Growing pains in children – can osteopathy improve the clinical picture?

Master Thesis to obtain the degree
Master of Science in Osteopathy
Donau Universität Krems

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Salzburg, December 2007

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DECLARATION

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

I have clearly marked as quotes all parts of the text that I have copied literally or rephrased from published or unpublished works of other authors.

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

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Date Signature

With love
for my husband Pepi
and my daughters Pia and Anna

Abstract

This osteopathic study looks at whether “growing pains” in children can be positively influenced by a global osteopathic treatment. The study is designed as controlled clinical application study which evaluates the two outcome measurements frequency and intensity of pain over a period of 3 months by means of a questionnaire developed by the author.

“Growing pains” are pulling nocturnal pains that usually occur in the lower extremities. They can be so bad that the children have to take pain killers. Since there is no standard therapy for the clinical picture of “growing pains”, it seemed to be interesting to find out whether osteopathy can contribute to improving the symptoms.

The 14 children in the experimental group received three osteopathic treatments over the study period of three months, while the 13 children in the control group were not treated at all in the same period. After the study period 7 children of the control group were treated like the children in the experimental group and compared with themselves (comparison group).

The hypothesis of this study that an individualized osteopathic treatment can influence “growing pains” in a positive way could be confirmed. The reduction of both the intensity and also the frequency of the pain were significant for the overall sample, but in comparison with the control group the tendency was more pronounced in the experimental group. However, the 7 children who were compared with themselves did show a significant change in the pain intensity after the treatment. Thus osteopathy can be regarded as reasonable form of therapy for children with “growing pains”. However, further examinations with a larger number of participants would be desirable.

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1. Introduction

“Growing pains” are a common phenomenon.
Naish et Apley (1951) report that in a sample of 721 children growing pains occur in 4.2%, while Oster et Nielson (1972) show that in 2178 children between the ages of 6 and 19 years 13% of the boys and 18% of the girls are affected. Based on the analysis of 1445 valid responses to a survey by means of a questionnaire carried out in Southern Australia Evans (2004) describes that in children aged 4 to 6 “growing pains” can be observed in 36.9%. According to Friedland et al (2005) “growing pains” are the most common cause of recurring pain in the locomotor system of children.

What is the clinical picture children who suffer from the common phenomenon of “growing pains” present with? In my opinion the authors Goodyear-Smith et Arroll (2006) provide a comprehensive and yet concise definition. They define “growing pains” as typical non-articular pain that occurs recurringly in both legs in the evening or at night and affects children between the ages of 3 and 12. The pain must not cause any limping, no restriction of movement and must not affect the joints. There must be no sign of local trauma or infections and also laboratory and radiology findings have to be normal. This means that the term “growing pains” actually represents a rule-out diagnosis.
If this rule-out diagnosis is made, the question is how to treat the problem. Goodyear-Smith et Arrol (2006) write that it is important for the parents to know that “growing pains” are benign and will stop by themselves (note from the author: at the latest when the child stops growing). Calabro (1972), Doughty (1998), Brady et Gray (1989), Szer (1989), Atar (1991) and Manners (1999) emphasize how important it is to establish a correct rule-out diagnosis and to explain to the parents the benign nature and course of the phenomenon. In acute cases massage and the application of warmth is recommended as treatment and if these measures do not help also the administration of medication (Knorr, 1986; Arroll, 2006; Manners, 1999; Halliwell et Monsell, 2001; Gedalia et al, 1996; Szer, 1989). Halliwell et Monsell (2001) probably refer to one of the few studies which look at therapeutic measures in the case of “growing pains” (Baxter et al (1988)) when they suggest that an idea to treat “growing pains” would be to apply physical therapy in the form of a muscle stretch program.

Articles that were published in recent years, e.g. by Mitchell et al (2004), point out repeatedly that the suggestions concerning the treatment of “growing pains" are insufficient. They also voice the hope that more research will be carried out on the topic in the future.
This is exactly the objective of this paper: to carry out more research with regard to the possibilities of therapy for children with “growing pains”. The actual question of this study is, whether osteopathy can influence the clinical picture of “growing pains” in children in a positive way.
The quest for possible therapies for children with “growing pains“ seems to be more than urgent especially because the administration of medication (Paracetamol) is recommended as treatment even though the effectiveness of this form of treatment has not been verified yet (Goodyear-Smith et Arrol, 2006).

This study will thus focus on the question whether it makes sense to treat children with “growing pains” with osteopathy. The study is designed as controlled clinical application study. The participants are divided into an experimental group and a control group. If and in how far osteopathy represents a reasonable form of treatment in children with “growing pains“ will be examined with regard to the phenomenon’s clinical picture, i.e. two parameters will be evaluated: the pain intensity and its frequency of occurrence. The two parameters will be measured over a period of three months by means of a questionnaire developed by the author of this paper.

In the first section of the paper the reader will find an overview of the current knowledge on the topic “growing pains“ and a description of how osteopathy tries to approach the problem. The next section will explain the methodology of the study and finally the results will be presented.

2. Basic facts

2.1. The term “growing pains”

The term “growing pains” was first used by Duchamp (1823). Duchamp observed various kinds of muscle pain in children, which seemed to occur less frequently in adults. Thus he attributed the pain to the children’s growth. Seham (1933) argues that the term “growing pains” is wrong, Brenning (1960) thinks that the term is misleading and also Oberkleid (1997) dismisses the term as incorrect. Abu-Arafeh (1996) proposes to rather speak about “recurrent limb pain in childhood”. Also Al-Khattat and Campbell (2000) recommend to use this expression as long as the aetiology of the pain is not completely clear. Until now there is no proof that growth as such is painful. However, the term “growing pains” is still used in the literature. (Al-Khattat et Campell, 2000)

2.2. “Growing pains” – a rule-out diagnosis

The diagnosis “growing pains” is a rule-out diagnosis.
Many authors who addressed the topic like Naish et Apley (1951), Brady et Grey (1989), Calabro et al (1976), Knorr (1986), Manners (1999), Halliwell et Monsell (2001), Weiner (1983), Peterson (1977), Doughty (1988) and Szer (1989) agree on how important it is to rule out severe pathologies or other serious conditions. Bernbeck (1981) takes on a quite radical stance arguing that in three decades of orthopaedic clinical practice he never met one single case where the diagnosis “growing pains” was a convincing explanation for the child’s complaints in the legs. In all cases causative factors like faulty axes, traumas, osteonecroses, tumours etc. could be detected. Contrary, the paediatrician Vanura (1982) is convinced that “growing pains” represent a typical phenomenon where children experience pain around the knees when they are about to fall asleep. The children are almost “hysterical” but can be clamed down quite quickly through massage, soothing words and the application of either cold or warmth. The pain varies in frequency and usually

disappears after a few months or years. When this description applies usually no organic problems can be found. Thus the question arises whether cost-intensive examinations and tests really make sense. The most important things are observation and possibly blood tests.

Besides serious pathologies of the locomotor system Bernbeck (1981) also mentions static insufficiencies of the feet, faulty axes of the knee joints and weakness of muscle function as causative factors for the "*fatal false diagnosis growing pains*". In contrast, Vanura (1982) writes that deviations from the axes in the case of genua or coxa valga or pes planovalgus are physiological variants and only a temporary phase which should be considered in "growing pains". After all, there seems to be a common denominator and the argument appears to be more an ideological one. Bernbeck, who is an orthopaedist and usually is confronted with serious dysfunctions in the locomotor system wants to *"ban"* and *"completely extinguish"* the term "growing pains" (note from the author: these are words that should be used carefully in the German speaking world). Apparently, he was confronted repeatedly with cases where children were wrongly diagnosed with "growing pains" although a more serious pathology was present. As paediatrician Vanura has to deal very often with the typical clinical picture of "growing pains". He made the experience that comprehensive and cost-intensive examinations to rule out serious diseases expose the child to radiation and aggravate the psycho-emotional mechanism linked with "growing pains" but often do not provide results. Vanura (1982) also mentions that so far almost no "hard" data exists concerning this diagnosis and he voices the request for more research to standardize examinations and accumulate the findings.

This controversy illustrates how complex the topic is and how important it is to have a well-defined clinical picture on the one hand to decide which cases belong to the category "growing pains" and on the other hand to recognize possible pathologies. Doughty (1988) lists a number of pathologies that can be interpreted as "growing pains" in their early stages:

- juvenile rheumatoid arthritis
- acute rheumatoid fever
- dermatomyositis/polymyositis
- leukaemia
- Perthes disease
- Osgood-Schlatter disease

- slipped capital femoral epiphysis
- osteoid osteoma
- osteomyelitis
- sickle cell disease
- thrombophlebitis
- sacral abscess
- lumbosacral spinal infection or tumour
- infectious or degenerative neuromuscular diseases

However, all these pathologies are usually accompanied by other symptoms like fever, weight loss, limping, neurological signs and positive findings in blood tests or abnormal radiological findings. If a child does complain of non-specific musculoskeletal symptoms the probability of a serious condition decreases over time. (Doughty, 1988)

2.3. Definition of "growing pains"

"Expression which describes pulling (nocturnal) pain in children and adolescents that mainly affect the lower extremities; since growth usually is not painful, it is always necessary to look for other causes, e.g. chondropathia patellae, aseptic osteonecrosis, rheumathoid conditions and in particular severe pathologies (leukaemia)." (Pschyrembel, Klinisches Wörterbuch, 1994, p.1652)

According to Hashkes et al (2005) the diagnosis "growing pains" is at present established merely on the basis of clinical symptoms. Since the cause is unknown there are no sensitive or specific laboratory tests.

In the relevant literature the indication of the frequency of "growing pains" ranges from 2.6% to 50% (Al-Khattat et Campbell, 2000).
This high variability of incidence also reflects the fact that the relevant studies applied different inclusion criteria and that also their sample sizes varied considerably. Three studies will be compared below to make this inconsistency even clearer. Naish et Apley (1951) describe a quite low incidence of 4.2% which probably results from the fact that the authors chose rather strict inclusion criteria (e.g. non-articular pain for at

least three months which is bad enough to impair normal activities) and that they interviewed mothers and children. Oster et Nielson (1972) collected their data only from children and found an incidence of 13% in boys and 18% in girls. Their study differed from the first also in the sample size: With 2178 children Oster et Nielson (1972) had three-times more test persons than Naish and Apley (1951).
With a sample size of 1445 children Evans (2004) found an incidence of “growing pains” of 36.9%. His study is based on a questionnaire with a good validity and reliability. He only looked at children aged 4 to 6 while Oster et Nielson (1972) examined children and adolescents between the ages 6 and 19.
The great diversity of inclusion criteria and sample sizes of these studies shows that the demographic incidence of “growing pains” cannot be determined in exact figures.

At what age do “growing pains” occur? In this regard the statements are more concurrent. Goodyear-Smith et Arrol (2006), Doughty (1988) and Oster et Nielson (1972) indicate that children mainly suffer between the ages 3 and 12. Naish et Apley (1951) describe the same picture but point out that the pain occurs most frequently between the ages 8 and 12. According to Calabro et al (1976) the pain can occur at any time during childhood and adolescence. Baxter et al (1988) indicate the period between the ages of 4 and 12, thus the time when growth continuously decreases before the growth spurt in adolescence takes place. Also Noonan et al (2004) indicate the same period (4 to 12). If all figures are summarized, the period between the ages of 3 and 12 can be regarded as the period where “growing pains” occur most frequently.
Besides the definition according to Pschyrembel (1994) mentioned above, there are a number of other definitions which will be presented below to find out whether there is a common denominator and also to illustrate that different authors put their emphasis on different things in describing “growing pains”.

Peterson (1977) defines “growing pains” as pain that occurs periodically late in the afternoon or in the evening in both legs. The pain is most commonly localized in the muscles of the anterior thigh, the calf or the popliteal fossa. There is no pain in the morning and the pain must not cause any limping or restriction of movement.

The description of Hashkes et al (2004) paints the following picture: “Growing pains” are non-articular, bilateral and usually located in the legs. They occur episodically in the early evening or at night and can last between some minutes up to hours with any degree of intensity. In severe cases the pain may also occur daily.

Calabro et al (1976) describe “growing pains” as continuous pain deep within the leg, which usually is a muscular pain, pain that sometimes occurs around the joint but rarely articular pain. The pain can occur at any time of the day or night, but more typically it starts at night. It is characteristic that the child can fall asleep without any problems but wakes up screaming during the night.
Girls are more often affected than boys. Family predisposition is reported in more than half of the cases. A weak immune system, flat feet and food allergies can be provocative factors.

Doughty (1988) describes the localisation of “growing pains” as often bilateral in the soft tissues of the thigh, the calf and popliteal fossa, less often in the arms, shoulders and inguinal region, in the back or back of the foot. The pain can often go hand in hand with a feeling of helplessness. It usually occurs in the late afternoon, in the evening or at night and is normally gone in the morning. Extensive physical activity can precede the pain. Also this author writes that family predisposition is possible.

Knorr (1986) writes that children with “growing pains” are healthy children without any injuries. The pain episodes typically occur at night and last from half a minute up to half an hour. The regions that are affected by the pain usually are the soft tissues of the thigh, the calf or the shin bone, typically bilateral but it can also change from one leg to the other. The children commonly describe the pain as deep.

Also Atar et al (1991) define “growing pains” as episodes of typically bilateral pain with symptom-free intervals of days, weeks or months in between. The pain occurs most often at the end of the day. The children might wake up during the night and they describe the pain as deep within the muscles of the thigh or the calf, sometimes in the popliteal fossa or groin and very rarely in the arms. “Growing pains” can be aggravated by a lot of running during the day, but the pain can occur due to fatigue also in children who were not excessively active.

The common denominator of all these definitions seems to be that **"growing pains" occur at night in the soft tissues of the legs**.

In my opinion the authors Goodyear-Smith et Arroll (2006) provide a quite concise and comprehensive summary: They define "growing pains" as typically non-articular pain that affects both legs and occurs recurringly in the evening or at night. In addition, this pain must not cause any limping or restriction of movement. There must be no sign of local trauma or infection and also the laboratory tests and radiological examinations have to be normal.
The definition of Goodyear-Smith et Arroll can be regarded as the basis for this study.

