body. With the increase of the body weight, this may lead to back pain, fast fatigability, cervicosyndrom-like complaints and loosening of the pelvic girdle. (FOURNIER, 1992)

4.9 Skin

There are three frequently observed changes during pregnancy: increased hyperpigmentation, teleangiectasia and striae gravidatarum (FOURNIER, 1992, LEE, 2000).

The hyperpigmentation is due to the melanocyte-stimulating hormones estrogen and progestreron. The hyperpigmentation is seen on areas where pigmentation already exists e.g. nevi or nipples. But it is also seen around the umbilicus and at the linea alba, that becomes the linea nigra (LEE, 2000).

Teleangiectasia is part of the genareal vasodilatation and appears in the skin as erythema or dark lines in the skin (“spiders”).

Striae gravidarum appear as pin striae on the breasts, anterior the axillary fold or the lower abdomen. As they appear early in pregnancy, before there is much tension to the skin and they look similar to the changes seen in cushings syndrome, it is more likely a hormonal cause than a mechanical issue. (LEE, 2000)

4.10 Water, Body weight

Besides retention of electrolytes as potassium and sodium, water is stored in the tissue. This can be as much as 10-15 liters accompanying with an additional increase of body weight (FOURNIER, 1992). The body weight also increases, by increased food intake (LEE, 2000). A weight gain of 12 to 14 kg is recommended.

4.11 Possible complaints of pregnant women

LEE (2000) divides the symptoms produced by normal physiologic changes in pregnancy in 3 groups:

- Complaints beginning early in pregnancy and persisting until delivery
- Complaints usually confined to the first half of pregnancy
- Complaints beginning in mid-pregnancy and increasing or persisting until delivery

4.11.1 Complaints beginning early in pregnancy and persisting until delivery

LEE (2000) lists complaints of women mentioned in the beginning of pregnancy that were collected in surveys:

Table 4.1: Complaints beginning early in gestation

- Sensory dysphoria (changes in taste an smell)
- Nausea and vomiting
- Concern about weight
- Ptyalism
- Nasal stuffiness
- Oesophageal reflux
- Change in voice
- Dyspnoea and hyperventilation symptoms
- Skin changes (teleangiectasia, increased pigmentation)
- Fatigability

These complaints are not pathologic because they are caused by the physiologic situation “pregnancy”. But they can be very bothering for the women that might cause her to look for help.

The complaint about the weight can be that the weight increase is too much. But there are also concerns, that the weight gain is too low.
The changes in gastrointestinal motility and secretion can lead to the complaints of esophagal reflux (in combination with the increased intraabdominal volume in later pregnancy) and constipation.
Other complaints include the symptoms caused by changes in mucosa of the nose and oropharynx, Dyspnoea and changes in skin (see chapter 4.6).

SANDLER (2003) describes a similar list of complaints of pregnant women that might be a reason for her to ask an osteopath for help:

- Nausea-vomiting
- Constipation
- Vaginal discharge
- Collapse
- Pain in the back and low back
- Pain of the sciatic nerve
- Haemorrhoids
- Varicose
- Itchy skin
- Oesophageal reflux
- Irritation of nerves
- Oedema
- Carpal tunnel syndrome
- Cramps in the calfs (legs)

4.11.2 Complaints usually confined to the first half of Pregnancy

The complaints observed only in the first half of pregnancy (LEE, 2000) are changes in the taste and smell and nausea and vomiting (“morning sickness”).
The definitive cause is not clear yet, but there seems to be a correlation between the degree of morning sickness and the level of hCG and thyroxine. (LEE, 2000)

4.11.3 Complaints beginning in midpregnancy and increasing or persisting until Delivery

Theses complaints are, according to LEE (2000):

- Constipation and Haemorrhoids
- Backache
- Pelvic, Pubic symphysis and Sacroiliac pain
- Carpal tunnel syndrome
- Abnormal wall syndrome
- Varicose veins
- Dependent oedema
- Muscle cramps
- Flank pain secondary to dilation and distension of urinary tract

5. The osteopathic approach to pregnancy and birth

5.1 The origin of osteopathy

Andrew Taylor Still (1828 – 1917) was the founder of osteopathy. His father was a doctor and Methodist Preacher who moved with the American frontier, which meant that Still grew up in Virginia, Tennessee, Missouri and Kansas. After studying medicine with his father, Still began his own practice in 1845. He and his family were firm abolitionists and he served briefly in the Civil War. After three members of his family died from spinal meningitis in 1864, he became disillusioned with conventional medicine and started his search for a better way to practice. He discovered the principles of osteopathy in 1874. Shortly afterwards he settled in Kirksville, Missouri where he lived for the rest of his life. It was there, in 1892, that he established the first osteopathic school, the American School of Osteopathy. (STILL, 1992)

5.2 The writings of A.T. Still

"The god of nature is the fountain of skill and wisdom and the mechanical work done in all natural bodies is the result of absolute knowledge. Man cannot add anything to this perfect work nor improve the functioning of the normal body. Disease is an effect only, and a positive proof that a belt is off, a journal bent, or a cog broken of caught. Man's power to cure is good as far as he has a knowledge of the right or normal position, and so far as he has the skill to adjust the bones, muscles and ligaments and give freedom to nerves, blood, secretions and excretions, and no farther. We credit God with wisdom and skill to perform perfect work on the house of life in which man lives. It is only justice that God should receive this credit and we are ready to adjust the parts and trust the results." STILL (1992, p xxiii)

This passage written by A.T. Still is very important to me, because it describes his way of thinking about health and disease. His very strict negation to all kinds of supplementary medicine like pills and drugs besides the work with his hands were one of his most outstanding ideas. His approach to all kinds of diseases was always only with his hands.
To use the hands in the right way, and to find the right indication for doing so, he always preached about the importance of perfect knowledge of anatomy. To make his mental attitude

clearer I gave this one example of Still's own writings in his last book "Research and Practice".

5.3 Definition of Osteopathy (during pregnancy)

Almost one hundred years later Penelope L. Conway described Osteopathy mainly as a holistic treatment. She points out the importance of the connection of all parts within the whole body. And she also writes about the importance of adjusting the tissues to their physiological function. I think she found very easy and understandable words to explain the idea of Osteopathy, and what an Osteopath can do during Pregnancy:

"Osteopathy is concerned with restoring and maintaining balance in the neuro-musculoskeletal systems of the body. This fine balance may have been disturbed by alterations in soft tissues through misuse, or change of use, through trauma to bones or joints, or by modification to the innervation of any of these structures. Therefore it is necessary to look at the patient as a whole, not just the area causing symptoms, and the effects they have on each other, can be included in the diagnostic process. Osteopathy is concerned with the biomechanics of the body and the maintenance of appropriate mechanical function.

The osteopath aims to preserve the balance between muscles, joints, ligamental structures and nerves which allow the body to function effectively.

During pregnancy this balance is constantly under attack from alterations in weight and weight bearing, hormonal changes and fluctuations in fluid balance. In addition there are the 'normal' influences of injury, overuse and physical or mental stress.

The osteopath will attempt to minimise the impact of all these changes by a carefully considered treatment plan formulated for that particular woman.

Osteopaths treat people, not conditions." CONWAY (2000, p 39)

5.4 Anatomy and physiology from an osteopathic point of view

According to the rules of STILL (1992), the free mobility of all organs, bones, and ligaments is very important to an osteopath.
Renzo Molinari, head of the European School of Osteopathy in Maidstone describes different aspects in pregnancy and the consequences for an osteopath. MOLINARI (2005)

5.4.1 Uterus and kidneys

From the beginning of pregnancy on the uterus starts to grow. The normal mobile kidneys, move cranial and caudal along the ventral aspect of the Musculus psoas. If one of the kidneys is fixed it cannot move cranial and if the uterus grows and moves upward, the uterus can only rotate and flex to the other side (the side of the mobile kidney). This for example causes an asymmetric situation. (MOLINARI, 2005)

5.4.2 Ligamentum latum and the ovaries

The Ligamentum latum is a peritoneal fold and runs from the lateral wall of the uterus to the lateral wall of the pelvis, and is covered by the peritoneum. Within the cranial part there runs the fallopian tube, and on the dorsal side, there stays the ovary in another fold of peritoneum. The ovarican artery and vein also run within the Ligamentum latum.
The tissue of this ligament is folded like an accordion, and should unfold in pregnancy.
At about the 14th to the 15th week of pregnancy the uterus grows to a size where these ligaments have to unfold because the uterus is pulling upward (due to the baby's growing). If the ligament does not unfold on one side, it will stay shorter than the other side. Because of this shortening of this ligament the uterus will turn and side bend towards the short side. The further growing of the uterus will not be symmetric anymore. The women can feel this pulling as a slight pain in the inguinal region.
The uterus will even develop neural reflexes from around the 25th week on and it could start to develop unphysiological contractions. The result could be that the baby cannot find an ideal position for birth. (MOLINARI, 2005)

5.4.3 Uterus and the Musculus Psoas Major

Another very important factor through the whole pregnancy is the Musculus psoas which acts as a railway for the baby and has a very strong influence in the positioning of the baby. The right tension in this muscle is necessary to help the baby turn when it is needed.

Starting at a certain size the baby cannot stay between the rails anymore. When the baby's weight reaches 2.5 kg it must turn its shoulders and slip in between the two psoas muscles. This is difficult for a small child since it can get stuck between the iliac bones. A taller child can push itself through with its shoulders and elbows. The resistance of the Musculus psoas is the fulcrum the baby needs. (MOLINARI, 2005)

5.4.4 Uterus and the Musculus Piriformis

A pregnant woman often shows a hyperlordosis on L5/S1. This can cause traction on the Musculus piriformis and the woman might tend to walk with an external rotation of the femur. Permanent traction may cause fibrosis of the Musculus piriformis . (MOLINARI, 2005)

The Musculus piriformis and the sacrouterine ligament have the same origin at the anterior surface of the sacrum (S2-S4). The insertion of the ligament is located at the cervix. The dysfunction of the Musculus piriformis lead to traction on the sacrouterine ligament. Therefore the cervix can be pulled posterior and cranial.