2.4. Facts and theories concerning possible causes

2.4.1. "Hard data"

From my personal experience as therapist I know it is much easier to treat a complaint whose origin is known than a problem, where it is unclear which structure is affected or which anatomic substrate is responsible for the symptoms.
To date there is no examination or test that clearly indicates "growing pains". The "hard data" in this respect is that there is a consistent decrease of the speed of growing between the ages of 4 and 12. This is the time before the growth spurt in adolescence starts. Also "growing pains" usually occur in this period. 65% of the growth of the lower extremity occurs in the distal femur and the proximal tibia. Children with "growing pains" thus often indicate the region around the knee as pain localization (Baxter et Dulberg, 1988).

2.4.2. Correlation between growth and pain

Naish and Apley (1951) had the objective to collect basic data concerning "growing pains". The two authors are quoted or mentioned in many articles on the topic, e.g. by Evans (2003), Hashkes et al (2004), Friedland et al (2005), Baxter et Dulberg

(1988), Oster (1971), Doughty (1988) and Atar et al (1991). The main questions in their clinical study were whether continuous non-arthritic pain in the extremities during childhood was always the same type of pain with the same aetiology and what clinical correlations the individual types of pain had. 721 school children and their mothers were interviewed. The children with “positive“ data concerning pain in the extremities were thoroughly examined and asked questions about the pain, family history, personal history, mentality and physical condition. The same number of children was used as control group. They were also examined and asked the same questions. After one to three years a questionnaire was distributed. An additional group of 54 children with pain in the extremities according to the criteria of the study was included a significant difference to the first group of school children was excluded. Overall 78 children with pain in the extremities remained for data collection. The study showed that continuous non-arthritic pain in the extremities among school children occurred in 4.2% with the most frequent occurrence between the ages of 8 and 12. In comparison to the control group rheumatoid conditions occurred significantly more often in the families of the children who suffered from “growing pains”. The authors of the study could divide the majority of these children into two groups: 1.) Children who experienced a sort of “fatigue pain during the day” that could be linked with exhaustion, tiredness and bad posture. In this group also emotional problems were common. 2.) Children suffering from rather “cramp-like nocturnal pain” who were emotionally more stable but who had a higher incidence of similar pain in their families.
The authors of the study advocate that the term “growing pains” is abolished because to date the pain does not show a recognizable correlation with growth.

Oster et Nielsen (1972) also studied the possible correlation between growth and pain. They looked at 2178 school children aged 6 to 19. The main objective of their study was to investigate the correlation between growth and pain which the term “growing pains” implied. The school children were asked about “growing pains” within the framework of the annual medical check-up at school. On the basis of strict inclusion criteria the authors of the study identified 337 children with “growing pains”. These children and a control group of the same size were examined further and their growth was evaluated with regard to three criteria: body height, weight and the height-weight ratio. The children were also asked about headaches or stomach ache.

The authors found out that out of 337 children with “growing pains” 332 children also suffered from headaches and/or stomach ache. The study could not establish any correlation between growth and pain. Nevertheless, the authors advocate the use of the term “growing pains” as long as one realizes that it is a rule-out diagnosis. In addition, they support the demand of more research concerning the aetiology and pathogenesis of the phenomenon and they postulate that “growing pains” like recurring headaches or stomach ache are part of a specific emotional family pattern.

The study of Lampl et al (1992) is another interesting one. It does not focus on “growing pains” as such but rather looks at growth itself. The authors wanted to examine the gentle upward curve of growth in more detail. Traditionally this growth curve is calculated on the basis of quarterly or semestral measurements of body height and weight. The authors carried out a series of body height measurements (weekly, half-weekly and daily) in 31 normal infants and were able to show that growth is discontinuous and happens in a-periodic growth spurts. These growth spurts have an amplitude of 0.5 to 2.5 cm and are usually followed by periods with no measurable growth. The intervals can last 2 to 63 days. These data suggest that growth in body height is a non-linear process and that during 90 to 95 % of the time in a child’s normal development no growth takes place.

Noonan et al (2004) used the findings of Lampl et al (1992) that growth occurs in spurts and looked at “growing pains” under this new aspect. The authors could gain new information on the longitudinal growth of bones by implanting microtransductors in the tibial bones of young lambs and measuring the length of the bones every 167 seconds for a period of 21 to 25 days. The results showed that 90% of the longitudinal growth of bones occurs during rest, while almost no growth was measurable when the animals were standing or moving around.
On the basis of these results the authors proposed the following hypothesis concerning the causes of “growing pains”: *“A possible mechanism of pain may result from increased tension in the periosteum as the growth plates spring back from released compression or by some signal transduction mechanism during recumbency.”* (Noonan et al, 2004)

Taking into account that the lower extremities of children grow mainly during rest and off weight bearing like Noonan et al (2004) suggest, and considering the information on episodic growth as described by Lampl et al (1992), one may reasonably expect that “growing pains” really have something to do with growth (due to the pain characteristics nocturnal and episodic; cf. chapter 2.3.). A possible connection between growth and this type of pain lies in the fact that “growing pains” mainly occur in the evening or at night, i.e. during a period of rest after physical strain or weight bearing. This is the time when the longitudinal growth of bones takes place. Another possible connection is the fact that “growing pains” occur episodic just like the longitudinal growth is non-linear and episodic and happens in growth spurts.

2.4.3. Causality of “growing pains”

If the pain is related to growth but growth as such cannot be considered as the cause of the pain because not all children experience pain during growth, the cause has to be found elsewhere.

Hashkes et al (2004) tried to further investigate the causes. They assumed that a possible cause could be a different pain threshold of the children. The authors measured the pain threshold of 44 children with “growing pains” and of 46 children in a control group with a Fisher-type dolorimeter. A pressure of 4 kg/cm2 is exerted on tender points that are indicated in fibromyalgia syndrome, on control points and on the anterior tibia, since the anterior tibia is the region that is most often indicated as painful in the case of “growing pains”.
The results showed that the pain threshold of the tender points in children with “growing pains” is significantly reduced in comparison with the children of the control group. In addition, children with “growing pains” seem to have more tender points than children that are not affected by this type of pain. Additional interesting data shows that in all children the pain threshold of the tender points of the anterior tibia is the lowest in the whole body. On the basis of these findings the authors of the study postulate that “growing pains“ represent a non-inflammatory pain syndrome in younger children, which does not only cause a locally disturbed function. In this study 20% of the children with “growing pains” also reported to suffer from headaches and stomach ache.

This study thus showed that an increased pain perception could probably be a contributing factor in the pathogenesis of “growing pains”.

Friedland et al (2005) do not really contradict this but according to them “growing pains” could be a syndrome of local over-straining. In their study they evaluated 39 children with “growing pains”. They measured the speed of bone conduction with quantitative ultrasound in the mid-tibial region and in the radius. The values were compared with standard values of 595 healthy boys and 490 healthy girls. The bone conduction speed of the tibia is significantly reduced in children with “growing pains”. In girls it is also reduced in the region of the radius. These results suggest that (locally) reduced bone density contributes to the pathogenesis of the syndrome “growing pains”.

Hashkes et al (2005) presented another theory. They suspected that due to a more frequent occurrence of migraine in families with children who suffer from “growing pains” and due to the sudden onset of the pain episodes, a vascular component could play a major role. Thus they evaluated children with and without “growing pains” and compared the painful mid-tibia region with the pain-free mid-femoral region. After an intravenous injection they measured the vascular perfusion patterns but could not detect a significant difference between the children or the regions of the leg. The authors thus concluded that in contrast to migraine “growing pains” are not coupled with changes of vascular perfusion in the painful regions.

In several articles and studies (Naish et Apley, 1951; Oster et Nielson, 1972; Calabro et al, 1976; Doughty, 1988; Hashkes et al, 2004) a predisposition in the family is mentioned as cause of “growing pains“. Naish et Apley (1951) examined this aspect more closely. In their study they detected a considerably tendency of “growing pains” in the families of affected children. The children with purely nocturnal pain usually had relatives who suffered from similar pain, while children who experienced the pain during the day had a distinct history of “muscular rheumatism” running in their families. Hashkes et al (2004) also support their findings with concrete figures: 39% of the children with “growing pains” (of a total of 44 children) have a predisposition running in the family.

According to Baxter et Dulberg (1988) and Evans (2003) there are three major theories about the origin of this type of pain:

- *Fatigue* as response to an overstraining in very active children
- *Anatomical causes* like pes planovalgus, genu valgum or varum, an excessive tibia torsion or femoral anteversion, a leg length difference or scoliosis
- *Emotional factors* as part of a larger pain pattern including headaches and stomach ache

However, none of the theories has been sufficiently examined to provide a definite conclusion.

There are many approaches concerning the causality of “growing pains“. Some hypotheses like a reduced pain threshold, family predisposition or a (locally) reduced bone density have already been confirmed by certain studies but these results are not sufficient to draw generally valid conclusions. Why and whence the pain occurs still remain unsolved questions. Another question is whether different causes can exist concurrently and contribute to the problem.

2.4.4. Treatment of “growing pains”

Among the available literature two studies looked particularly at the treatment of “growing pains”. The “reasonable” treatment approaches vary depending on which theory on possible causes is chosen as a basis.

Baxter et Dulberg (1988) based their study on the muscular fatigue theory, for which they indicated two hypotheses: muscle spasm or tissue damage. The background of muscle spasm could be a local ischemia, while tissue damage could be attributed to an inflammatory process. Stretching the muscles is one possibility to increase the blood supply and thus reduce the ischemia and also to speed up the healing of the inflammation. Based on these hypotheses 34 children with “growing pains” fulfilling the inclusion criteria according to Naish et Apley (1951) were included in a randomized controlled study. They were repeatedly examined over a period of 18 months and the participants in the experimental group also were treated with a muscle stretch program. In the experimental group (18 children) a significantly faster

reduction of the symptoms could be observed than in the control group (16 children). The authors of the study also pointed out that the natural course of “growing pains” is that the pain usually lasts 12 to 24 months and than slowly decreases in frequency but nevertheless can occasionally flare up right into teenage years.

Evans (2003) considered the anatomical theory as cause of the “growing pains“. The author examined the observed correlation between “growing pains” and the position of the feet in children aged between 3 and 10 and also the efficiency of a therapy with shoe lifts (wedges) and ortheses in children who suffer from this type of pain and have pronated feet. The proposition of this study is that a pronated foot creates a muscle dysbalance between the Mm. tibiales anterior and posterior and the Mm. peronei, which means that the supinators have to work harder. This overstraining produces pain in the legs. The hypothesis is based on both theories of possible causes: fatigue and anatomical problems. In single case experimental designs 8 children aged between 3 and 10 received shoe wedges (children between 3 and 5) or ortheses (children between 7 and 10). The A-B-A-B design helps to recognize the connection between intervention and effect. In the study the frequency and intensity of pain was measured. Both the theoretical correlation between the foot position and “growing pains“ as well as the efficacy of shoe wedges and ortheses in children with pronated feet who suffer from “growing pains“ could be confirmed in this methodologically well-designed study. Nevertheless, it has to be considered a pilot study due to the small number of participants.

2.4.5. Summary

The information gained so far can be summarized as follows:
The term “growing pains” seems to be justified because there are several indicators (Lampl et al, 1992; Noonan et al, 2004; Baxter et Dulberg, 1988) that growth and pain that mainly occurs at night in the children’s legs are correlated. But since children with and without “growing pains” grow equally (Oster et Nielson, 1972), there must be another or several other factor(s) that contribute to the pain onset. One underlying factor could be family predisposition (Naish et Apley, 1951; Hashkes et al, 2004). Another factor that possibly plays a role in this context could be a reduced pain threshold (Hashkes et al, 2004). It is also worth mentioning, that a reduced bone

density especially of the tibia could be a contributing factor (Friedland et al, 2005) and also the position of the feet could also play a considerable role as contributing factor in the pain onset (Evans, 2003). In the case of “growing pains” the anterior tibia is the region that is most commonly indicated as the site of pain. This could be attributable to the fact that in all children the pain threshold of the tender points in the region of the anterior tibia is the lowest in the whole body (Hashkes et al, 2004). The affected tissue could be the periosteum, which reacts with increased tension as the growth plates spring back from released tension (Noonan et al, 2004). Therapeutic work on the muscles of the lower extremity (Baxter et Dulberg, 1988) and treatment of the position of the feet (Evans, 2003) can have a positive influence on “growing pains”.

2.5. Osteopathic approach to “growing pains”

“To understand a clinical manifestation it often is necessary to look for the origin of the dysfunction even if it is far away from the site of the manifestation” (Paoletti, 2001, p. 193). This sentence describes a quintessential thought in osteopathy which is also important for the present study especially since the phenomenon “growing pains” is only insufficiently explored to date.
The task of the osteopath is to understand the mechanism of “growing pains” in children on the basis of the information of only a few studies on the topic (cf. Facts and theories concerning possible causes) and with the aid of osteopathic models. The practitioner then has to find the best possible treatment approach.

The findings and conclusions that are summarized in chapter 2.4.5 serve as basis for an osteopathic approach. These include: **a probable link with growth**, **a reduced pain threshold, a reduced bone density and the foot position which can be contributing factors in the onset of pain,** the fact that **the complaint seems to run in the family**, that **the affected tissue** could be **the periosteum** and that **therapeutic work on the muscles of the lower extremities and the treatment of the foot position have a positive influence** on “growing pains”.
Again it has to be pointed out that to date no clear cause for the occurrence of “growing pains” has been found. Neither the pathogenesis nor the pain mechanism

itself can be explained in a scientifically sound way or if there is a sound explanation it has not been confirmed yet. This means that any treatment approach remains hypothetical or experimental.

How can osteopathy treat the problem based on the above mentioned findings and conclusions?

Several studies (Lampl et al, 1992; Noonan et al, 2004; Baxter et Dulberg, 1988) point out a link between “growing pains” and growth. However, growth as such cannot be “blamed as culprit” for the pain because otherwise every single child would suffer from this type of pain. In my opinion a growth spurt is the most probable trigger for the onset of this kind of pain. The onset also seems to be facilitated by a predisposition running in the family (Naish et Apley, 1951; Hashkes et al, 2004). However, the factors **family predisposition and growth** cannot be approached in treatment.