This might cause that the head of the unborn child may not push directly against the cervix during labor leading to insufficient opening of the cervix.

Because of this close relation of the sacrouterinum ligament and the piriformis muscle to each other an extension of the Musculus piriformis is indicated.

In addition to the sacrouterinum ligament also the latum ligament and the hypogastric plexus are responsible for the dilatation of the cervix during birth (MOLINARI, 2005).

5.4.5 The Pelvic Floor

During the second stage of birth the flexibility of the pelvic floor becomes very important.
The Musculus levator ani with its 3 different layers (Musculus sacrococcygeus, Musculus iliococcygeus, Musculus pubococcygeus) can be visualized as a system of steps where the baby's head has to move downward during labor. The need for the pelvic floor to expand to let the head pass trough, leads to a contraction of the muscle to push the baby further downward. When the head produces pressure to the first step of the Musculus levator ani, the Musculus sacrococcygeus, the muscle contracts and pushes the head back into the centre. Now the head can move on the next step, the Musculus iliococcygeus. This muscle will contract as well and again push the head back to the centre so it can move down to the last step, the Musculus pubococcygeus. (MOLINARI, 2005)

5.4.6 The Fascia Thoracolumbale

The fascia thoracolumbale reaches from the midthoracic spine to the Os coccygeum. The mobility of this fascia is very important during the first stage of birth when the sacrum needs to extend and the lumbar spine has to delordose. If the fascia is too short it will not allow free mobility to the bones to open and let the baby's head pass through. (MOLINARI, 2005)

5.4.7 The Ribcage, the Thorax and the Diaphragm

CONWAY (2000) describes a few changes that can happen during the first stage of pregnancy:

1. The increase of weight of the breasts can lead to flexion of the thoracic spine, to protraction and internal rotation of the shoulders as a protective mechanism in the women. This can result in muscle shortening and fatigue.
2. The nausea and vomiting which is often described in the first trimester can affect the ribs, the diaphragm and the thorax. Vomiting can be very exhausting for the woman.
3. During the last trimester of pregnancy as the uterus grows and pushes against the diaphragm, breathing can become more difficult which can lead to a higher tonus in the diaphragm.
4. The oesophageal opening can be constricted if the diaphragm gets very tense thus a swallowing disorder can occur as well as reflux. (CONWAY, 2000)

5.4.8 Mobility of the Uterus

According to BARRAL (2002), the uterus is a very mobile organ, which mainly moves in the sagital plane of motion. The position can change very easily according to the organs around.

- The full bladder pushes the uterus posterior.
- The full colon and rectum push the uterus anterior.
- If bladder and rectum are full, the uterus moves superior.
- Gravitation pulls the uterus inferior.
- In case of fibroses of the ligaments around, the uterus can be pulled to the side of fibrosis.

MEERT (2006) describes the importance of the free gliding of the uterus itself. The uterus should be able to glide against the organs and tissues around.

Besides this, the uterus itself should have the right tension. If the uterus is too tense it can lead to a stress syndrome for the baby which can result in developmental problems of the bony and cartilage skeleton.

If the baby is not in the right position and doesn't turn, the tension of the uterus should be checked. If the tension is too high it can keep the baby in a position where it has difficulties to turn again (for example being stuck in breech presentation).

5.4.9 Mobility of the Pelvis

Especially during birth the whole range of mobility of the pelvis is needed to provide as much space as possible for the baby. MOLINARI (2005) describes the biomechanical function of the pelvis during the first two stages of birth.

During the first stage the baby has to enter the pelvis, therefore the upper part of the pelvis has to open:

- The sacrum has to be able to make an extension (conternutation)
- The ilea need to make an outflair
- The lumbar spine has to delordose
- The upper part of the pubis has to open.

During the second stage of birth the reverse mobility is needed because the lower part of the pelvis has to open:

- The sacrum now needs to go into flexion (nutation)
- The ilea show an inflair which results in an opening of the pelvic outlet (Ossa ischii)
- The lower part of the pubis has to open and the Os coccygeum has to open for extension.

For a physiological delivery of the foetus the normal mobility of the pelvis, the uterus and all other organs in the body is necessary.

5.4.10 Mobility testing of the Pelvis with the Michaelis Rhombus (the Diamond Test)

GOERKE, STELLER, VALET (2000) recommend to have a look at the Michaelis rhombus, to get an idea of the shape of the pelvis.
MOLINARI (2005) uses the parameters of the Michaelis rhombus as a good examination of the woman's whole pelvis and hips. He describes a special test (the diamond test) which to him is a good indicator for delivery of the baby and in his opinion the more mobility a woman shows in this test, the better it will be for her first and second stage of birth.

Performance of the test according to MOLINARI (2005):

- Draw a rhombus with a skin friendly pen, on the sacrum of the women. The upper tip is on L5, the two lateral tips are on both Spina iliaca posterior superior (PSIS), and the lower tip is on the hiatus of the sacrum (S5). This should look like a diamond now.
- Draw a vertical line between the two PSIS and a horizontal line between L5 and the hiatus of the sacrum (S5).

The pregnant woman now should go into the squatting position; the heels must stay on the ground. The interesting point now is how this diamond did change. A balanced widening of all lines would be the ideal result.

The following findings can be observed:
The upper part of the diamond is too flat: L5 might be in extension.
The heel position cannot be performed: the thoraco-lumbal fascia pulls too strong.
The distance between L5 and PSIS does not widen in squatting: the Ligamenta iliolumbalia are too short.

The lower tip of the diamond gets too long: the sacrum is in conternutation.

The horizontal line becomes oblique: the sacrum is in torsion.

The lower tip of the rhombus deviates to one direction: there is some dysfunction in the hip.

The upper tip becomes very high: L5 might be hypermobile.

6. Osteopathic manipulative treatment

6.1 Osteopathic manipulative treatment for pregnant women described in literature

6.1.1 Still´s Aproach

Still wrote in his book ”Research and Practise” about “Development of the foetus”:
“Nature has placed all the functions of animal life under laws that are absolute and must be obeyed. Just as long as digestion and assimilation keep in harmony and the mother generates good blood in abundance, the child grows; and by nature the womb is prepared to carry the work of building the body of the child on to completition.“ (STILL, 1910, p.169)

Andrew Taylor Still, the founder of osteopathy taught only a few techniques. But the holistic approach was one of his most important issues in pregnant patients as well. His aim always was to get an idea of the supply in that special area that needed treatment. Therefore he always examined the nerve supply, the blood supply and the position of the organ or bone to be treated.

6.1.2 Myofasciale Release Technique for the lumbosacral area

KRASSER (2006) describes a technique for the lumbosacral area according to Tom SHAVER ´s (2003) Myofascial Release Techniques.
The idea of Myofascial release is to help the body release strain patterns by working on the pathophysiological barrier in all three planes of motion. Thereby it is important to feel a balanced tension in all these planes of motion and to let the body work through its inherent forces to release the strain pattern. A new balanced position is then found at the new pathophysiological barrier and the process is repeated until full motion is restored or the body does not respond with any more releases. (SHAVER, 2003)
There are two possibilities to work with Myofascial Release Techniques (MFR): either direct or indirect. I will describe both ways:

Starting position:

The woman lies on her side, the hips and the knees are flexed, to provide a comfortable position for the woman. The therapist sits behind her.

Positioning of the hands:

The cranial hand is placed on the occipital bone, and the caudal hand is placed on the sacrum.

Performance of the technique:

a) Direct:

To treat a dysfunction of the sacrum with direct MFR, the therapist has to find out if flexion or extension is the direction of restriction. With the hand on the sacrum maintaining at this position of restriction, try also all other planes of motion (rotation, side bending), to find out where the greatest restriction is located. Also add the components of compression or distraction to come to the point of maximum resistance. Maintain at this position until you feel the tissues softening or spreading. Repeat this release as often as needed to feel the freedom in the motion of tissues.

b) Indirect:

To treat a dysfunction of the sacrum with indirect MFR the therapist has to find out weather flexion or extension gives the direction of easiest movement. Then maintain at the position of ease and add the components of rotation and side bending at the sacrum as well as either traction or compression. Maintain this position at the indirect barrier until you feel movement further toward the position of ease, a softening or spreading of the tissues which indicates that a release has occurred. Repeat this release until you feel the freedom of motion in the tissues.

6.1.3 Frog–Technique (relaxation of Musculus illiopsoas and Thoracolumbar fascia)

The „Frog Technique“ leads to relaxation of the Musculus illiopsoas and to relaxation of the thoracolumbar fascia. (MOLINARI, 2005) But it also can be a good technique for vitalisation of the pelvis. (MOLINARI, 2005; SANDLER, 2003; MARCER, 2002) MOLINARI (2005) describes that an imbalance of the Musculus psoas often leads to an imbalance of the Uterus.

Description of the Frog Technique according to MOLINARI (2005):

Starting position:

The patient lays in supine position with knees in flexion and the soles of the feet touch each other (like a frog). Which leads to a flexed, external rotated and abducted position of the legs. The therapist stands on the side of the patient.

Positioning of the hands:

The therapist touches the diaphragm with his cranial hand. Working with pregnant women, the contact should be at the ribs - at the level of the Proc. xiphoideus. The caudal hand is positioned underneath the sacrum.

Performance of the technique:

As the patient takes a deep breath in she extends her legs slowly while the contact of her feet stays. At the same time the therapist gently pulls the sacrum caudal which leads to a delordosis (extension of the sacrum). Since the diaphragm moves cranial during exhalation, the therapist gives a slight pressure posterior and caudal to imply a stretch here as well.
This process can be repeated about 3 times.

6.1.4 Stretching of the lower part of the Musculus psoas major

REITER-HORNGACHER (2006) describes in her paper how to use Mitchell's "Muscle Energy Technique" to stretch the lower part of the Musculus psoas major. The right tonus in the Musculus psoas major is important for the optimal positioning of the baby. (MOLINARI, 2005)

Starting position:

The patient is in supine position and the leg to be treated is hanging over at the end of the table. The hip of the opposite leg is in flexion. The therapist stands at the foot of the table facing the patient.

Positioning of the hands:

While one hand is positioned on each knee the therapist also fixes the patients leg to be treated with his thigh slightly to the outside.

Performance of the technique:

By flexing the contra lateral leg until the other leg moves upward the therapist looks for a motor barrier. The patient pushes her leg toward the ceiling for 7-10 seconds. After a time of relaxation a further motor barrier is looked for by increasing the extension of the leg.

6.1.5 Stretching of the Musculus piriformis

According to MOLINARI (2005) it can be very useful at the first stage of birth (opening of the cervix) to stretch the Musculus piriformis. (Explained in chapter 5.4.4.)
WALLACE (2004) describes a soft tissue technique to stretch the Musculus piriformis:

Starting position:

The patient is in supine position, legs are in extension. The therapist stands on the opposite side of the leg to be treated.

Positioning of the hands:

Both hands are placed on the Trochanter major, the tips of the finger have good contact underneath, on the Musculus piriformis.

Performance of the technique:

During exhalation of the patient the therapist pulls the Trochanter major up. Through internal rotation of the thigh the Musculus piriformis is being stretched.

This technique can be repeated as often as necessary.

6.1.6 Technique for the relaxation of the Os sacrum and the Os coccygeum

MOLINARI (2005) describes this technique to release the tension in the lumbosacral area which gives the sacrum, the uterus and the Os coccygeum (needs extension during the second stage of birth) more space to move.

Technique for relaxation of the Os sacrum and the Os coccygeum according to MOLINARI (2005):

Starting position:

The patient is on all fours on the table.

Positioning of the hands:

The therapist stands beside her and takes a hold of a fold of skin at the level of the Os coccygeum. The other hand gives counter pressure at the level of the first and second lumbar vertebra.

Performance of the technique:

While the therapist holds this stretch, the patient lowers her body unto her forearms to increases the effect. Holding this position the patient slowly moves her bottom towards her heels.

To be repeated as often as necessary.

6.1.7 Compression of the 4th ventricel (CV4)

W.G.Sutherland developed the compression of the 4th ventricle technique (CV4) to influence all important centres in the brain and to receive a regulating effect to the whole craniosacral rhythm. (HARTMANN, 2004)

LIEM (2001) writes that this technique supports uterine contractions as well as the beginning of labor. Therefore it can be used to get labor started at the end of pregnancy.

Thus he sees it as a contraindication to perform the CV4 between the 7th month of pregnancy and the due date of the baby.

LIEM (2001) also shares the opinion of Dr. Viola Frymann that this technique only regulates labor. (LIEM, 2001) Thus it should not cause early contractions at any point during pregnancy.

Technique of the compression of the 4th ventricle according to LIEM (2001):

Starting position:

The patient is in supine position unless the pregnant woman has to lay on the side due to a Vena Cava Syndrome, the therapist sits at the head end of the table.

Positioning of the hands:

The therapist cups both hands into each other while the tips of the thumbs are touching and the thumbs form a V. The hands are positioned under the occiput, the tips of the thumbs point caudal while placed between the second and third cervical vertebra.

The positioning of the palms of the thumbs medial on the squama of the occiput is very important to avoid compression of the Sutura occipitomastoidea!

Performance of the technique:

During exhalation the therapist follows the movement of the occiput (getting narrow) with the palms of the thumbs, and during inhalation the therapist avoids the widening of the occiput.

During each following exhalation the therapist follows the narrowing of the occiput and avoids the widening during inhalation.

After a few breathing cycles the pressure of widening will decrease until a still point is reached with no further movement.

Stay in this position on the occiput for the duration of the still point. This can last a few second to a few minutes.
The signs for a successfully reached still point are the deepening of the patients breathing, relaxation of the muscles, slight sweating on the forehead, and general relaxation of the patient.
The end of the still point is reached when the therapist feels a strong pressure into the direction of inhalation again. The therapist follows this impulse passively and controls the quality of the primary respiratory rhythm.
This technique can be applied several times.

6.1.8 Cranio-Sacral relaxation

LOMBA (2005) describes technique of cranio-sacral relaxation for general release of tension in the lumbosacral area as well as for problems of the sacrum, the coccygeum and the sacroiliac joints:

Starting position:
The patient lays on her side, if necessary place a pillow between her knees. The hips and knees are positioned in about 50° flexion and the lumbar spine should be in a neutral position as well as the head (if necessary use a pillow). The therapist sits beside the patient.

Positioning of the hands:
The cranial hand has contact on the Os occipitale with the fingers pointing cranial while the caudal hand contacts the sacrum with the fingers pointing caudal.

Performance of the technique:
Mobilisation of the Os sacrum and the Os occipitale with both hands until an improvement of mobility is being felt.

6.1.9 Technique for mobilisation of the intercostal muscles and the diaphragm

CONWAY (2000) describes this technique for mobilisation of the intercostal muscles and the diaphragm in order to the need of free mobility in this special area, to guarantee good breathing function:

Starting position:

The woman lies on her side in a comfortable position.

Positioning of the hands:

The therapist fixes the upper arm of the patient with his arm and with the other hand he provides a good contact to the ribs.

Performance of the technique:

Soft stretching of the intercostals muscles by pulling the ribs inferior. Stretching of the diaphragm in the same position.

Repeat for every section of the ribcage.

6.1.10 Technique to enhance respiration, and release tension in the diaphragm

CONWAY (2000) describes a technique to enhance respiration and release tension in the diaphragm. She also writes, that the later stages of pregnancy, as the uterus rises and pushes against the diaphragm, breathing gets more difficult especially deep inhalation. The lower ribs cannot move sufficiently anymore thus upper rib breathing dominates. (CONWAY, 2000)

CONWAY (2000) also describes a connection between reflux, swallowing difficulties and the contracted diaphragm. Therefore she recommends this technique to release the tension in the lower ribs and the diaphragm:

Starting position:

The patient is sitting and places both arms on one shoulder of the therapist who stands in front of the patient.

Positioning of the hands:

The therapist provides a good contact to the lower ribs at the back of the patient.

Performance of the technique:

Gentle rib stretching into all directions at every level needed and direct stretching of the diaphragm in the thoracolumbal region as well as stretching the midthoracic spine in this position.

6.2 Contraindication of Osteopathic Techniques during pregnancy according to particular authors, recommendation of them from other authors

6.2.1 Techniques applied on the pelvic floor

BARRAL and MERCIER (2002) call general techniques for the pelvic floor during pregnancy an absolute contraindication. They warn that these techniques can cause miscarriage.

MOLINARI (2005) on the other side recommends applying techniques on the pelvic floor.

MOLINARI (2005) describes two techniques for the pelvic floor:

1. Pelvic floor technique:

Starting position:

The patient is in supine position; the therapist sits at her side at the level of her pelvis.

Positioning of the hand:

The middle and the index finger of the caudal hand are medial from the tuber in the fossa ischiorectalis. The other hand lies below the sacrum.

Performance of the technique:

The sacrum is brought into flexion and thus the pelvic diaphragm is lowered. The patient makes a deep inspiration and holds her breath as long as possible. In the meantime the therapist looks for the point of balance between the tissues and fascias not only in this region, but also between the diaphragm and the tentorium cerebelli.

During the spontaneus expiration the pelvic diaphragm moves back superiorly.

2. Treatment of the Musculus levator ani:

Starting position:

The patient lies on her back, the leg is flexed in the hip joint. The therapist stands beside the bed.

Positioning of the hand:

With his thumb the therapist takes contact with the membrana obturatoria.

First the therapist has to find out which part of the muscle needs to be extended.

At a flexion of the hip of 90° the therapist is on the post fibres of the pelvic floor and the pressure the thumb exercises goes downward in the direction of the table.
At a flexion of the hip of 45° the therapist is on the middle fibres. The pressure the thumb exercises goes toward the patients head.
At a flexion of the hip of 20° the therapist is on the anterior fibres. The pressure the thumb exercises goes toward the patients head.

Performance of the technique:
Starting position as explained above, during each inspiration the therapist's thumb goes in deep enough to feel a pressure against the thumb.
Then the thumb in its turn exercises pressure. The therapist lets the body come to terms with the lesion. At the end of a deep inspiration the therapist lets the tissue go slowly into relaxation.

6.2.2 Structural techniques at the Cervico Thoracal junction

LIGNER (2004) mentioned some concerns about techniques at the cervico throracal junction, and their effect on inducing labor.

6.3. Absolute contraindication in pregnancy:

6.3.1 Visceral manipulation on the Uterus:

BARRAL und MERCIER (2002) say that there must be no visceral treatment of the genitaltract at all, in pregnancy. These far-reaching restrictions are also shared by HEBGEN (2005). MOLINARI (2005) says that the treatment of the uterus is contraindicated in pregnancy, and LIEM, TOBLER and PUYALERT (2005) also write, that there must be no treatment of the uterus in pregnancy.

6.4. Modification of Osteopathic Manipulative Treatment because of the "Vena cave inferior compression syndrome", and other changes in the maternal organism.

Many authors who wrote about pregnancy did whether mention any specific techniques in detail, nor give any recommendations about how to apply techniques for pregnant women. (STILL,1910; BARRAL, 2002; FOSSUM, 2001; HEBGEN, 2005; LIEM, 2001; KRUEGER, 2000; WALDMAN, 2002; KING, 2000; CARPENTER, 2001; VAN DEN HEEDE, 2002)

But I think at least the Vena Cava inferior compressions syndrome should be mentioned in the work with late pregnant women:

With an increase of volume and weight of the uterus during pregnancy, the vessels dorsal of the uterus (Vena cava inferior) are compressed and the blood flow back to the heart is reduced. This might lead to symptoms of shock and decreased perfusion of the uterus. Possible resulting hypoxia would be a serious risk for the foetus (MARTIUS, 1981).

To be able to perform osteopathic manipulative treatment in pregnant women, the osteopath might modify the position:

6.4.1 Supine positioning:

Especially in late pregnancy, as the uterus gains volume and weight, the supine positioning can cause the Vena cava inferior compressions syndrome.

To prevent and to treat the Vena cava inferior compression syndrome the patient should lie on the side.

6.4.2 Prone positioning:

As the womb grows and gets bigger the prone position might be uncomfortable for the mother and should not be recommended.