2.5.1. Reduced pain threshold

A **reduced pain threshold** is a factor that is worth looking at with regard to a therapeutic intervention. Pain is an individual sensory perception, something that the affected person experiences. (Mayer-Fally, 2007) *“Normally pain is perceived if a lesion has occurred in the body (…) The pain perception is influenced by various factors. First of all, pain is modulated by higher centres through the regulation of descending inhibiting pathways and through the release of endorphins. These centres are again subject to the influence of the superordinate centres of attention, emotion and concentration (…) the pain threshold can be elevated in a soldier in the battle field. Conversely, social and cultural influences can lower the pain threshold.”* (Sammut et Searle-Barnes, 2000, p.59) Concerning the intensity of the pain the following statement is interesting: *“Up to a certain degree the intensity of the pain correlates with the intensity of the nociceptor stimulation even though the limbic system can have a strong modifying function depending on the emotional sensitivity and cultural background of the patient. “* (Sammut et Searle-Barnes, 2000, p.118) With regard to pain children have very different learning experiences. It is very important for the future perception of pain how the adults in the environment of the

child deal with their pain. When learning the feeling of “pain” the comparative observations are lacking in the learning process, while in other learning experiences the comparison is quite easy, e.g. in learning what is “loud” and “quiet”. (Millner, 2001)

A general therapeutic approach to increase the pain threshold can be to point out the benign character of “growing pains” within the framework of the treatment and if necessary to help (especially through explanation) the persons to deal with pain in a more relaxed and calm way. This therapeutic approach within the framework of an osteopathic treatment is also recommended by Deoora (2006) with regard to functional stomach ache. A more concrete osteopathic approach to increase the pain threshold is to harmonize the hormonal situation. It has already been mentioned above that endorphins are released in the process of pain modulation. Cranio-sacral osteopathy postulates that it is possible to influence the hormonal situation. Depending on the model that serves as the basis for the work it is assumed that the pituitary gland can be influenced via a regulation of the sphenobasilar symphesis (Liem, 2001, p.475-517) or via a compression of the third ventricle [CV-3 technique] (Liem, 2001, p.362), that the “hormonal axis” of the whole body can be affected (Wutzl, 2006) or that a hormonal regulation can be achieved with fluid techniques (Darraillans, 2004).

The aforementioned description of pain indicates that in the wider sense pain is modulated by the centres for attention, emotions and concentration. In addition social and cultural influences can lower the pain threshold. Mitha (2006) writes that according to her experience many children with recurring stomach ache (of unclear origin) suffer from a vegetative dysregulation. She argues that this vegetative dysregulation is caused by various emotional and physical stress factors. With the aid of osteopathy this functional abdominal pain can be influenced through techniques that regulate the autonomous nervous system. From that it can be deduced that also in the case of “growing pains” the regulation of the autonomous nervous system may be a possible approach, which could elevate the pain threshold. Fürpaß (2007) showed in 12 test persons that an osteopathic intervention tends to have a positive influence on the autonomous nervous system. The younger the patients are the better the result. Within osteopathy itself there are different approaches to influence the autonomous nervous system, e.g. work on the solar plexus (Deoora, 2006), manual mobilisation of the thoracic spine (Ligner, 2007), work on the cranial base

with preceding work on the interosseous membranes between fibula and tibia and between radius and ulna (Darraillans, 2004), compression of the 4th ventricle (CV-4 technique) (Liem, 2001, p.358).
The approach via the regulation of the autonomous nervous system is based on the assumption that besides physical stress factors there is also a link between the vegetative and emotional dimensions of pain. In the context of functional (nervous) abdominal pain Deoora (2006) points out that the autonomous nervous system is very sensitive with regard to emotional stress. She presents another osteopathic approach where the practitioner looks for persistent *"shock patterns"*. It is assumed that emotional stress can be stored in the tissues and that the osteopath can palpate and treat this tissue memory. According to the author it seems that releasing these *"shock patterns"* can influence the autonomous nervous system in a positive way. This idea can definitely also be applied to "growing pains" especially because in the literature (Naish et Apley, 1951; Hashkes et al, 2004) a connection between headaches and stomach ache in children is described.
This implies that within the framework of an osteopathic treatment of "growing pains" in children the work on the autonomous nervous system according to the above mentioned assumptions would make sense with regard to increasing the pain threshold. In addition, craniosacral therapy to influence "shock patterns" can represent a reasonable treatment approach. The harmonization of the hormonal situation and some help to deal with pain in a calmer and more composed manner can also help to increase the pain threshold.

2.5.2. Locally reduced bone density

The **locally** (at the tibia) **reduced bone density** discovered by Friedland et al (2005) can represent another starting point for an osteopathic treatment of "growing pains". Turner (2006) writes that movement is a factor that has a great influence on the development of joints both intrauterine and in childhood. Stimulating forces, i.e. intermittent compression and tension, are necessary. Bone atrophy can be the consequence of persistent compression. In this respect the task of an osteopath would be to make sure that all parts of the body can move well in relation to each other and are free to adapt. One possibility to achieve this is a treatment according to the principle of "Balanced Ligamentous Tension" (BLT) with regard to the ligaments

around the joints or “Balanced Membranous Tension” (BMT) in the case of the interosseous membranes in the extremities.
The locally reduced bone density in the tibia could also be influenced through a treatment of the bone itself. There are several models in osteopathy concerning the treatment of bones as such. Liem (2001) describes a “fluid impulse”, a technique that focuses directly on the bone and offers the possibility to work on the elasticity and dynamics of intraosseous structures. The same author mentions the principle of “moulding” as another treatment method for intraosseous dysfunctions, where the practitioner tries to influence the form and pliability of the bone through external traction or compression.
Intraosseous strains and compressions can be the result of the sudden impact of traumatic forces or the consequence of a slow deformation. These strains can occur in any bone of the body and have an effect on the whole body structure and function. In childhood this is often the case especially before ossification is completed. (Grundberg, 2006)
In the introduction to his article “Lower Extremity Problems In Children – An Osteopathic Approach” Pratt (1950) writes: *“To understand and to treat intelligently the various problems that arise during the development and growth of the lower extremities it is necessary to know the fundamentals of embryological development and the normal changes taking place during childhood.”* In this context it is worth mentioning that the synostosis of the proximal epyphyseal line of the tibia takes place around the age of 17 or 18 (Turner, 2006). None of the authors, however, indicate “growing pains” at that age (cf. chapter 2.3.). The “growing pains” are most often localised in the region of the proximal anterior tibia (Hashkes et al, 2004), thus exactly the region of the proximal epiphysis. Grundberg (2006) mentions that the period shortly before ossification is completed is the period where intraosseous strains or compressions occur quite often. Also Carreiro (2007) argues that bones react particularly sensitive to stretching or compressing forces during ossification. She also explains that in the lower extremities ossification starts quite early and is completed relatively late thus this region of the body is vulnerable for a long time. The ossification of the proximal tibia, for instance, starts with birth and is completed only between 16 and 19 years of age. The topic ossification is only briefly mentioned in this paper to illustrate that osteopathy tries to gain a fundamental understanding of human development which serves as the basis for the treatment.

2.5.3. The periosteum as “key structure” in “growing pains”

The tissue that is affected by “growing pains” could be the **periosteum**, which reacts with increased tension as the growth plates spring back from released compression (Noonan et al, 2004). Also in osteopathy the periosteum is regarded as the tissue that is most promising with regard to the treatment of this type of pain. Even though I could not find it in the literature, a common view among osteopaths concerning “growing pains” is that bones and soft tissues grow at different rates so that a growth spurt produces a pull of the muscle tendons on the periosteum. The tendons are the “slower” tissues. This pull or traction of the tendon on the periosteum is responsible for the perceived pain.

Turner (2006) writes that in order to grow bone forms new at the periostal surface while it is absorbed at the endosteal surface. This would support the theory that the periosteum is a sort of “cushioning zone” which reacts to growth. Mayer-Fally (2007) describes periostal pain as stabbing pain that is present also during rest. An explanation for the fact that “growing pains” usually occur during rest could be the following: all contact, movement, tension and position afferences (proprioceptors) that are located in abundance in all tissues of the locomotor system lead among other things to a down regulation of the motoric and sympathetic system activation. (Böhni, 2006) This means that e.g. through movement the actual pain transmission can be suppressed. It can also be an explanation of why stroking or massaging can momentarily influence the “growing pains” in a positive way.

Based on the above mentioned views shared by many osteopaths, a possible osteopathic approach to influence the periosteum would be to work locally and systemically on the muscle tone to reduce the pull of the tendons on the periosteum. In my opinion, also the concept of the myofascial meridians according to Myers (2004) offers a good possibility. The author expands the view of the attachment of muscles on the bones by emphasizing that most myofascias merge with the periostal envelopes of the bones (Myers, 2004, p.74). Therapeutic work on the myofascias would thus have an even more direct influence on the tension of the periosteum.

“The term “myofascia” describes the inseparable entity of muscle tissue (myo-) and the connective tissue that forms a network around it (fascia), (…).” (Myers, 2004, p.4)

The myofascial meridian model focuses on the aspect that myofascias

“communicate” over longer distances and wide regions in the body. It thus supports the holistic view of structure and movement of the human body. Given this information there are a number of osteopathic techniques which can be applied in the case of “growing pains”. Since Turner (2006) emphasizes that rather gentle techniques should be used for children, one appropriate method with regard to the myofascial structures would be a treatment according to the principle of “Balanced Fascial Tension” (BFT).

2.5.4. The three theories about causative factors: fatigue, anatomical causes and emotional factors

Considering that **work on the muscles of the lower extremities and treatment of the position of the feet are reasonable treatment options,** it could helpful to reiterate the three theories about possible causative factors (cf. chapter 2.4.3.) according to Baxter et Dulberg (1988) and Evans (2003):

- **Fatigue** as answer to an overstraining in very active children
- **Anatomical causes** like pes planovalgus, genu valgum or varum, an excessive tibia torsion or femoral anteversion, a leg length difference or scoliosis
- **Emotional factors** as part of a larger pain pattern with headaches and stomach ache

The study of Baxter et Dulberg (1988) is based on the theory of **muscular fatigue**. The authors were able to show in their work that a program of muscle stretching has a positive influence on the clinical picture of “growing pains”. The muscles of children react differently than the muscles of adults because the children’s muscle cells are further apart. This also means that the muscles of children tire more quickly if they are strained over a longer period (Carreiro, 2007). There are a number of osteopathic techniques which concentrate on improving the function of the muscles like the Jones techniques, myofascial release, AORT, or Mitchell techniques. In my opinion the application of these techniques in the overall context of an osteopathic therapy seems to meet the objective with regard to the treatment of “growing pains”.

The overall context of osteopathy requires that the practitioner reflects whether muscular fatigue as such can be the cause of the problem or whether misalignments in the skeletal system can entail the muscle fatigue.

The theory of **anatomical causes** of “growing pains” is advocated by Evans (2003). Her study postulates that a pronated foot can cause a muscular dysbalance between the Mm. tibiales anteriores and posteriores and the Mm. peronei, which means that the supinators have to work harder. The leg pain is a result of this overstraining. The study looks at the use of shoe wedges and ortheses as therapeutic intervention to correct the position of the feet.

Cleghorn (2006) writes that osteopathic treatment can help a great deal especially in the case of functional disturbances of the arches of the foot. Also in cases of true deformities the treatment can reduce the misalignment considerably. In this context Cleghorn regards two osteopathic treatment approaches as particularly helpful: intraosseous work (cf. chapter 2.5.2.) and treatment to affect the blood vessels. He also mentions how important it is that the treatment also addresses and normalizes the proprioceptive system in the body. According to Cleghorn especially the feet, the membrana interossea cruris and the fascia lumbalis are important in this respect because these structures have many proprioceptors. He postulates that once these tissues are normalized atypical feedback mechanisms are reduced.

The theory of anatomical causes for “growing pains” considers misalignments or pathologies like pes planovalgus, genu varum or valgum, an excessive tibia torsion or femoral anteversion, a leg length difference or scoliosis as the origin of the problem. In my opinion this is a very broad field of conditions and a large topic for osteopathy. It would go beyond the scope of this paper to discuss all the various misalignments in detail. Therefore I would like to pick out two problems: the position of the feet for the pronated foot position seems to be of importance to me, also because of the study results of Evans (2003), and the tibial torsion because the tibia is the region where “growing pains” are most often localized.

A pronated foot can also be called flatfoot. A flatfoot is characterized by a dropping of the medial arch. It is normal up to the age of 5. Often it is combined with a skew foot. In later ages it is an acquired problem e.g. due to misalignments of the axes in the knee (Mayer-Fally, 2007). Cleghorn and Möckel (2006) write that the correction of arches of the foot by means of osteopathy is no problem but can take very long. They emphasize how important it is to incorporate the whole body in the treatment and to

start at the head and to work on the spine and the pelvis before treating the feet, where the treatment should particularly look at the navicular bone. In addition, all articulations in the foot and also the plantar aponeurosis have to be normalized. According to Cleghorn and Möckel the fitting of inlays in addition to an osteopathic treatment makes sense. The authors do not describe any treatment techniques, which in my opinion this is due to the fact that there are countless osteopathic techniques in this field, which could be applied in line with the above described concept.

As already mentioned Evans (2006) postulates that a pronated foot causes a muscular dysbalance between the Mm. tibiales anteriores and posteriores and the Mm. peronei, which means that the supinators have to work harder. The leg pain is cause by this overstraining. Carreiro (2007) mentions that in a pes planus the M. tibialis anterior is being pulled down during weight bearing or physical strain which causes the tibia to be more medial and thus have less external rotation. This entails a change in the tension of the M. quadriceps which again increases the strain on the region of the patella. The pulls on the tibial tuberosity are altered. This model could represent a possible explanation of why an altered position of the foot can be the cause of pain in the region of the tibia. If we take the theory of anatomical causes as basis for the therapy treatment of a tibial rotation could make sense in addition to the treatment of the foot position itself. How can the tibia rotation be influenced through osteopathic treatment? Carreiro (2007) recommends the BLT (Balanced Ligamentous Tension) technique especially for children. The aim is to achieve a balance in the tension of the muscles, which would allow that the bone can better adapt to the next growth spurt. The tibia rotation is influenced by muscles like the M. biceps femoris, M. sartorius or the iliotibial tract (Carreiro, 2007).

It has already been mentioned in chapter 2.4.3. that the theory of **emotional factors** as cause for “growing pains” has not been thoroughly examined yet. Given the fact that there is a study on the role of muscular fatigue (Baxter et Dulberg, 1988) and that there is also a study looking at the theory of anatomical causes (Evans, 2003) the theory of emotional factors is to date a kind of “dark horse”.

After discovering that 332 of 337 children with “growing pains“ also suffered from headaches and/or stomach ache Oster et Nielson (1972) postulated that “growing pains” are part of a special emotional family pattern. An osteopathic approach to this has already been described in chapter 2.5.1. with regard to “shock patterns”.

In my opinion Conroy (2006, p. 244) presents a very interesting statement with regard to the emotional theory: *"Examples for a hidden emotional aetiology: patients with pain in the locomotor system which cannot be put down to a recognizable origin and whose symptoms cannot be sufficiently explained by osteopathic or pathologic paradigms."* Conroy uses the expression "emotional patterns" which are expressed in the body as specific variants of the expression of involuntary movement (in the context of craniosacral osteopathy). The palpation and recognition of such patterns in a treatment can already influence them in a positive way. But as osteopath without psychotherapeutic training it is necessary to refer patients with clearly psycho-emotional problems to a specialist. Since emotional patterns act quite often as hidden etiologic and maintaining factors, it is important to be aware of their presence, especially because their presence can explain inconsistencies in clinical findings or therapeutic success according to Conroy.
Liem (2001, p. 335) explains the effects of emotional patterns on the structure: *"…Equally past and present professional and private, sudden traumatic or long-lasting events, memories or believe systems can contribute to the development of abnormal tissue tension and formation and function of cell tissues."* He also describes that the osteopath's function in releasing these patterns is to give an impulse to the patient and to accompany him/her in the release.

2.5.5. Conclusion

Paoletti (2001) pointed out that it is often necessary to look for the origin of a dysfunction also far away from its clinical manifestation. In this context also Ligner et van Assche (1993) have to be quoted with their interpretation of one of the fundamental principles of osteopathy *("the body functions as an entity")*: *"Not the sum of the individual parts adds up to a functioning whole but their interaction, the result of their mutual relationship. Already the tiniest disruption of their balance can lead to lesions which can often manifest far away from the site of their origin and do not necessarily have a dimension that is proportionate to the triggering mechanism."*
From an osteopath's point of view I can postulate the hypothesis that in addition to all the other previously mentioned approaches to treat children with "growing pains" it is absolutely necessary to treat the child in its totality. For me this means to include all detectable lesions in the treatment even if it seems that they have nothing to do with

the clinical picture of “growing pains”. It is possible that the sum of several lesions or maybe only one lesion can play a role and thus be responsible that this possibly inherited pattern of pain is expressed. In this context the term *“lesion”* designates any kind of restriction of movement, any change in the tissue tension, any alteration of the function of a tissue, in short any *“dysfunction”* (Pschyrembel, 1994, p. 840). Liem (2001, p.9) writes that the aim of an osteopathic treatment is: *“(…) to release or reduce causative factors, to re-establish the free mobility of joints and fascias, to normalize the exchange processes of all body fluids, to coordinate bioelectric phenomena, to re-balance the autonomous nervous system, to harmonize the body’s statics, to release visceral disturbances, to support and regulate the nourishing elements in the body, to improve the breathing, to help relaxation, to balance the muscle tone, to strengthen the body’s immune system and to stimulate the body to activate its self-regulating powers in order to heal itself.”*

I would like to close the chapter 2.5. Osteopathic approach to “growing pains” with a statement of Fryman (1998, p.155): *“Every child has a different clinical problem and a unique structural and functional status. Therefore every child needs an individual therapy in osteopathic care (…)”*

3. Methodology

3.1. General remarks

This study deals with **the basic question** whether osteopathy could represent a good treatment option for children with “growing pains”.
The effect of the treatment is evaluated on the basis of changes in the clinical picture. Two outcome measurements are analyzed in particular: intensity and frequency of the pain. These two parameters are assessed by means of a questionnaire developed by the author. The study period is set with three months.
The **study design** is a controlled clinical application.

The children of the experimental group receive three osteopathic treatments over a period of three months. The treatment sessions are spaced at four week intervals. At the beginning of the three-month period the questionnaire has to be filled in, the case history of the individual patients is taken and the children are thoroughly examined. The children also receive their first treatment. After three months the questionnaire has to be filled in again.
The children of the control group are not treated at all during the three-month period. They, too, have to fill in the questionnaire at the beginning of the study period. In addition, a thorough case history of each child is taken. After the study period of three months the children of the control group are thoroughly examined and they also receive three treatments because all participants of the study were promised three osteopathic treatments. The results of the treatment of the children in the control group are also included in the statistical analysis, i.e. the children are compared with themselves. Since there is no generally reliable or standard form of therapy for “growing pains“ in children, the children of the control group are definitely not deprived of therapeutic help even though they do not receive any treatment during the three-month study period.
First, the children and their parents receive all the necessary information about the study. Also all pending questions are discussed in detail. If the parents agree to participate in the study, they sign a written form of consent (cf. annex). The

participants are also informed about the fact that all data will be anonymised and that all treatments are free and not subject to any condition.
All the participants recruited at the beginning of the study are randomized into two groups (experimental group and control group) by drawing of lots. The participants who join in later are attributed alternately into the two groups according to their order of calls. The test persons do not know whether they belong to the experimental or control group.
To make sure that the diagnosis “growing pains” can be considered as right for every participant, their paediatricians or GPs are contacted.

All children who participated in the study fulfilled the inclusion and exclusion criteria described in the following chapters.
The completion of the questionnaires, examinations and treatments of all participants took place at the Praxis für Physiotherapie und Osteopathie (practice for physical therapy and osteopathy), Prinzingerstrasse 11, 5020 Salzburg.
The study period of three months was chosen with the assumption that the pain occurs at least once per month so that a minimum observation period was available. If the “growing pains” were actually correlated with growth, this minimum observation period would be sufficiently long according to the study of Lampl et all. (1992) (cf. chapter 2.4.) to observe at least one growth spurt.

3.2. Inclusion criteria

In this study only healthy children who were diagnosed with “growing pains” (rule-out diagnosis) by their paediatrician or GP were examined and treated.

The age of the test persons was set between 2 and 13 years of age, exactly from the second birthday to the completion of the thirteenth year of age. These age limits are an estimated mean of the age indicated in the literature (Goodyear-Smith et Arrol, 2006; Doughty, 1988; Oster et Nielson, 1972; Naish et Apley, 1951). Due to discussions with paediatricians and based on my own experience in osteopathic practice the lower age limit was set with 2 years.

Another inclusion criterion was that the pain occurred at least once per month.

The clinical picture of “growing pains” had to be present for at least 3 months to estimate an average of the pain frequency and to make sure that the rule-out diagnosis on “growing pains” was the right one. (Doughty, 1988).

3.3. Exclusion criteria

The following pathologies were excluded from the study: juvenile rheumatoid arthritis, acute rheumatoid fever, dermatomyositis/polymyositis, leukaemia, Perthes disease, Osgood-Schlatter disease, slipped capital femoral epiphysis, osteoid osteoma, osteomyelitis, sickle cell disease, thrombophlebitis, sacral abscess, lumbosacral spinal infection or tumour and infectious or degenerative neuromuscular diseases. According to Doughty (1988) these conditions could be interpreted as “growing pains” in their early stages.
According to Manners (1999) other clinical symptoms also serve as characteristics to exclude that other diseases are regarded as “growing pains”: morning stiffness, limping, recurrent fever, nocturnal sweating, discomfort, back pain, stiffness, and abnormal locomotor system.

In addition, children who had a fracture of the lower extremities (confirmed by imaging techniques) were excluded because of the possibility that the pain occurred as after-effect of the fracture.

Children who received an osteopathic treatment in the last three months or had started another course of treatment during this period because of the “growing pains” (e.g. acupuncture, physical therapy, homeopathy) could not be included in the study because this would have made it impossible to assess the therapeutic effect of osteopathic treatment.

3.4. Case history

In both groups the participants were asked to fill in a questionnaire and provide a detailed account of their case history.
The case history of the test persons in the control group was carried out in order to filter out exclusion criteria like fractures, other therapies, abnormal general condition, serious pathologies etc. In general, the parents are also asked about the pregnancy, the birth process and the development of the child in question, important events/data in the child's medical history as well as the global physical condition. The body height, weight and the length of the child's feet are measured in particular. Given the studies of Noonan et al (2004) and Lampl et al (1992) and considering that "growing pains" is in deed related to the longitudinal growth of bones, the measurement of the body height is of particular interest. Another specific question is the question about stomach ache. The background for this is provided by Naish et Apley (1951) and Hashkes et al (2004) who postulate a correlation between "growing pains" and stomach ache. In addition, the participants are asked about "growing pains" in the family to find out whether there is a tendency of this kind of pain to run in families as described by Doughty (1988), Naish et Apley (1951), Oster et Nielson (1972), Calabro et al (1976) and Hashkes et al (2004).

3.5. Examination findings

The test persons of the experimental group were examined after the case history, while the test persons of the control group were examined after the study period. The examination looked at the statics of the patient and paid particular attention to the leg axes and arches of the feet to integrate the findings of Evans (2003). In addition, the body symmetry is observed. Specific tests assessed the child's motor skills, e.g. standing on one leg. A deviation of symmetry and instable one-legged stance can provide information about the balance system in the body. According to Sammut et Searle-Barnes (2000) the muscles have to consume more energy to provide stability if the body does not have a good balance. Thus the theory of muscular fatigue (Baxter et Dulberg, 1988; Evans, 2003) could be considered if the findings concerning body symmetry and one-legged stance are suspicious. The

clinical tests focused on the Fabere-Patrick sign as indicator for Perthes disease (Buckup, 2005), which was also mentioned by Doughty (1988) as exclusion factor. The osteopathic tests assessed in particular the mobility of the spine and the lower extremities to respond to the anatomical theory (Baxter et Dulberg, 1988; Evans, 2003) as well as the visceral and cranial situation to take the correlation between "growing pains" and headaches or stomach ache described by Naish et Apley (1951) and Hashkes et al (2004) into account. It has to be pointed out that every test person underwent an osteopathic examination tailored to his/her specific needs and that the diagnosis was based on the "red thread" of the case history and the individual clinical findings.

3.6. Questionnaire and pain scales

During the first session the parents of both the children in the experimental group and the control group were asked to complete the following questionnaire. The parents had to estimate the average frequency of the pain by means of a numeric rating scale (NRS) and they were also asked to keep track of the pain's frequency from that moment on. They did not have to provide a written record of their observations because the conditions for the second pain rating should be as similar as possible to the first one. From a statistical point of view NRS (numeric rating scales) and VAS (visual analog scales) are preferable over verbal assessments. NRS have the advantage that they have a limited number of possible answers (Dowell et Newell, 1996)

Questionnaire 1 for the study “Growing pains in children – can osteopathy help to improve the clinical picture?”

Thank you for participating in this study! Please take your time to read the following questions and circle the appropriate answers.

1. Is your child physically able to carry out all normal activities without morning stiffness or limping?

Yes / No

2. How long have the growing pains been present?

longer than 3 months

longer than 6 months

longer than 1 year

3. How often does your child experience the pain?

1 / 2 months

1 / month

2 / month

1 / week

2 / week

more often

4. At what time of the day or night does the pain occur?

5. Are there factors that influence the pain, e.g. physical activity, lack of sleep, nutrition, emotional stress, etc.?

Yes / No

If yes, what are these?

6. Where is the pain localized?

Left leg: Pelvis/ Thigh/ Knee/ Lower leg/ Foot

Right leg: Pelvis/ Thigh/ Knee/ Lower leg/ Foot

7. How bad is the pain? Please indicate the average intensity of the pain on the scale (0-10) below. 0 means no pain, 10 means very bad pain.

0	1	2	3	4	5	6	7	8	9	10

8. Does your child take pain killers because of the growing pains?

Yes / No

If yes:

How often do you administer the pain killers?

regularly/ occasionally/ very rarely

If (also) no:

How long does the pain usually stay if you do not give pain killers to your child?

less than 10 min/ 10 min/ 20 min/ 30 min/ longer than 30 min

9. Is there anything that influences the growing pains positively, e.g. massage, warmth, etc.?

Yes / No

If yes, what?

Items 3 and 7 (in questionnaire 2 items 2 and 5) were the cornerstones of the study which allowed analysing the changes in the clinical picture concerning the frequency and intensity of the pain. Also items 5, 6, 8 and 9 could be relevant for observing changes in the clinical picture but in this study they were used to describe the initial situation. In addition to the medical diagnosis and osteopathic case history items 1, 2 and 4 helped to clearly establish the inclusion and exclusion criteria.

After three months during which the children of the experimental group received three osteopathic treatments while the children of the control group had no therapeutic intervention at all, the parents received another questionnaire (cf. below). Also the children of the control group, who received three treatments after the study period, had to complete the following questionnaire after the third treatment.

Questionnaire 2 for the study “Growing pains in children – can osteopathy help to improve the clinical picture?”

Thank you for participating in this study! Please take your time to read the following questions and circle the appropriate answers.

1. Is your child still physically able to carry out all normal activities without morning stiffness or limping?

Yes / No

2. How often does your child experience the pain?

1 / 2 months

1 / month

2 / month

1 / week

2 / week

more often

3. At what time of the day or night does the pain occur?

4. Where is the pain localized?

Left leg: Pelvis/ Thigh/ Knee/ Lower leg/ Foot

Right leg: Pelvis/ Thigh/ Knee/ Lower leg/ Foot

5. How bad is the pain? Please indicate the average intensity of the pain on the scale (0-10) below. 0 means no pain, 10 means very bad pain.

0	1	2	3	4	5	6	7	8	9	10

6. Did your child take any pain killers because of the growing pains during the past three months?

Yes / No

If yes:

How often did you administer the pain killers?

regularly/ occasionally/ very rarely

If (also) no:

How long did the pain usually stay if you did not give pain killers to your child?

less than 10 min/ 10 min/ 20 min/ 30 min/ longer than 30 min

7. Was there anything during the past three months that influenced the growing pains positively, e.g. massage, warmth, etc.?