6.4.3 Positioning on all fours (quarto paddle):

The position on all fours is safe for techniques till the end of pregnancy, and it even can be a very good position for giving birth. (MARTIUS, 1981)

6.4.4 Sitting position:

During the whole pregnancy, sitting can be a good position for osteopathic manipulative treatment. It can also be a big help in the second stage of delivery when the pelvic outlet has to open. (MOLINARI, 2005)

6.4.5 Position on the side

Lying on the side is a possible position for the treatment of pregnant patients. For anatomical reasons, as the Vena cava inferior runs on the right side of the midline (SOBOTTA, 2000), the left side should be preferred for longer treatments to avoid any possible compression to the Vena cava inferior.

7. Methodology

7.1 Structure of the Study

7.1.1 Inclusion criteria

Women had to be at least in the 36th week of pregnancy and for legal reasons they had to be at least 18 years old. To take part in the study, the women had to be pregnant with only one foetus.

7.1.2 Exclusion criteria

- Pregnant with more than one foetus
- Pregnancy with increased risk or complication (e.g. premature labor)
- Diagnosed heart disease of the foetus
- Age of the mother below 18 years.

7.1.3 Procedure

The study was made in the Landesfrauenklinik Linz, a large hospital in Upper Austria.
Due to recommendations, the women come to the clinic at the 36th week of pregnancy for a CTG examination.
For one week 60 women who fulfilled the inclusion criteria were asked if they would like to take part in this study. They were informed about the study verbally and by the handout (see Appendix A). If they agreed, the women who were treated had to sign the agreement. (Appendix B)
They were examined medically (blood pressure and heart rate) by a midwife of the clinic. The osteopath did her anamnesis and examination with the main focus on the mobility of the pelvis (Diamond test). With a skin friendly pen the points were drawn on the skin above L5 and S5, but also on the PSIS. Then the diamond was drawn. The distance from the points at L5 and S5 was measured and also the distance from PSIS to PSIS, first in standing, then in squatting position. These distances were documented.
Then the women laid on a bed on the left side and a CTG was recorded for at least 20 minutes. After 5 minutes on the CTG the patients in group 1 were treated with Myofascial release for at least 15 minutes.

After the CTG was finished (approx. 20 min), the distance at the diamond was measured again. (L5-S5, PSIS-PSIS)
In the control group (group 2) everything was the same, but the pregnant women were not treated.
About two months later the data about the birth was collected as they were documented in the records:

- Date of birth
- Duration of pregnancy
- Blood-pH-of the umbilical cord
- Duration of Stage 1 and 2 of the birth
- APGAR-score of the baby after 1, 5 and 10 minutes
- If there were any instruments needed during delivery (e.g. vacuum)
- If there was a caesarean section

One woman of the treated group and 2 women of the control group had the delivery in other clinics; therefore there were no follow up data available.

7.2. Methods

7.2.1 Cardiotocography (CTG)

With cardiotocography the activity of the fetal heart and the activity of the uterus are recorded.

Tocography

The external tocography detects movement of the maternal wall which is transduced into an electric signal. There are detected the movement of the uterus by labor or by fetal movement.
For the external tocography an elastic rubber band is used to place the transducer on the belly of the mother in the area of the fundus uteri. (STELLER, 2000)

Criteria for interpretation are:

a) Frequency of contractions
b) Duration the of the contraction
c) Type of increase and decrease of the contraction (type of the wave)

Cardiography

For routine diagnostic the Doppler-ultrasoundcardiography is used. The principle is the change of the frequency of reflected sound waves by moving parts (e.g. heart of the foetus). This allows detecting the fetal heart frequency.
The transducer for the cardiography should be placed on the punctum maximum of the fetal heart sounds. (STELLER, 2000)

Interpretation of the Cardiogram

- Basal frequency, fetal heart frequency
- Variability (frequency and amplitude)
- Floatingline

Basal frequency

The basal frequency is the middle value of the fetal heart rate outside labor. The normal value is between 110-150 beats/min. Higher frequencies are called tachycardia, lower frequencies are called bradycardia. (PFLEIDERER et al., 2000; SCHNEIDER et al., 2004)

Variability and Amplitude

The frequency of the fetal heart normally changes a few times a minute. The result is an oscillating line. The oscillating frequency is defined a numbers of changes of the fetal heart frequency per minute. Depending on the amplitude of the line, there can be defined 4 types of oscillation (PFLEIDERER et al., 2000):

Oscillation type 0: Amplitude <5 beats per minute (bpm). May be a sign of hypoxia or sedation of the foetus

Oscillation type 1: Amplitude 5-10 bpm. May indicate a sleeping foetus.*

Oscillation type 2: Amplitude 10-25 bpm: Typical type of an foetus awake with many movements

Oscillation type 3: Amplitude >25 bpm: May be a sign of a compressed umbilical cord.

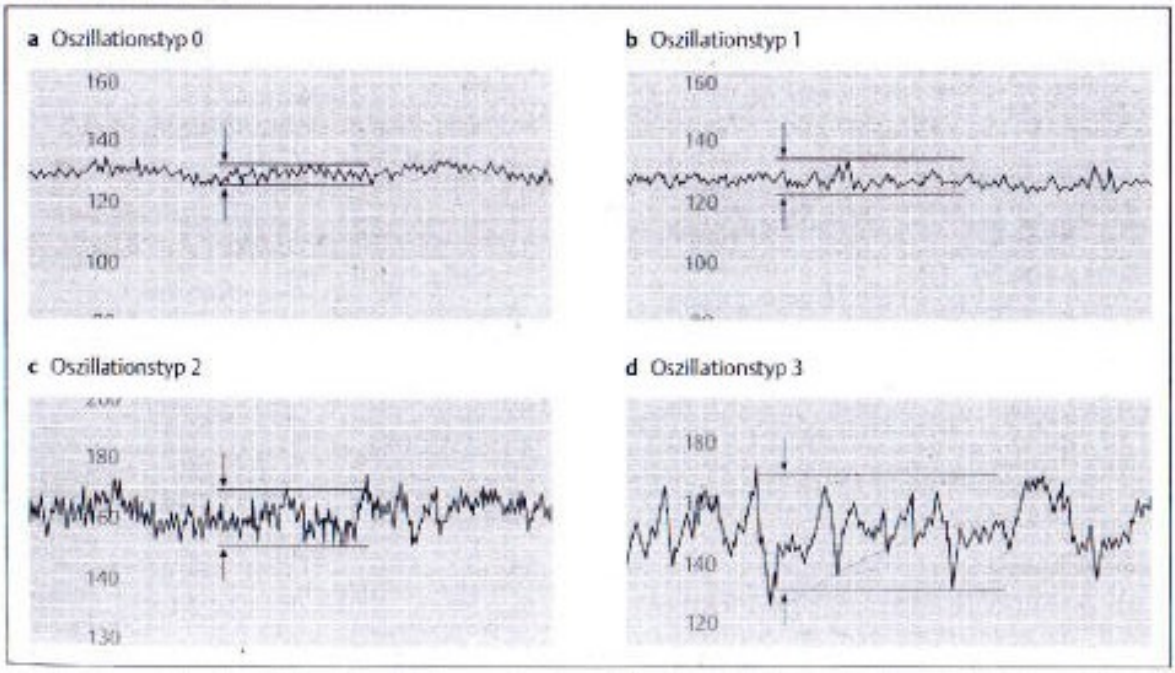

Fig: 7.1 Oscillation types (PFLEIDERER et al., 2000, p 291)

*To find out if a baby is only sleeping, in case of the oscillation type 0 or 1, it can be tried to wake the baby up. This can be done a ringing a bell close to the womb, or by softly shaking the womb, or by asking the women to sit up. If the oscillation type does not change after these attempts there is serious concern about possible problems of the baby.

Floatingline

Acceleration:

Increase of the frequency more than 15 bpm and for at least 10 seconds.

This increase normally comes from a movement of the foetus and indicates an active foetus. (PFLEIDERER et al., 2000).

There are normally 2 accelerations per minute. Missing accelerations over 40 minutes are a pathologic sign. (SCHNEIDER et al., 2004)

Deceleration:

Decrease of the fetal heart rate more than 15 bpm for more than 15 seconds below the level of the basal frequency.

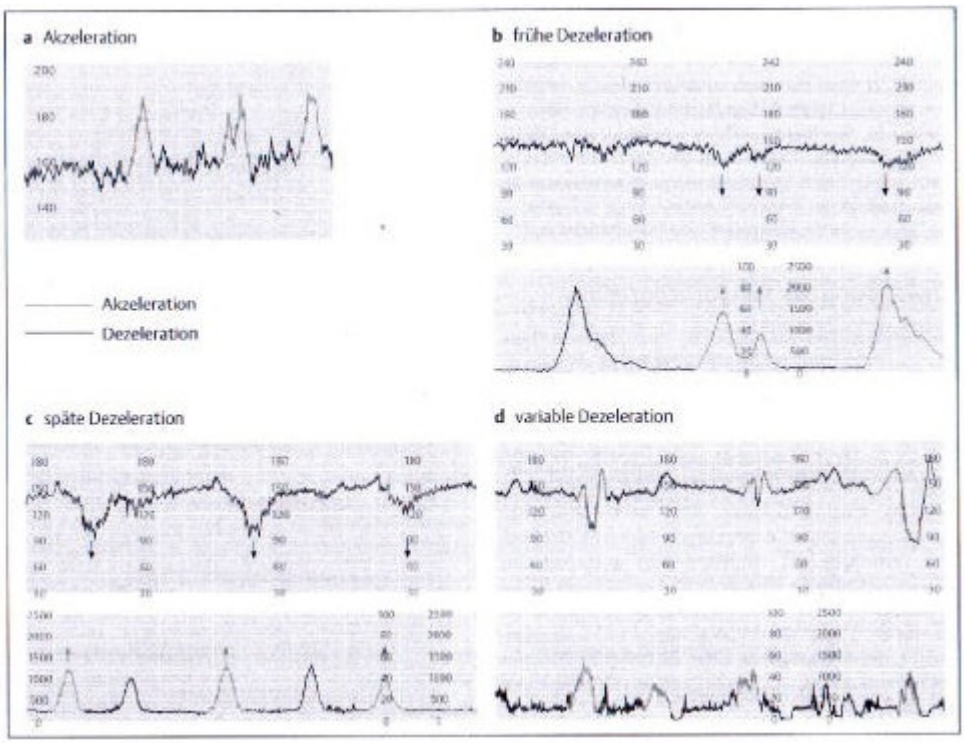

Fig. 7.2 CTG samples for Acceleration and Deceleration (PFLEIDERER et al., 2000, p 293)

Early decelarations	starts with labor and ends with a labor
Late deceleration	starts after the beginnig of a labor contraction and ends after the labor contraction has ended
Variable deceleration	does not correlate with labor

Fischer Score

To put all the parameters to a number, the Fischer Score is widely used. The CTG should be recorded for at least 30 minutes (PFLEIDERER et al., 2000). The basalfrequency, variability, oscillating frequency and the occurrence of accelerations and decelerations are noted and rated from zero to two points.