Yes / No

If yes, what?

8. Did you or persons in your child's environment notice any changes in your child's behaviour over the past three months? If yes, what changes?

9. If your child's growing pains have changed over the past three months, please describe the change briefly in your own words.

In addition, all children between the ages 7 and 13 marked the Faces Pain Scale – Revised (Hicks et al, 2005). Actually, the Faces Pain Scale –Revised is designed for children ageed four and older but since the children had to describe a pain that they

did not feel at the moment of assessment, they had to judge the “growing pains” from their memory. Lise Eliot (2002) writes that with the age of 6 children enter a new phase of intellectual maturity which also goes hand in hand with a change in the memory skills. Thus children from the age of 7 onwards should have the ability to assess pain from memory.

This means that for a certain number of test persons there is only one pain assessment available for others there are two assessments.

For those children with two pain assessments the subjective change in the pain intensity according to the children’s estimation was thus also analysed in the statistics.

Further, the correlation between the parents’ and the children’s evaluation of the pain was analysed.

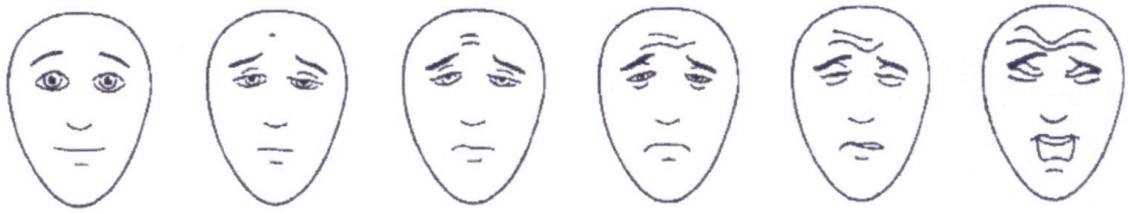
Faces Pain Scale-Revised - Pain scale for children

Annex to the questionnaire for the study “Growing pains in children – can osteopathy improve the clinical picture?”

Date: .....

Name of the child: .....

Age: .....



Instructions:
These faces show how much something can hurt. This face (point on the face at the far left) has no pain. These faces have more and more pain (point on each face from the left to the right) and this one (point on the face at the far right) – has a lot of pain. Please, point on the face that shows how much pain you feel.

3.7. Osteopathic treatment

This study deliberately did not provide a set treatment program for children with "growing pains" because on the one hand this would completely contradict osteopathic principles and on the other hand a clinical picture whose causes are unknown from an allopathic point of view cannot be treated with a standard "recipe". *"An osteopathic and craniosacral treatment is always individual because no patient is like the other and even the same patient presents differently in his tissue tension and energy potential from one day to the other."* (Liem, 2001, p.334) The test persons were treated with techniques tailored to their individual needs according to the dysfunctions that could be found on that day and in that moment. An osteopathic therapy comprises the whole range of osteopathic treatment options. This means that in this study not only craniosacral or only structural techniques were applied.
The children of the experimental group received three osteopathic treatments during sessions of 45 minutes maximum. The children of the control group received the same amount of treatments with the same duration after the study period.
The number of treatments was set on the basis of the following considerations: Due to their much more dynamic changing physiology children need much less osteopathic input for a positive change than adults. It is also important to avoid an over-treatment. (Marris, 2006) The diagnosis "growing pains" is a rule-out diagnosis, a clinical picture describing the pain of children. There is a lack of medical findings. For an osteopath the problem thus belongs to the group of "functional problems". Functional dysfunctions need less therapeutic input than problems involving structural changes (Carreiro, 2007). In addition, fundamentally healthy children can undergo quite rapid changes due to their vitality. (Grundberg, 2006)
In my opinion, it makes thus sense to space the treatments at intervals of several weeks and to opt for a minimum of intervention (three treatments) in this study (which is an osteopathic pilot project on "growing pains").

It has already been mentioned that the children were deliberately not treated with a set treatment program. According to osteopathic principles each child received an individual treatment according to the examination findings and the obvious dysfunctions of the day. My hypothesis concerning "growing pains" was that possibly the sum of several lesions or maybe only one lesion triggered the inherited "pattern"

of this kind of pain. The child thus needed to be treated in his/her totality. In this study osteopathy could be regarded as black box. Nevertheless, the treatment put a certain emphasis on particular aspects according to the explanations in chapter 2.5.
The emphasis lay on:

1. increasing the pain threshold, in particular by influencing the autonomous nervous system
2. correcting the position of the feet and leg axes
3. reducing the pull of the tendons on the periosteum of the lower extremities, in particular by increasing the muscle tone
4. improving the condition of the bones themselves (above all the tibia) by means of intraosseous techniques
5. being open to emotional problems of the child in question by integrating this aspect in the treatment situation and by influencing the emotional component through craniosacral treatment

4. Results

4.1. General remarks

The participants in the study were recruited through distributing and posting information sheets in kindergartens, schools and paediatric, orthopaedic and GP practices in the districts Salzburg Stadt and Salzburg Umgebung as well as through phone calls and personal conversations with paediatricians, orthopaedists and general practitioners.
Overall the parents of 36 children with “growing pains” responded to the announcement of the study, whose children met the inclusion criteria and did not present any exclusion criteria.
At the start of the study in January 2007 24 children were already recruited. They were randomized into two groups by drawing of lots. Over the following months another 12 children joined in the study. According to the order of calls these 12 children were alternately attributed into the two groups. Three children of the control group dropped out of the study because it seemed that their “growing pains” ceased due to their age (12, 11 and 10.5 years of age). They had already observed a distinct progressive reduction of the pain frequency during the months preceding the start of the study. When the parents registered for the study they indicated the frequency of their child’s pain with once every two months but over the next couple of weeks it could be considered as no longer present. In the beginning the inclusion criterion concerning the frequency of pain was defined with at least once every two months. But this idea was later discarded as methodological “absurdity”. Thus the frequency was set with at least once per month. Since the inclusion criterion was changed when the study had already started five children (in addition to the three already mentioned) with pain once every two months were included in the study. Four of these children were in the experimental group and one in the control group. Even though they finished the study like all the others, they were excluded from the statistical analysis. Due to time constraints of the mother one child of the control group could not finish the study. **Thus 27 children finished the study, 14 in the experimental group and 13 in the control group.** It has already been mentioned that the children in the control group also received three osteopathic treatments in the same way as the experimental group after the study period. When the results

were statistically analysed 7 children of the control group had already finished their course of treatments. Thus the data of these 7 children was also analysed and the children compared with themselves.
All participants except two were questioned, examined and treated by the same osteopath. The two exceptions were patients of the experimental group. They were questioned, examined and treated by a different osteopath.
It has already been mentioned in chapter 3.6. that children aged 7 and older had to indicate their subjective pain on a Faces Pain Scale in addition to the parents' rating on a different scale. This means that in this study 12 of the 27 children who finished the study marked their pain perception on the Faces Pain Scale Revised. For these 12 children two pain measurements were available while for 15 children only one pain scale could be analysed.

4.2. Sample description

As already mentioned 27 children remained in the overall sample, 14 in the experimental group and 13 in the control group. The distribution of the children by group and gender is summarized in the table below. 12 children were male, 15 female. The gender distribution is approximately similar in both groups.

Table 1
Distribution of the participants by group and gender

	Group					
	Experimental group		Control group		Overall sample	
Gender	N	in %	N	in %	N	in %
male	6	42.9	6	46.2	12	44.4
female	8	57.1	7	53.9	15	55.6
overall sample	14	100.0	13	100.0	27	100.0

Table 2 illustrates the distribution of the participants by age. The three youngest participants were two years old; the two oldest children were 10 years old. 5 children were five and another five children were 7 years old. Between one and three children

belonged to the other age groups. The distribution of the different age groups in the experimental and control group can be regarded as approximately similar.

Table 2

Distribution of participants by group and age

	Group					
	Experimental group		Control group		Overall sample	
Age	N	in %	N	in %	N	in %
2 years	2	14.3	1	7.7	3	11.1
3 years	3	21.4	0	0.0	3	11.1
4 years	0	0.0	3	23.1	3	11.1
5 years	2	14.3	3	23.1	5	18.5
6 years	0	0.0	1	7.7	1	3.7
7 years	3	21.4	2	15.4	5	18.5
8 years	1	7.1	1	7.7	2	7.4
9 years	2	14.3	1	7.7	3	11.1
10 years	1	7.1	1	7.7	2	7.4
Overall sample	14	100.0	13	100.0	27	100.0

The mean age of the children at the beginning of the study was almost 6. The average body height was 116 cm, with the height of the smallest child being 81 cm and that of the tallest child being 150 cm. The mean weight of the children was 21 kg with deviations between 9.4 to 45.7 kg.

Table 3

Descriptive statistical values of the various parameters

Parameter	N	M	Md	SD	Min	Max
Age	27	5.8	5.0	2.5	2	10
Body height	27	115.6	114.0	17.3	81	150
Weight	26	21.1	19.3	8.1	9.4	45.7

4.3. Descriptive analysis

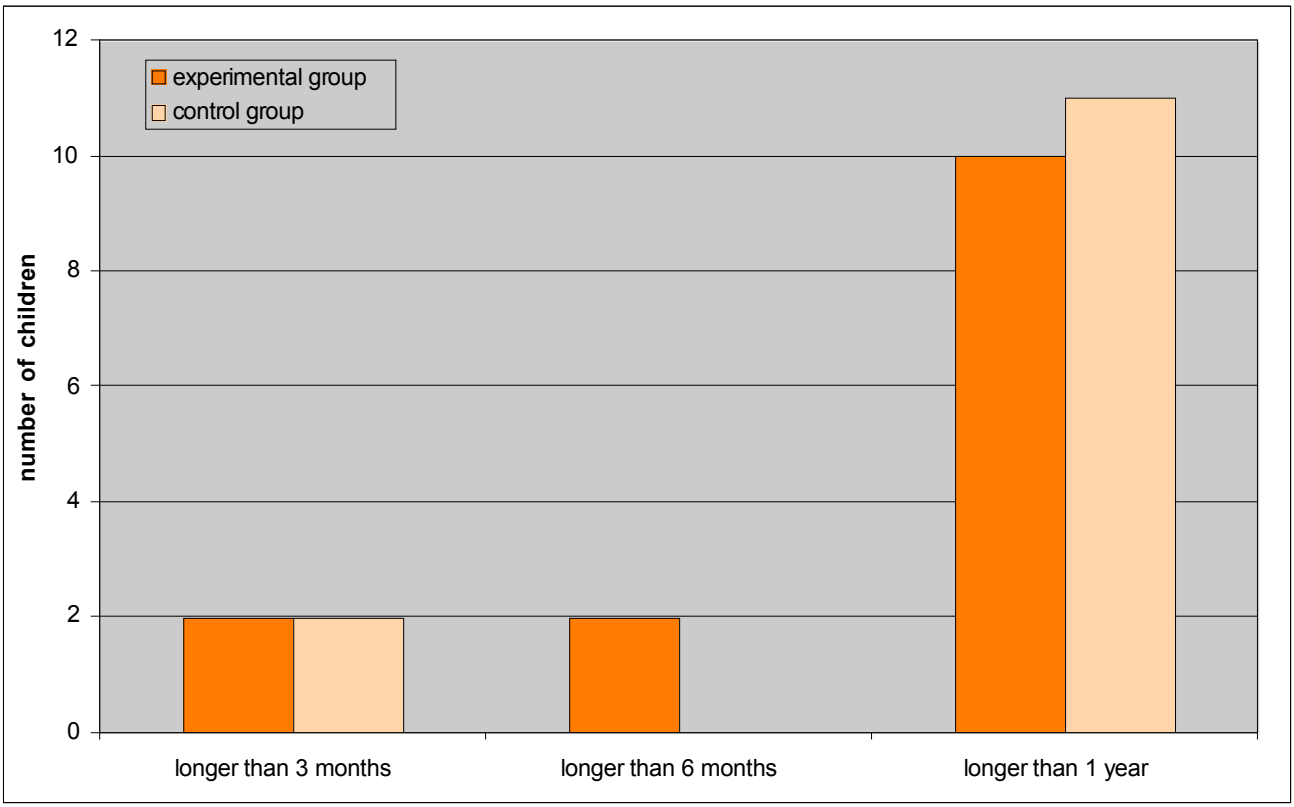
The following section contains a descriptive presentation of the collected data. The values of the experimental group and the control group are presented separately.

Only in one case the parents declared that their child could not carry out all normal activities without morning stiffness and limping. In all other cases this was not the case. The child in question was sent to a paediatrician for further investigations to exclude serious pathologies. However, the diagnosis “growing pains” was confirmed and the morning stiffness and limping were thus not considered as excluding factors.

Figure 1 illustrates the duration of “growing pains” in both groups. The majority of the children already suffered from the pain for more than a year, two children indicated a duration between 6 months and one year and in the case of four children the duration ranged between 3 months and six months.

Figure 1

Duration of “growing pains” by groups



Most of the children experienced the pain once or twice per month. In 15 % of the children the pain occurred once per week and 2 children reported to suffer from the pain at least twice per week.

Table 4

Distribution of the participants by groups and frequency of pain

	Group					
	Experimental group		Control group		Overall sample	
Frequency	N	in %	N	in %	N	in %
1 every 2 months	0	0.0	0	0.0	0	0.0
1 per month	5	35.7	5	38,5	10	37.0
2 per month	4	28.6	5	38.5	9	33.3
1 per week	2	14.3	2	15.4	4	14.8
2 per week	1	7.1	1	7.7	2	7.4
More often	2	14.3	0	0.0	2	7.4
Overall sample	14	100.0	13	100.0	27	100.0

Most of the children felt the pain in the evening or at night. This holds for both the experimental and the control group.

One question was whether there are factors that influence the pain. Figure 2 illustrates that the majority of the participants in both groups answered this question with yes.