If the CTG is not recorded long enough and a Fischer's score is calculated, there might be a false result by missing accelerations or decelerations. In longer periods, the likelihood of higher variability is bigger than in short periods.

The best rate is 2 points at each parameter.

The Fischer´s Score gives 0 points for:

- a basal frequency smaller than 100 beats per minute (bpm), or more than 180 bpm.
- for the variability bigger than 5, and an oscillating frequency bigger than 2.
- if there are no accelerations,
- and late, variable decelerations with additional pathologic signs.

The Fischer´s Score gives 1 point for:

- a basal frequency between 100 and 120bpm or between 160 and 180 bpm
- for a variability from 5-10 or bigger than 30
- an oscillating frequency between 2- 6
- periodic accelerations
- variable decelerations

The Fischer´s Score gives 2 points for:

- a basal frequency between 120 and 160bpm
- for a variability from 10-30
- an oscillating frequency bigger than 6
- some accelerations
- non or only sporadic decelerations

Table 7.1: CTG-Score by Fischer

	0 points	1 point	2 points
Basal frequency bpm	<100 or >180	100-120 or 160-180	120-160
Variability	<5	5-10 or >30	10-30
Oscillating frequency	<2	2-6	>6
Accelerations	none	periodic	some
Decelerations	late, variable with additional pathologic signs	Variable	None, only sporadic

Interpretaton of the Fischer score's result:

8-10 points normal

5-7 points suspect, further examination needed

<5 points indicates an acute danger for the foetus

7.2.2 APGAR Score

The Apgar score was first described by Dr. Virginia APGAR (MD). It rates the status of the Skin color, Heart rate, Reflex irritability, Muscle tone and Respiration. The better the baby appears at this very first examination, the better the rate. The best rate is 2 points for each parameter.

For a normal *skin colour* the baby gets two points, if it is blue only at the extremities it gets one point. For complete cyanosis it will not get any point in this criterion.

The heart rate is fine above 100 bpm, therefore the baby would get 2 points. For values below 100 bpm, one point is given. No point is given if there is cardiac arrest.

The normal reflex, rated with two points, is sneezing, coughing and pulling away the extremities when stimulated. For weaker responses, one point is given. If there is no response at all to stimulation, no point is given in this category.

For the muscle tone, the own activity of the baby is quoted. For active movement, two points are rated. If there is no movement but flexion of the extremities, one point is given. If there is no muscle tone, meaning the baby is only lying without moving and not even holding the extremities, no point is given.

The normal respiration should be strong, rewarded with two points. Weaker or irregular respiration is rated with one point. For missing respiration no points are added to the score.

Table 7.2: the APGAR Score

	Score of 0	Score of 1	Score of 2	Acronym
Skin colour	blue all over	blue at extremities	normal	***A**ppearance*
Heart rate	Absent	<100	>100	***P**ulse*
Reflex irritability	no response to stimulation	grimace/feeble cry when stimulated	sneeze/cough/pulls away when stimulated	***G**rimace*
Muscle tone	none	some flexion	active movement	***A**ctivity*
Respiration	absent	weak or irregular	strong	***R**espiration*

7.2.3 Blood-pH of the umbillical cord

After birth the pH of the venous and arterial blood is measured routinely in the Landesfrauenklinik by an automatic instrument. The values in this study were used as they were written in the medical record.

7.2.4 Applied osteopathic manipulative treatment

The women were treated with Myofascial release as described in 6.1.2.

7.2.5 Duration of pregnancy, duration of birth

This data was used as recorded in the medical record of the women. The entries were done by the midwifes or gynaecologists.

8. Results

60 women that primary fulfilled the inclusion criteria were included in the study. The first 30 were included in group 1 (treated group).The other 30 women were in group 2 (control group). The average age of the women in group 1 was 28,70 years (sd=5,67). The average week of pregnancy was 38,73 weeks (sd=1,71)

8.1 Prior births and prior caesarean sections

16 women (53,33%) had not given birth before, 11 women (36,67%) already had one baby before, one woman (3,33%) had two, one woman (3,33%) had three and one woman (3,33%) had had five births before. Two women (6,67%) had had caesarean sections before.

Table 8.1: Number and percentage of births in group 1 (n=30)

Number of births before	number of patients	percentage
None	16	53,33%
1	11	36,67%
2	1	3,33%
3	1	3,33%
4	0	0,00%
5	1	3,33%

8.2 Prior uterine contractions during this pregnancy (only group 1)

8 women (26,67%) said, they had had uterine contractions during this pregnancy.

8.3 Cigarettes (only group 1)

4 women (13,33%) of group 1 were smoking during pregnancy. These women were smoking 5 cigarettes per day in average.

8.4 Stress (only group 1)

15 women (50,0 %) did not complain about stress during pregnancy. Four women (13,33%) mentioned few stress, six women (20%) a medium amount of stress and five women (16,67%) complained about a lot of stress.

Table 8.2: Stress of women in the treated group (n=30)

	Number of women	
No stress	15	50,0 %
Few Stress	4	13,33%
Medium amount of stress	6	20,0%
Much stress	5	16,67%

8.5 Pain (only group 1)

17 women (56,67%) did not complain about any pain. 13 (43,33%) women did have at least one area of pain. Five women (16,67%) mentioned two areas of pain, one woman (3,33%) had three painful areas. The areas which caused pain: see tab. 8.3

Table 8.3: Painful areas mentioned by the patients of group 1

	few pain		intense pain	
Head	1	3,33%	0	0,00%
Neck	0	0,00%	0	0,00%
Back	2	6,67%	1	3,33%
Low back	4	13,33%	1	6,67%
Hip	1	3,33%	4	13,33%
Other	2	6,67%	2	6,67%

Other areas: Pelvic symphysis, Lig. latum uteri, Os coccygeum

8.6 Measurement of the Michaelis Rhombus (Distance from L5 to S5 in cm)

In group 1 the average distance from L5 to S5 shifted from 11,27 cm in the standing position to 15,20 cm when the patients squatted. So the distance increased 3,93 cm (increase of 34,87%).

After the CTG of group 1 (group 1 was treated during the CTG) the distance measured in the squatted patient was 15,63 cm. This is 0,43 cm more compared to the values before treatment. This means an increase in mobility of 10,95%.

In group 2 the distance from L5 to S5 was 11,65 cm in the standing patient and 14,94 cm in the squatting patient. After the CTG (these women had no treatment) the distance was 15,05 cm. It had only increased 0,11 cm. (increase of 3,13%).

The increase of the distance L5-S5 in the treated group compared to the control group is significant (t-test, $p<0,05$). (Tab. 8.4)

Table 8.4. Distance L5-S5 (cm). The increase of the distance L5-S5 in the treated group compared to the control group is significant (t-test, $p<0,05$).

	Group 1 (treated group)		Group 2 (control group)	
Distance between L5-S5 (cm)	average	standard deviation	average	standard deviation
Standing Position	11,27	2,73	11,65	2,18
Squatting Position	15,20	3,96	14,94	2,87
Squatting after treatment	15,63	3,89	15,05	2,69
Difference before treatment / CTG	3,93	1,45	3,29	1,38
Difference after treatment / CTG	4,36	1,43	3,40	1,20

Fig 8.1: change of the distance from L5-S5

The distance from PSIS to PSIS did not change significantly.

8.7 Results of the Cardiotocogram

8.7.1 Fischer Score

The Fischer Score should be calculated over a period of 20-30 minutes (PFLEIDERER et al., 2000). As the normal registration period of the women in the hospital was only 20 minutes, the Fischer score was measured for the first 5 minutes and for the following 15 minutes. The main influence to the value of the score if not measured for 30 minutes is the number of accelerations or decelerations. Thus an extra score was calculated, assuming no abnormalities in accelerations or decelerations (2 points for each):

In the first group the regular Fischer score increased from 8,86 to 9,24 points (Difference = 0,38 points, sd=1,06), the corrected score (not calculating missing accelerations or decelerations) decreases from 9,62 to 9,38 points (Difference = -0,24 points, sd=0,50). (Tab. 8.5)

Table 8.5: Results of the Fischer Score of group 1

	regular score	sd	corrected score	sd
Fischer Score following 15 minutes group 1	8,86	1,01	9,62	0,49
Fischer Score first 5 minutes group 1	9,24	0,68	9,38	0,49
Difference first 5 min/following 15 min group 1	0,38	1,06	-0,24	0,50

In the second group the Fischer score increases from 8,86 to 9,14 points (Difference = 0,29 points, sd=0,5), but the corrected score decreases from 9,36 to 9,29 points (Difference =-0,07, sd=0,46). (Tab. 8.6)

Table 8.6: Results of the Fischer Score of group 2

	regular score	sd	corrected score	sd
Fischer Score first 5 min group 2	8,86	0,79	9,36	0,48
Fischer Score following 15 min group 2	9,14	0,64	9,29	0,45
Difference first 5 min/following 15 min group 2	0,29	0,75	-0,07	0,46

(group 1: n=29, group 2: n=28)

Test for significance indicates that the decrease in the first group using the corrected score is significant. (p=0,02). The other results are not significant. (Tab. 8.7)

Table 8.7: Significance values (t-test) of the Fischer Score

		p
first 5 min/following 15 min group 1	regular score	0,07
	corrected score*	0,02
first 5 min/following 15 min group 2	regular score	0,06
	corrected score	0,42
Group 1 / group 2	regular score	0,71
	corrected score	0,20

*significant

8.7.2 Basal frequency

The basal frequency was measured for the first 5 minutes and for the next 15 minutes on the CTG. In group 1, after 5 minutes the osteopathic manipulative treatment started.