Figure 2

Factors influencing the pain by groups

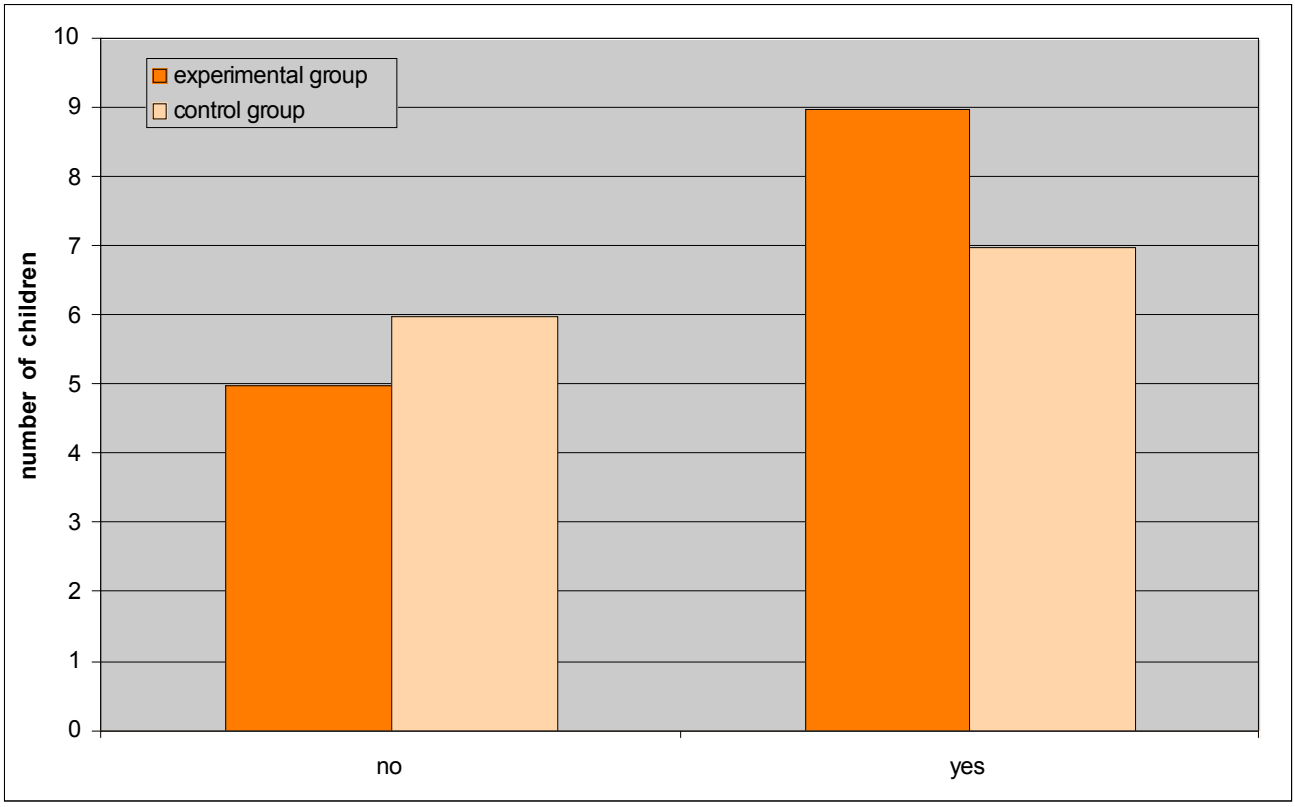


Table 5 provides an overview of the pain localisation. For each localisation the number of participants who experienced pain in this region is indicated. With more than 85 % the large majority of the participants in both groups experiences “growing pains” in the lower leg – on both sides. 56 % (right leg) and 59 % (left leg) indicate the foot as site of pain, with the percentage being higher in the control group than in the experimental group. 44 % (left leg) and 48 % (right leg) experienced “growing pains” in the region of the knee. The pelvis and thighs are rarely indicated as sites of pain.

Table 5

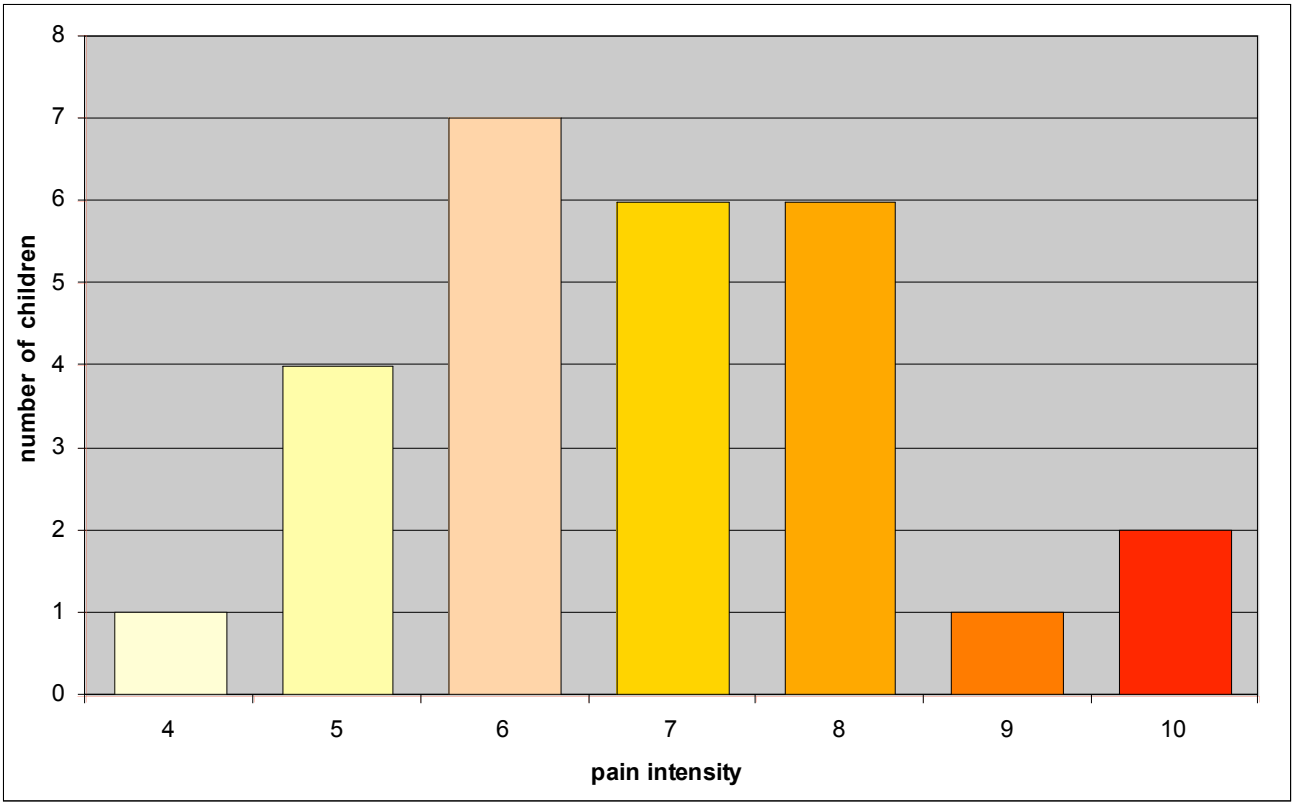
Number of participants and pain localization

	Group					
	Experimental group		Control group		Overall sample	
Localization	N	in %	N	in %	N	in %
left leg						
pelvis	1	7.1	0	0,0	1	3.7
thigh	1	7.1	2	15.4	3	11.1
knee	6	42.9	6	46.2	12	44.4
lower leg	12	85.7	11	84.6	23	85.2
foot	6	42.9	9	69.2	15	55.6
right leg						
pelvis	1	7.1	0	0.0	1	3.7
thigh	1	7.1	3	23.1	4	14.8
knee	7	50.0	6	46.2	13	48.2
lower leg	12	85.7	11	84.6	23	85.2
foot	6	42.9	10	76.9	16	59.3

The intensity of the pain was evaluated on a zero-to-ten scale. The distribution among the individual intensity categories is illustrated in the figure below. The majority of the children figure in the pain categories six to eight. No child indicated a pain intensity below four. Three children figured in the highest categories nine and ten.

Figure 3

Pain intensity in the overall sample



On average the children experienced a pain intensity of 6.9 at the beginning of the therapy. With 7.1 the mean pain intensity was slightly higher in the control group than in the experimental group (6.6). However, this difference is statistically not significant. (t=0.74; p=.467).

Table 6

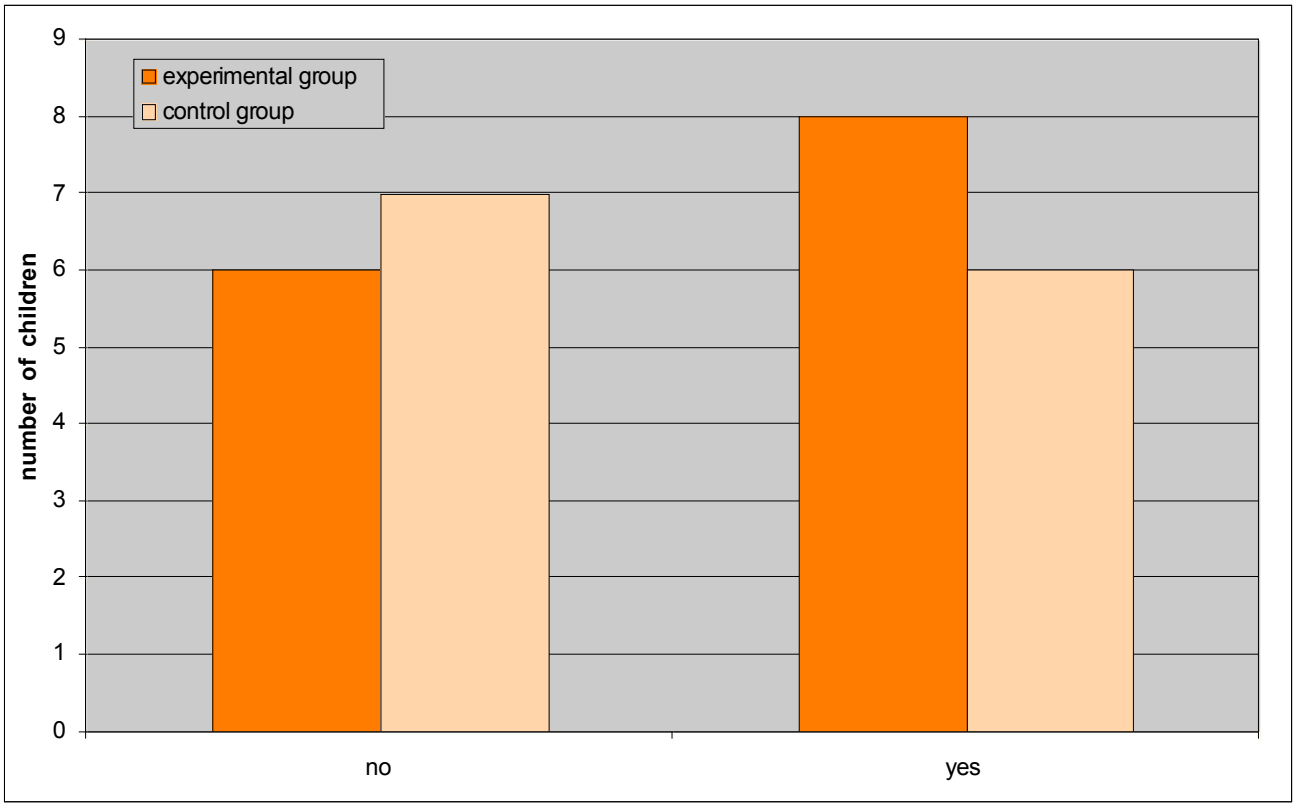
Descriptive statistical values for pain intensity by groups

Group	N	M	Md	SD	Min	Max
Experimental group	14	6.64	6.50	1.22	5	8
Control group	13	7.08	7.00	1.80	4	10
Overall sample	27	6.85	7.00	1.51	4	10

Approximately half of the participants took pain killers for the “growing pains”. The share of children who had to take pain killers is slightly larger in the experimental group than in the control group.

Figure 4

Administration of pain killers by groups

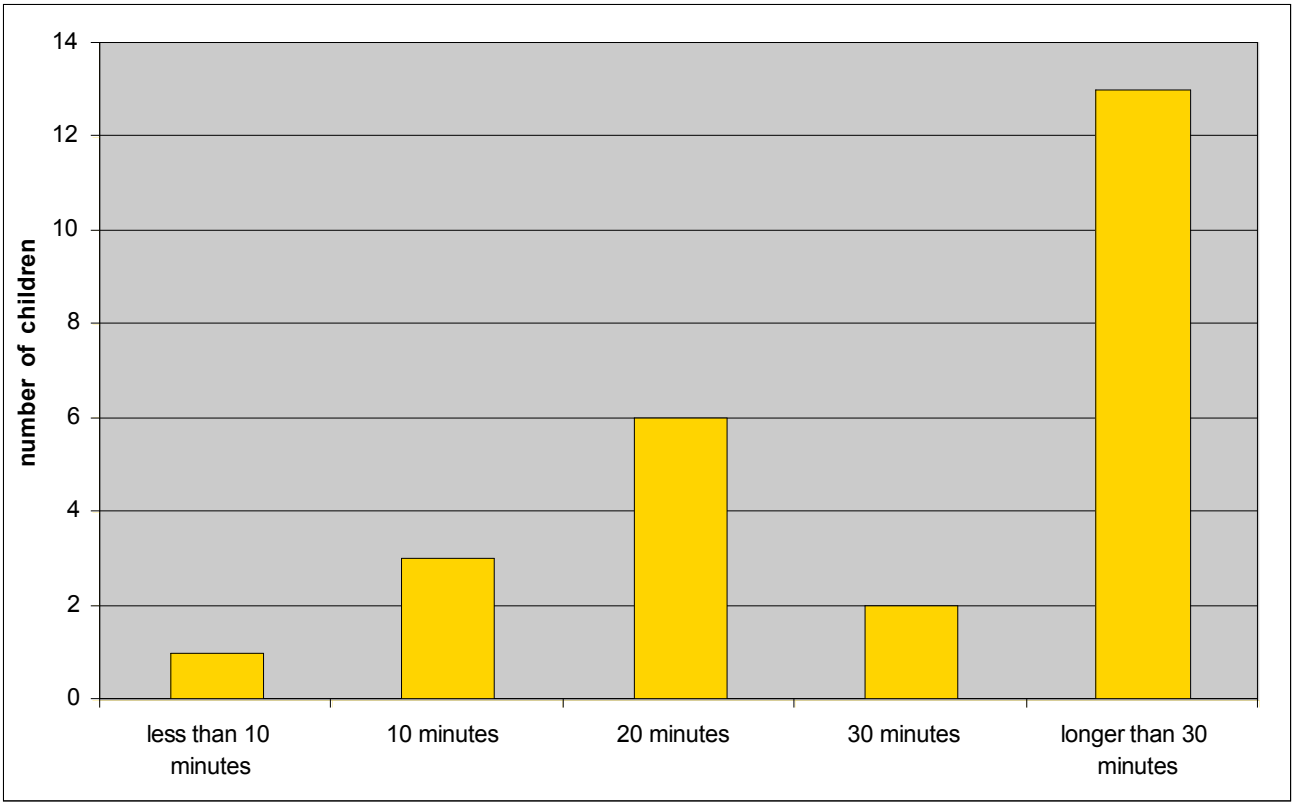


The children who had to take pain killers had to do this occasionally or only very rarely. Only one child took the pain medication regularly.