As the influence of the attempts to wake the baby up was unclear, the two groups were calculated with and without the data of the patients with these attempts.
One patient had an elevated body temperature. As this increases the heart rate of the baby as well increases. In this calculation the data of this patient was not included.

In group 1 (29 women) the average basal frequency for the first 5 min was 140,66 bpm (sd=10,08). In the following 15 minutes the basal frequency decreased for 1,28 bpm to 139,38 bpm (sd=8,63). If the the CTGs with the attempts to wake the baby up are eliminated, the medium frequency was 140,71 (sd=10,17) and changed to 140,29 (sd=9,12) in the following 15 minutes.

Table 8.8: Results of group 1 (treated group)

Group 1	whole group	without attempts to wake up the baby
Number of women	29	24
average1 (first 5 min) [bpm]	140,66	140,71
standard deviation [bpm]	10,08	10,17
average2 (following 15 min) [bpm]	139,38	140,29
standard deviation [bpm]	8,63	9,12
difference [bpm]	-1,28	-0,42

In group 2 (29 women) the average basal frequency for the first 5 min was 139,59 bpm (sd=6,8). In the following 15 minutes the basal frequency increased 1,24 bpm to 140,83 bpm (sd=6,11). If the the CTGs with the attempts to wake the baby up are eliminated, the medium frequency was 138,70 (sd=6,75) and changed to 140,80 (sd=6,16) in the following 15 minutes.

Table 8.9: Results of group 2 (control group)

Group 2	whole group	without attempts to wake up the baby
Number	29	20
Average1 (first 5 min) [bpm]	139,59	138,70
Standard deviation [bpm]	6,80	6,75
Average2 (following 15 min) [bpm]	140,83	140,80
Atandard deviation [bpm]	6,11	6,16
Difference [bpm]	1,24	2,10

The values within group 1 were compared and tested for significance. Neither the change with all women nor the data without the attempts to wake up the baby, turned out to be significant. In group 2 the comparison between the first 5 minutes and the following 15 minutes was not significant when all CTGs were used. But when only the data was used without attempts to wake up the baby, the increase from 138,70 bpm to 140,8 bpm turned out to be significant with p=0,1.

If the changes of basal frequency are compared between the two groups, the heart rate is decreasing in group 1 and increasing in group 2. This is statistically significant ($p<0,05$) for both groups of data.

Table 8.10: Results of the significance tests

Significance test	p-value	result
Difference between stage 1 and 2 whole group1	0,208	not significant
Difference between stage 1 and 2 whole (reduced) group1	0,649	not significant
Difference between stage 1 and 2 whole group2	0,051	not significant
Difference between stage 1 and 2 whole (reduced) group2	0,010	significant
Difference of chance between whole groups	0,035	significant
Difference of chance between reduced groups	0,041	significant

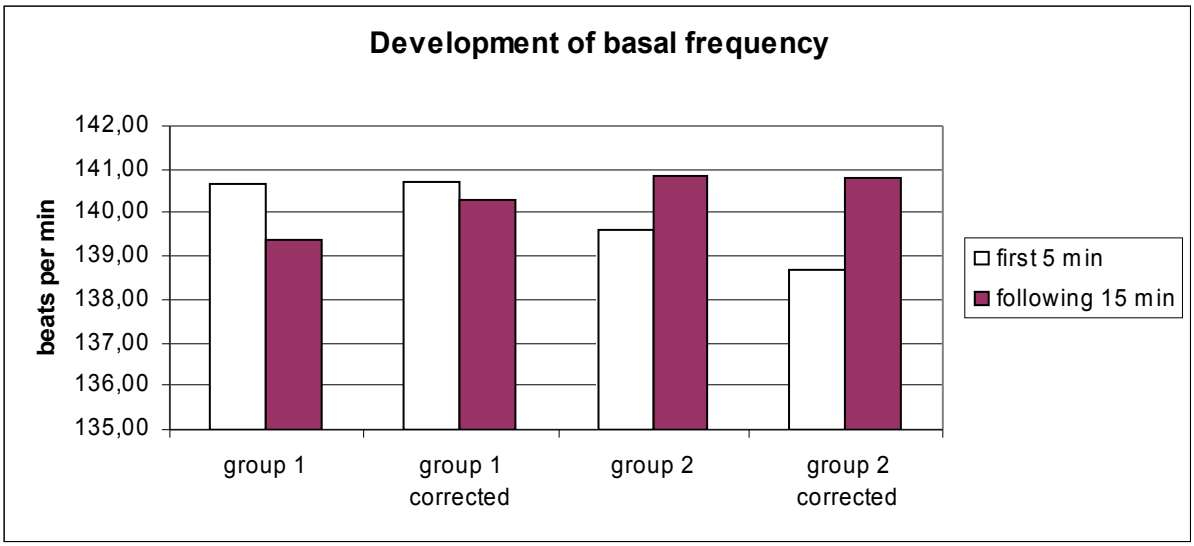

Fig 8.2: Development of the basal frequency

8.8 Duration of pregnancy

The duration of pregnancy of the treated group was 279,93 days (n=30, sd=9,06). In the control group pregnancy lasted for 282,64 days(n=59, sd=7,33). This difference is not significant.

8.9 pH value of the blood of the umbilical cord

The pH of the arterial and venous blood was measured after birth.

In the treated group the median value of the arterial pH was 7,29 (sd=010), of the venous blood the pH was 7,32 in average (sd=0,08).

In the control group the arterial pH was 7,26 in average (sd=0,08), the median venous pH was 7,33 (sd=0,06).

This is not a significant difference. (Tab. 8.11)

Table 8.11: Results of the arterial pH of the umbilical cord

	group 1		group 2	
	median (n=29)	sd	median (n=28)	sd
Arterial pH	7,29	0,10	7,26	0,08
Venous pH	7,32	0,08	7,33	0,06

8.10 APGAR Score

In Group 1 the APGAR Score after 1 minute was 8,48 (sd=1,45), after 5 minutes 9,76 (sd=0,82) and after 10 minutes 9,90 (sd=0,40).

In Group 2 the APGAR score after 1 minute was 8,46 (sd=1,32), after 5 minutes 9,68 (sd=0,89) end after 10 minutes 9,86 (sd=0,44).

Between group 1 and group 2 there was no significant difference.

Table 8.12: Results of the APGAR score

	Group 1			Group 2		
	1 min	5 min	10 min	1 min	5 min	10 min
APGAR	8,48	9,76	9,90	8,46	9,68	9,86
sd	1,45	0,82	0,40	1,32	0,89	0,44

Table: 8.13: The test for significance between the two groups was not significant in minute 1, 5 and 10:

	p
1 min	0,96
5 min	0,73
10 min	0,73

8.11 Duration of birth

The duration of stage 1 and 2 of birth were noted in the medical record of the patient. To be able to compare the results, the groups were divided into those patients who had the first delivery and the group who have had at least one delivery before.

8.11.1 Patients who had the first delivery

For the first group, stage 1 lasted 607,31 minutes (sd=425,32). In group 2 the average time for stage 1 was 630,92 minutes (sd=365,45). (tab. 8.14) The difference is not significant. (tab. 8.15)

In stage 2, the duration of group 1 was 33,0 minutes (sd=27,27). For group 2 the average duration was 66,31 minutes (sd=50,70). . (tab. 8.14)

The difference was not significant by using the t-test. But the significance value of 0,05 was only slightly missed, as the value was 0,056. (tab. 8.15)

8.11.2 Patients who had at least one delivery before

The mean time for stage 1 of delivery in group 1 was 255,82 minutes (sd=264,49). In group 2 the average time for stage 1 was 206,09 minutes (sd=105,18). (tab. 8.14)

The difference is not significant. (tab. 8.15)

In stage 2, the duration of group 1 was 35,0 minutes (sd=36,85). For group 2 the average duration was 27,91 minutes (sd=24,92). (tab. 8.14)

The difference is not significant. (tab. 8.15)

Table 8.14: Duration of stage 1 and stage 2 of delivery (min) of group 1 (treated group) and group 2 (control group) [min.]

		stage 1		stage 2		n
		average	Stand. Dev.	average	Stand. Dev.	
Group 1	no births bef.	607,31	425,32	33,00	27,27	13
	deliv. before	255,82	264,49	35,00	36,85	11
Group 2	no births bef.	630,92	365,45	66,31	50,70	14
	deliv. before	206,09	105,18	27,91	24,92	11

Table 8.15: t-test values if the duration of delivery is significant (significance value $p<0,05$) between group 1 and group 2.

		Stage 1	Stage 2
t-test-values	No deliv. before.	0,89	0,056
	Delivery before	0,59	0,62

8.12 Caesarean sections

The number of necessary caesarean sections in group 1 was four of 23 (17,39%).
Additionally one caesarean section was planned following the decision of the mother.
In group 2 the number of indicated caesarean section was two of 25 (8%).
Due to the small numbers, a test for significance was not performed. In a study of SCHIESSL et al. (2005) 17,6% of 1456 women had a caesarean section. This indicates that the amount of caesarean sections observed in this study might be in normal limits.

Table 8.16: indicated caesarean section

	Caesarean sections	ratio	Total number of deliveries
Group 1	4	17,39%	23
Group 2	2	8,00%	25

8.13 Vacuum extractions

In group 1, in two out of 23 deliveries (8,7%) a vacuum extraction was indicated. In the control group, three vacuum-extractions (12,0%) out of 25 deliveries were performed.
Due to the small numbers, a test for significance was not performed.

Table 8.17: number of vacuum extractions

	Vakuum		Total number of deliveries
Group 1	2	8,70%	23
Group 2	3	12,00%	25

8.14 Did the mobility of L5-S5 influence the duration of stage 1 or 2 of delivery?

An important question of the study was, whether the mobility of S5-L5 did influence the duration of delivery. First I tried to find out, if the mobility and the duration of delivery were correlated at all. For this reason the correlation coefficient was calculated. A negative value means a negative correlation indicating, that higher values of mobility might cause a shorter time of delivery. Therefore would a positive value indicate a positive correlation, meaning that higher mobility correlated longer time of delivery.

The correlation coefficient can be between -1 and +1. A value of 0 means, that there is no correlation at all. A value of -1 or +1 indicates, that all values are on a line (=perfect correlation). With a significance test, depending on the number of sample values, the significance was tested.
The correlation was tested from group 1, group 2 but also the correlation of the first values of all women to the duration of the stages of delivery.

8.14.1 Correlation of mobility of L5-S5 in women who had not given birth before

The correlation in group 1 with stage 1 before and after treatment was positive. Before treatment the correlation coefficient was 0,096, after treatment it increased to 0,198.
In group 2 the correlation coefficient was negative (-0,115). All women together had a correlation coefficient close to zero (-0,001), meaning that there is no correlation at all.
Correlation with stage 2 was positive in all groups. Group 1 before treatment was 0,224, after treatment the coefficient was 0,212. In group to the correlation coefficient was 0,406 and all women together correlated with stage 2 with a coefficient of 0,145.
None of the correlation coefficients was significant.

Table 8.18: Correlation coefficients of women who had not given birth before

	Correlation with stage 1	Correlation with stage 2
all women	-0,001	0,145
group 1 before treatment	0,096	0,224
group 1 after treatment	0,198	0,212
group 2	-0,115	0,406

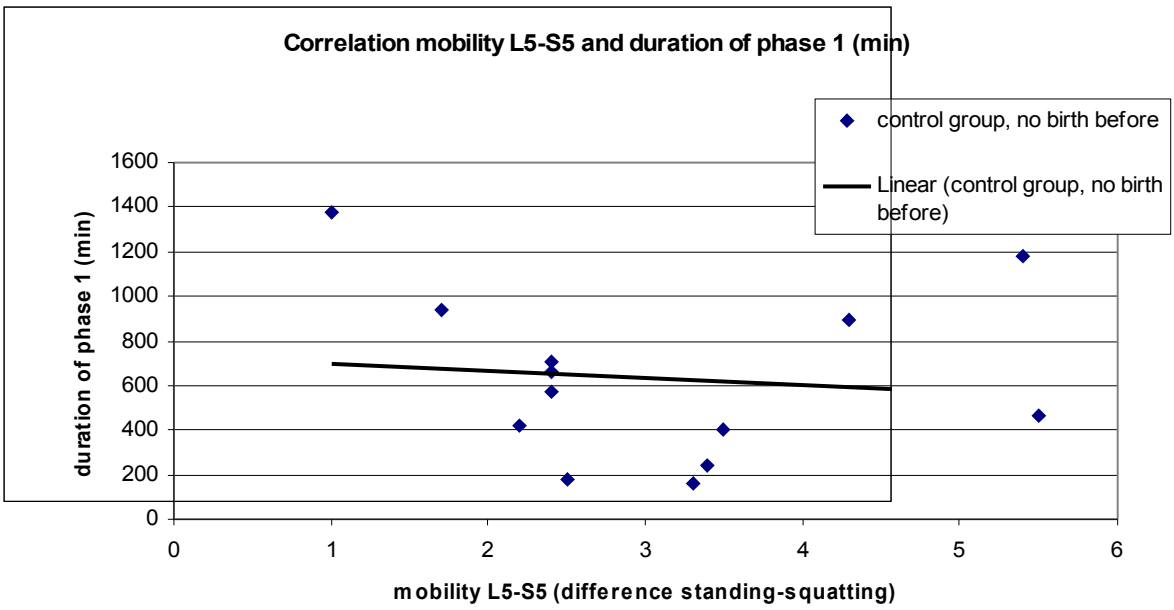

Fig. 8.3: Correlation of mobility L5-S5 and duration of stage 1 (min) with trend line (group 2)

8.14.1 Correlation of mobility of L5-S5 in women who had given birth before

Only in group 1, the correlation with stage 1 was positive. After treatment the correlation coefficient in this group increased from 0,191 to 0,283.

In all other aspects (correlation with stage 2, group 2, all women together) there was a negative correlation.

In the control group, the correlation between mobility of L5-S5 and duration of stage 1 was significantly correlated ($p<0,05$) indicating, that a higher mobility means a shorter duration of stage 1 of delivery.

Table 8.19: Correlation coefficients of women who have had given birth before

	Correlation with stage 1	Correlation with stage 2
all women	-0,028	-0,146
group 1 before treatment	0,191	-0,062
group 1 after treatment	0,283	-0,040
group 2	-0,697*	-0,343

*significant

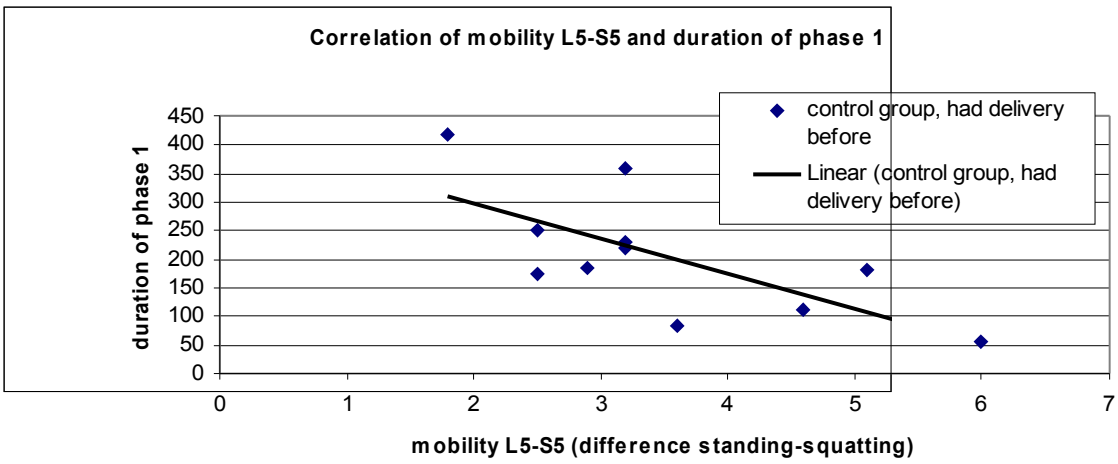

Fig 8.4: Correlation of mobility L5-S5 and duration of stage 1 in group 2 (with trendline)

9. Discussion of the results

I'd like to discuss the results from three different points of view:

1. Are there any results indicating, that the treatment did influence the mother and the baby during or after the treatment?
2. Are there any results indicating, that the treatment did influence the birth parameters?
3. Can the result of the mobility test of the Michaelis rhombus (L5-S5, PSIS-PSIS) be used to predict the duration of delivery?

9.1 Are there any results indicating, that the treatment did influence the mother and the baby during or after the treatment?

Are there any results indicating, that the treatment did influence the mother and the baby during or after the treatment?

There have been 3 parameters that turned out to be significantly different comparing the treated group (group 1) and the control group (group 2):

1. Mobility L5-S5 increased significantly in group 1
2. Basal frequency of the fetal heart rate decreased significantly in group 1
3. A modified Fischer Score decreased significantly in group 1

1. During delivery the bony frame of the female pelvis has to expand. In stage 1 of delivery the head of the baby has to pass the lumbosacral area of the mother. More mobility of the frame assumes less resistance to dilation of the birth canal and easier delivery.
The study shows, that there is an effect in the treated group. The distance between L5 and S5 increased after the treatment.

2. The Fischer score indicates that the fetal heart rate between 120 and 160 beats per minutes is normal. The question is, if the observed effect that in the treated group the basal frequency decreased significantly does mean anything to the baby? The stress and adrenalin level of the mother can influence the heart rate of the baby. LEINWEBER (2004) and DOWLING (2006) write that stress of the mother (and also stress of the baby during pregnancy - which shows in a high heart rate) might cause problems in the later life of the baby. Therefore everything that reduces stress for the mother - and so reduces the heart rate of the baby from a too high level

(but of course still in the normal score of 120-160 bpm) could possibly help the baby. The myofascial release indicates to be a possibility for this purpose at least in the short term.

3. Interpretation of the CTG turned out to be more complex. The CTG is not an optimal instrument, but in lack of a better one, it is widely used to try to observe possible abnormalities during pregnancy.
For a study, the parameters should be objective. For the CTG there are several parameters, but hardly one is really objective if the CTG is not recorded and analyzed digitally.
The Fischer Score tries to put the CTG waves into an objective pattern. But there is a reason, why the duration of the CTG for using the Fischer score should be at least 20-30 minutes: Important changes like accelerations or decelerations only occur over a period of time. It happened, that for the first 5 minutes there were no acceleration in a women, but in the next 15 minutes there were some. But no acceleration means a decrease in the Fischer score. We tried to correct this by using a modified score assuming that the number of accelerations were normal in every CTG.
The amplitude is defined as the highest rate minus the lowest rate during the time. But there is still a problem, that the amplitude might be higher if the score is taken for a longer period, as it is more likely to have a very high or very low level. As the Fischer score decreases for one point if the amplitude is higher than 30, the significant decrease of the score and the evaluation of the influence by using the Fischer score for a 5 or 15 minute period must be doubted.
Nevertheless the score always stayed in the area, were it is normal.

9.2 Are there any results indicating, that the treatment did influence the birth parameters?

All parameters that we looked at did not show a significant difference between the treated group and the control group. We looked at the ph of the umbilical cord after birth, at the APGAR score after birth, the duration of stage one and stage two of delivery and the duration of pregnancy. And we also looked for the need of any necessary helps at birth like the need of caesarean section, or the use of vacuum extraction. The women were all treated only once.
For me it is very important, that with this study I could not observe any negative effect of Osteopathic manipulative treatment on birth or birth parameters.