If the pain occurred and the patients did not take any pain killers, the pain usually lasted more than 30 minutes in half of the children. Six children indicated the duration of the pain with 20 minutes. Only one to three children figured in the other categories.

Figure 5

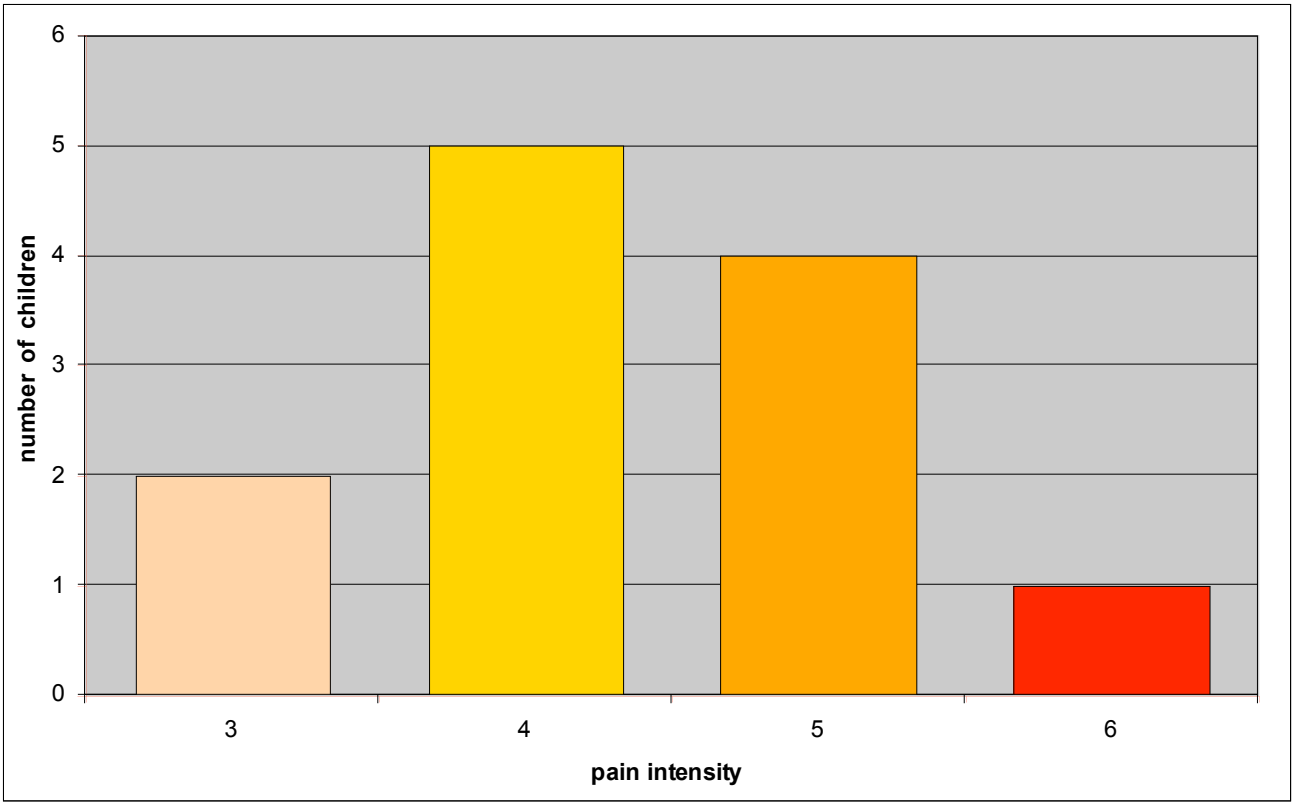
Duration of pain without pain medication in the overall sample



The children aged 7 and older had to evaluate their pain on a six-category scale. Five children indicated a pain intensity of four, four children described the pain with the intensity five, two children chose intensity three and one child indicated a pain intensity of six.

Figure 6

Children's subjective perception of the pain intensity



With a mean value of 4.60 the pain perception of the children in the control group was slightly higher than that of the experimental group (4.14). But the difference between the mean values of the two groups is statistically not significant (t=0.87, p=.405).

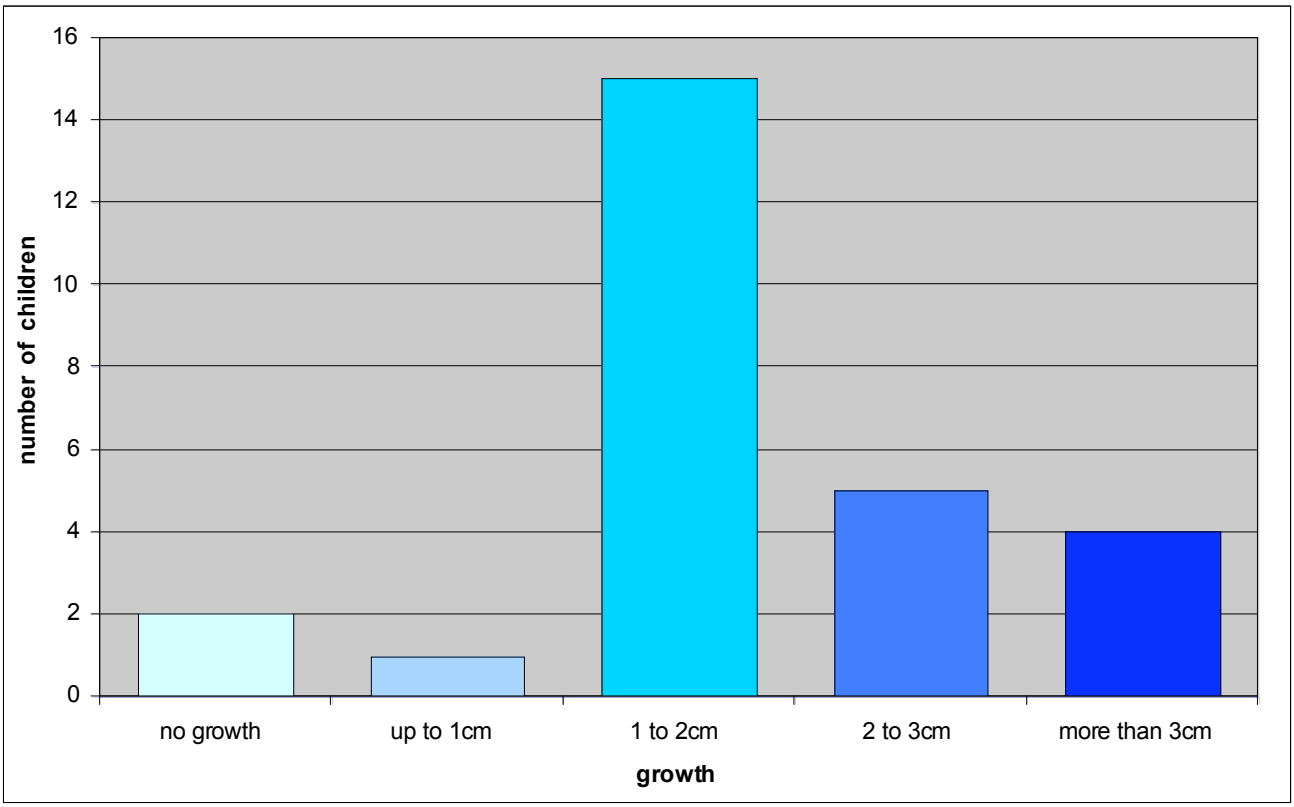
Table 7

Descriptive statistical values of pain intensity according to the children's subjective perception by groups

Group	N	M	Md	SD	Min	Max
Experimental group	7	4.14	4.00	0.69	3	5
Control group	5	4.60	5.00	1.14	3	6

Since this study is based on the assumption that the children's pain is related to growths, the participant's body height was measured during the study period to see whether any growth took place over this period.
Figure 7 below illustrates the absolute changes in the participants' body height between the first and the second measurement.

Figure 7
Changes of body height between first and second measurement



Only in two children no change in body height could be measured. In the majority of the children the body height increased by 1 to 2cm. The children of the experimental group grew a little bit more than the children of the control group. A statistical comparison did not show a significant difference between the two groups ($t=1.44$; $p=.163$).

Table 8

Descriptive statistical values of changes in body height by groups

Group	N	M	Md	SD	Min	Max
Experimental group	14	2.50	1.75	2.65	0	11
Control group	13	1.38	1.50	0.94	0	4

4.4. Evaluation of the effect of the intervention

The term *intervention* designates the osteopathic treatment in the experimental group. With regard to the control group *intervention* designates the period without therapy.

The evaluation of the effects of the intervention looks at different aspects. One aspect that is evaluated is whether the frequency of the pain has changed due to the intervention. In addition, the pain intensities before and after the intervention are compared – regarding both the parents rating and the subjective perception by the children. Further, it is evaluated whether changes could be observed in the children of the control group who received a course of treatment after the study period. Finally, the analysis looks at whether the children's gender, age or changes in body height have an influence on the pain.

4.4.1. Changes in the pain's frequency according to the parents' rating before and after the intervention

At first it is analysed in how far the frequency of the pain changed between the first and the second rating without considering to which group (experimental or control group) the children belonged. Table 9 presents the most important values of the two ratings.

Table 9

Descriptive statistical values concerning the pain frequency before and after the intervention

Rating	N	M	Md	SD	Min	Max
Before the intervention	27	3.15	3.00	1.23	2	6
After the intervention	27	2.04	2.00	1.13	0	4

1 = 1 / 2 months, 2 = 1 / month, 3 = 2 / month, 4 = 1 / week, 5 = 2 / week

Before the intervention (of the patients in the experimental group) the mean value ranged slightly above 3.0. This corresponds to the category 'two times per month'. In the second rating the mean value was only 2.04 (= 'once per month').
Since the two ratings were provided by the same persons the t-test for dependent samples was used to calculate whether a statistically significant change of the mean value between the two ratings could be observed. The result was a highly significant difference (t=3.50; p=.002) for the overall sample. With regard to the two groups the change was significant only in the experimental group (t=3.16; p=.008). In the control group the result only showed a tendency of change (t=1.85, p=.089).

The two groups were compared with regard to the change in the pain frequency. Table 10 presents the relevant values for both groups. While the frequency was reduced by 1.64 in the experimental group, the decrease in the control group was only 0.54.

Table 10

Values concerning the change in the pain frequency by groups

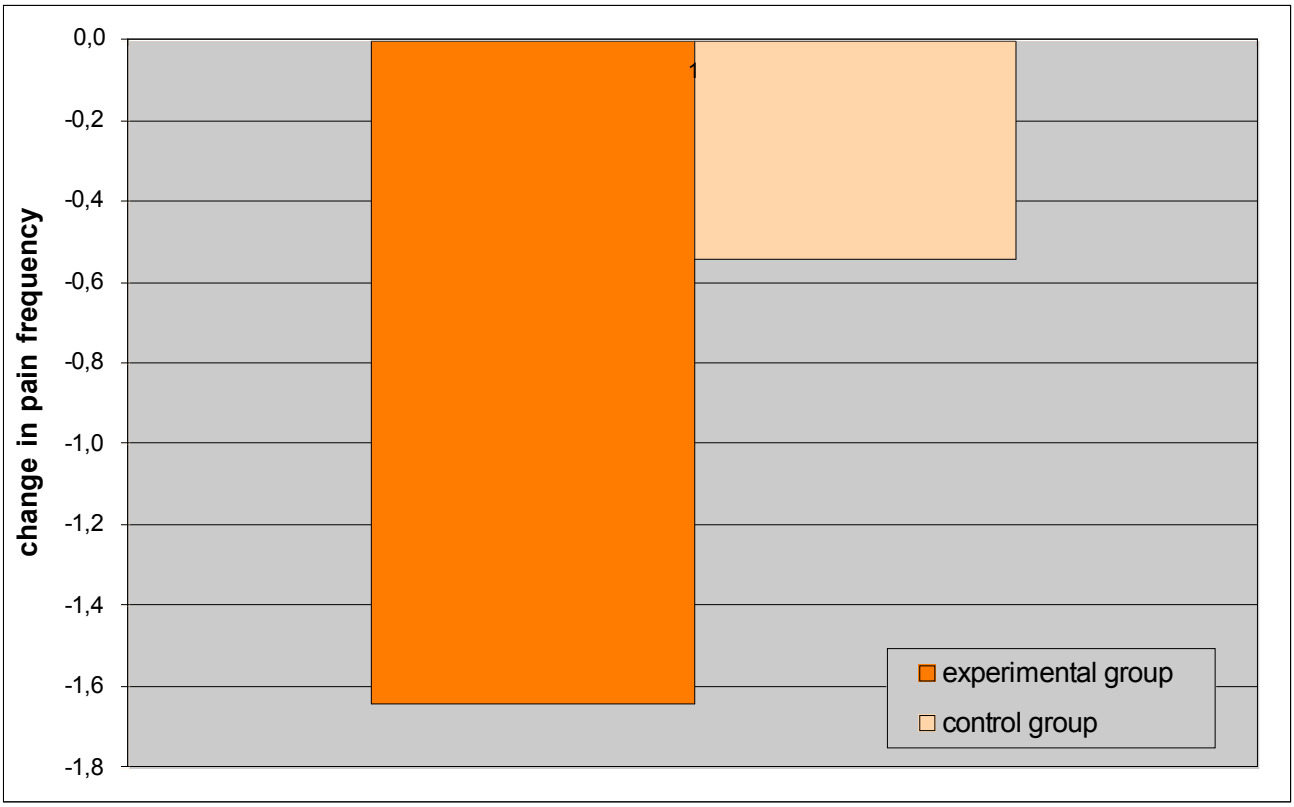
Group	N	M	Md	SD	Min	Max
Experimental group	14	-1.64	-2.00	1.95	-6	2
Control group	13	-0.54	0.00	1.05	-3	1

The difference of the mean values of the experimental group and the control group was verified with the t-test for independent samples. The result proved a very small

difference between the two groups, which only narrowly fell short of the necessary 5% probability of error (t=1.81, p=.082).