Further studies will be needed to answer more questions about osteopathy during pregnancy. There are much more osteopathic techniques that might be indicated in pregnant women and there are much more parameters to observe.

9.3 Can the result of the mobility test of the Michaelis rhombus (L5-S5, PSIS-PSIS) be used to predict the duration of delivery?

According to the theory of MOLINARI (2005) a higher mobility indicates, that an easier and shorter delivery is more likely. In this research I compared the mobility of the distance from L5 to S5 and from PSIS to PSIS, between the standing and the squatting pregnant patient to the duration of delivery. The mobility from PSIS to PSIS did only change very little, (from standing to squatting), so I only took the data of the mobility from L5 to S5.

The only significant finding was in those women of group 2, who had given birth before, a higher mobility was combined with a shorter duration of stage 1 of delivery. In all other groups there was no significant correlation.

Trying to find a trend in the correlation coefficient I found out that based on my data, there was no correlation at all between stage 1 and those women who had no delivery before. But there was a trend of positive correlation in this group with stage 2.

In the group of women who had at least one birth before, there was a trend, that a higher mobility was combined with a shorter duration.

Looking at my data and the significance values concerning the duration of birth the theory of MOLINIARI (2005) can not be supported.

In a study of SCHIESSL et al (2005) they looked at factors influencing duration of stage 2 of delivery. They found out, that the use of oxytocin, nulliparus women and the use of epidural analgesia lead to a longer stage 2 in delivery. Of course they did not look at the mobility of L5-S5 before, but the study indicates, that there are multiple factors influencing the duration of delivery. In my study I did not look at the use of the factors mentioned by SCHIESSL et al. (2005), that might influenced the data in this study as well. To give a final answer to the theory of MOLINARI (2005) a study with more women, looking on more factors during pregnancy and delivery must be done.

The duration of birth is not the only criteria for level of difficulty in delivery. As a matter of fact, in my studies I could not find a formula, to predict something about the duration of

delivery based on the results of measuring at the Michaelis rhombus. Maybe other factors have to be looked at, to describe the level of difficulty of pregnancy to find a correlation between mobility at the Michaelis rhombus and duration of delivery.

10. Summary

The purpose of this study was to find out if there is a measurable effect in pregnant women during and after Osteopathic manipulative treatement. 60 late pregnant women were included in the study. In addition to the routine check of late pregnant women (from their 36th week of pregnancy on) the mobility of the Michaelis rhombus (diamond test) was examined and a CTG was recorded. Under the CTG Control 30 women were treated with Myofascial releasing techniques in the lumbosacral area. The other 30 women only had their routine CTG control, without a treatment. (They were the control group.) The CTG´s of both groups were analyzed, and the lumbosacral mobility (Michaelis rhombus) was measured again.

As birth parameters the duration of pregnancy, duration of stage 1 and 2 of delivery, any additional help (caesarean section, vacuum extraction), the pH of the umbilical blood and the APGAR-Score of the newborn child were noted and compared.

One important finding was that the mobility in the lumbosacral area of the treated women increased significantly compared to the control group. The second outstanding result was that the basal frequency of the fetal heart decreased significantly but stayed in normal limits in the treated group while applying the Myofascial releasing technique. This might show an relaxing effect of this technique to the unborn child.

No significant differences in the birth parameters were noted.

Based on the data of this study, myofascial release technique in late pregnant women had a positive effect to the mother and the unborn child, but did not create any negative side effects to the pregnant women, nor to the baby, nor to birth.

Appendix A

Information

Was ist Osteopathie?
Osteopathie ist eine sanfte Methode um Verspannungen und Blockaden im Körper zu lösen.
Die Ausbildung zum Osteopathen ist in Österreich nur für PhysiotherapeutInnen, ÄrztenInnen und Hebammen möglich. Die Ausbildung ist berufsbegleitend und dauert mindestens 6 Jahre.

Was wird bei dieser Studie untersucht?
Obwohl sich viele schwangere Frauen osteopathisch behandeln lassen, gibt es nur sehr wenige wissenschaftliche Untersuchungen dazu. Mit dieser Studie soll die Wehentätigkeit sowie die Herzfrequenz des Kindes während einer osteopathischen Behandlung dokumentiert und statistisch erfasst werden.

Besteht für die Mutter oder das Kind irgendeine Gefahr?
Nein. Seit Beginn der Osteopathie lassen sich schwangere Frauen aus den unterschiedlichsten Gründen osteopathisch behandeln. Diese Behandlungen werden von den Patientinnen als sehr wohltuend empfunden.

Die Teilnahme an der Studie ist absolut freiwillig. Sie können zu jeder Zeit die Teilnahme verweigern und die Untersuchung bzw. Behandlung abbrechen ohne Gründe anzugeben.

Ablauf der Studie
Phase 1: Erfassung des Vorberichtes und Befundung; Mobilitätstest
Phase 2: während Ihrer Routinekontrolle (CTG) hier im Krankenhaus werde Sie von Fr. Hampel osteopathisch behandelt.
Phase 3: kurze Nachuntersuchung und Mobilitätstest.
Zeitaufwand ca. 10 Minuten zusätzlich zur Routinekontrolle.

Information zu Fr. Elke Hampel

1995	Abschluss der Ausbildung zur Diplomierten Physiotherapeutin in Graz.
1995-1999	Physiotherapeutin im Landeskrankenhaus Wagna (Stmk)
1999-2004	selbständige Physiotherapeutin in einer Gemeinschaftspraxis in Hallein.
2000-2006	Ausbildung zur Osteopathin an der Wiener Schule für Osteopathie (www.wso.at)
seit 2004	selbständige Physiotherapeutin in einer Praxis für Osteopathie und Physiotherapie in Linz. Frau Elke Hampel wird Ihre Ausbildung zur Osteopathin an der Donau Universität Krems im Jahr 2006 abschließen.

Fr. Hampel ist verheiratet und hat 1 Sohn (Vincent, geb. 15.1.2004)

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elkeho@yahoo.com

Appendix B

Fragebogen für Osteopathiestudie

1. Ihr Alter: ____ Jahre
2. Sie befinden sich in der ___ Schwangerschaftswoche (SSW)
3. Wieviele Entbindungen hatten Sie bisher? ____
4. Treffen für Sie folgende Punkte zu?

❒ nein	❒ ja	Diese Schwangerschaft ist eine Mehrlingsschwangerschaft
		Bei meinem Baby ist folgende Erkrankung bekannt:
❒ nein	❒ ja	Bei vorherigen Schwangerschaften kam eines der Babys per Kaiserschnitt zur Welt
❒ nein	❒ ja	Hatten Sie bisher schon starke Wehen? Wenn ja wann? ___ Schwangerschaftswoche
❒ nein	❒ ja	Waren Sie während der Schwangerschaft in osteopathischer Behandlung?

5. Rauchen Sie zur Zeit : ❒ nein ❒ gelegentlich ❒ ja, ca. ___ Zigaretten pro Tag
6. Hatten Sie während der Schwangerschaft ❒ keinen ❒ wenig ❒ mittel ❒ viel Stress?
7. Hatten Sie im Laufe der Schwangerschaft Schmerzen?

❒ nein	❒ ja	Kopf	❒ leicht	❒ stark
❒ nein	❒ ja	Nacken	❒ leicht	❒ stark
❒ nein	❒ ja	Rücken	❒ leicht	❒ stark
❒ nein	❒ ja	Kreuz	❒ leicht	❒ stark
❒ nein	❒ ja	Hüften	❒ leicht	❒ stark
❒ nein	❒ ja	andere: _____	❒ leicht	❒ stark

8. Mein Blutdruck ist ❒ eher niedrig ❒ eher normal ❒ eher erhöht

Hiermit erkläre ich mich einverstanden, an der Studie zur Dokumentation des CTG sowie Messung der Pulsfrequenz vor und während einer osteopathischen Behandlung teilzunehmen. Die Teilnahme ist für mich mit keinerlei finanziellen Forderungen verbunden. Ich weiß, dass ich die Teilnahme an der Untersuchung jederzeit abbrechen kann.

_____ _____

Ort, Datum Unterschrift

Appendix C

Arbeitsblatt

Patientenname: _____

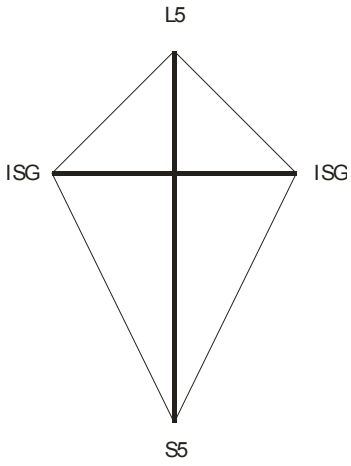
Datum der Behandlung: _____

Kriterien erfüllt ❒ Ja ❒ Nein

Messung:

		L5-S5	ISG-ISG
1.	Raute stehend		
2.	Raute hockend (Fersen am Boden)		

3.	Puls	/ min
4.	Blutdruck	mm Hg

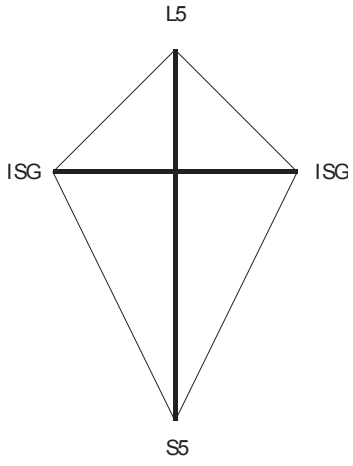


Behandlung:

Abschlussmessung

		L5-S5	ISG-ISG
1.	Raute hockend (Fersen am Boden)		

2.	Puls	/ min
3.	Blutdruck	mm Hg



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List of abbreviations

bpm	beats per minute
PSIS	spina iliaca posterior superior
sd	standard deviation
Min	minute
n	number of (samples)
p	Significance value
MFR	Myofasciale Release Technique
M	Musculus
Musc	Musculus
PSIS	Spina illiaca anterior superior
L5	Lumbar vertebra 5
S5	Sacral proc. Spin. 5

List of Pictures and Diagrams