Figure 8

Changes in the pain frequency between the first and second rating by groups



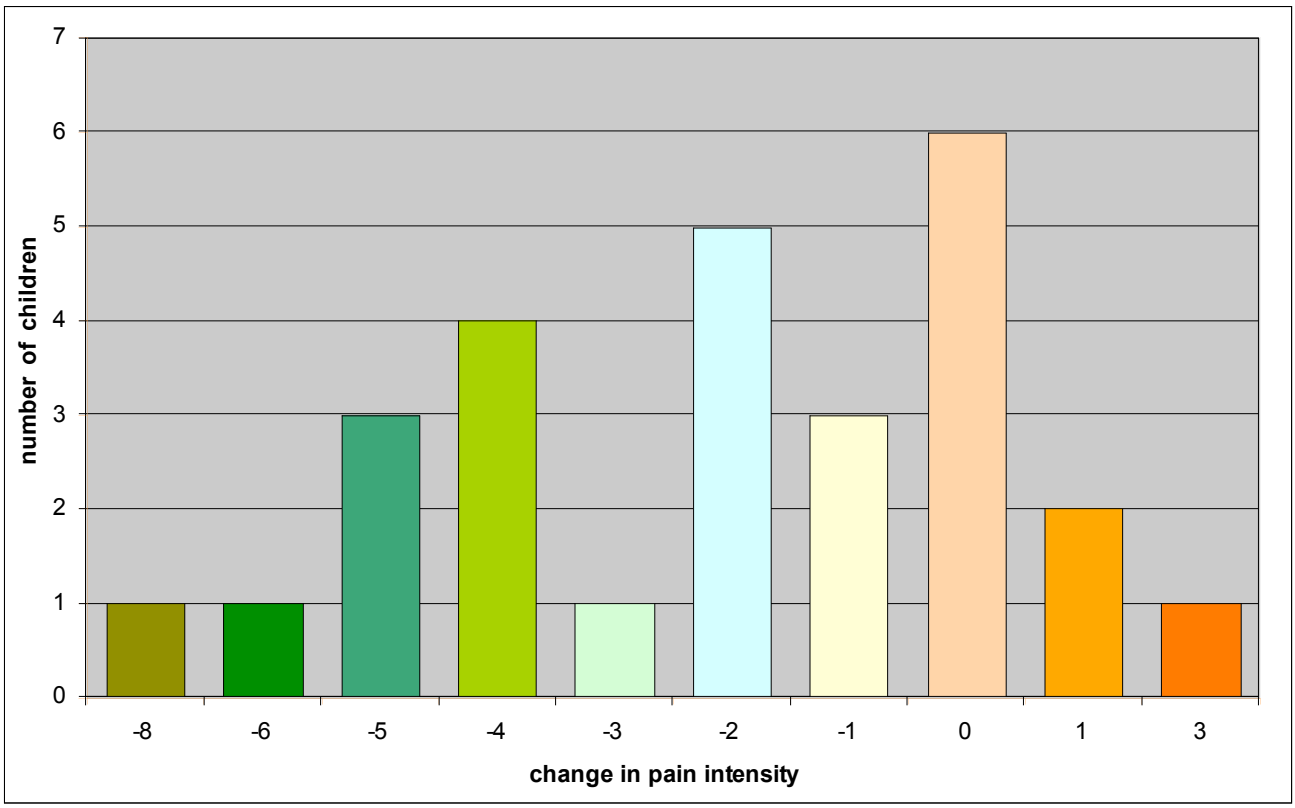
In general, the pain frequency deceased in both groups. But the changes in the frequency were more pronounced in the experimental group than in the control group. Nevertheless it was surprising that also in the control group (without therapy) a decrease in the pain frequency could be observed.

4.4.2. Changes of the pain intensity according to the parents' rating before and after the intervention

Besides the frequency of the pain also its intensity was rated on a zero-to-ten scale. In this case, the parents had to rate the pain experienced by their children. Figure 9 below illustrates the distribution of the change in the pain intensity for all children without considering the division into experimental and control group. A majority of the children observed a decrease in the pain intensity between the two ratings. No change could be observed in six children and three children even experienced an increase of the pain's intensity.

Figure 9

Changes in the pain intensity between the first and second rating



The descriptive statistical values like mean value, median value and standard deviation of the pain intensity are presented in the table below. A clear reduction of the mean pain intensity (from 6.85 to 4.78) can be observed.

Table 11

Descriptive values concerning pain intensity before and after the intervention

Rating	N	M	Md	SD	Min	Max
Before the intervention	27	6.85	7.00	1.51	4	10
After the intervention	27	4.78	4.00	2.39	0	9

This difference is significant also from a statistical point of view (t=4.27; p<.001). The changes were significant for both groups (experimental group: t=3.45; P=.004, control group: t=2.85; p=.015).

Table 12 illustrates the dimension of the change by group. In the experimental group the difference between the pain intensity before and after the therapy was 2.79, while the pain intensity in the control group was reduced only by 1.31. Due to the large statistical spread the difference between the two groups marginally missed the level of statistical significance of 5 % (t=1.56, p=.131).

Table 12

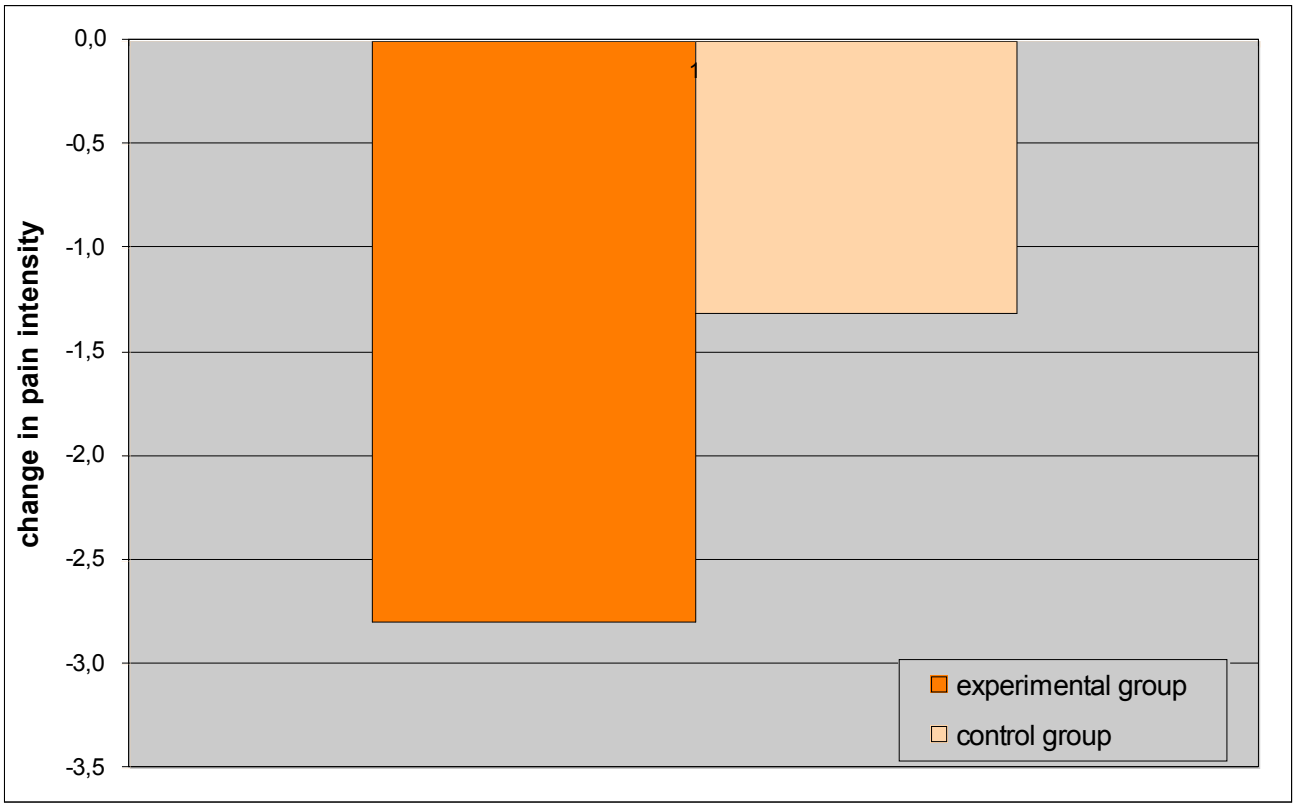
Statistical values concerning changes in the pain intensity by groups

Group	N	M	Md	SD	Min	Max
Experimental group	14	-2.79	-3.50	3.02	-8	3
Control group	13	-1.31	-1.00	1.65	-5	0

In general, the pain intensity decreased considerably between the two ratings. This holds for both the control group and the experimental group. Even though the decrease is more pronounced in the experimental group the statistics only show a tendency.

Figure 10

Changes in pain intensity (parents' estimates) between the first and second rating by groups

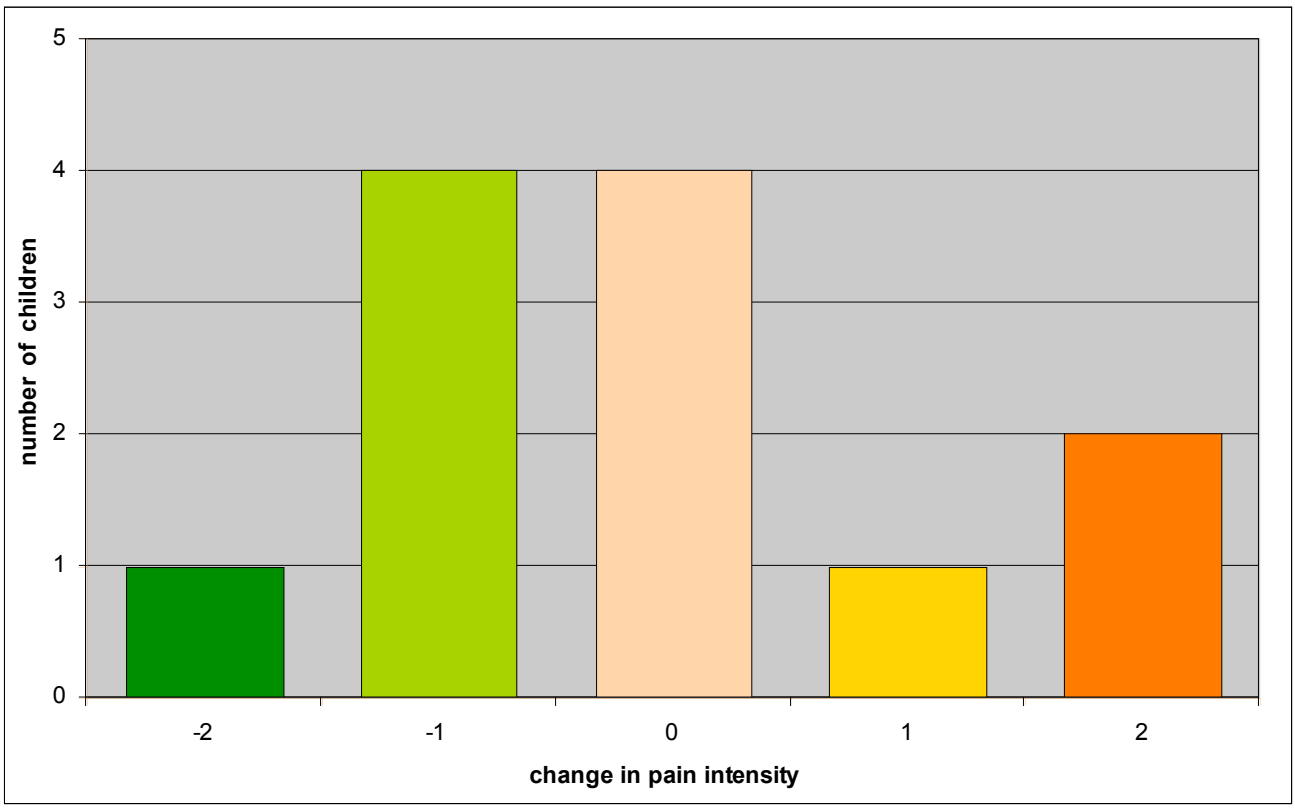


4.4.3. Changes in pain intensity according to the children's perception before and after the intervention

The children aged 7 and older were asked to subjectively judge the intensity of the pain they experienced. Figure 11 illustrates the changes in the values before and after the intervention for all children. Five children felt the pain intensity had decreased, four children thought the pain remained the same and three children had the impression the pain intensity had increased.

Figure 11

Changes in the pain intensity according to the children's perception between the first and the second rating



The mean values for the two ratings are summarized in the table below. The average pain intensity was a little bit lower after the intervention. However, the change is statistically not significant (t=0.89; p=.407).

Table 13

Descriptive statistical values of pain intensity before and after the intervention

Rating	N	M	Md	SD	Min	Max
Before the intervention	12	4.33	4.00	0.89	3	6
After the intervention	12	4.25	4.50	1.42	2	6

The changes in the experimental group and the control group were compared with each other to find out whether there was a difference. The illustrations below show

that the pain intensity decreased in the experimental group, while it even increased slightly in the control group according to the children's perception. However, the difference in the change between the groups is statistically not significant (t=1.16, p=.274).

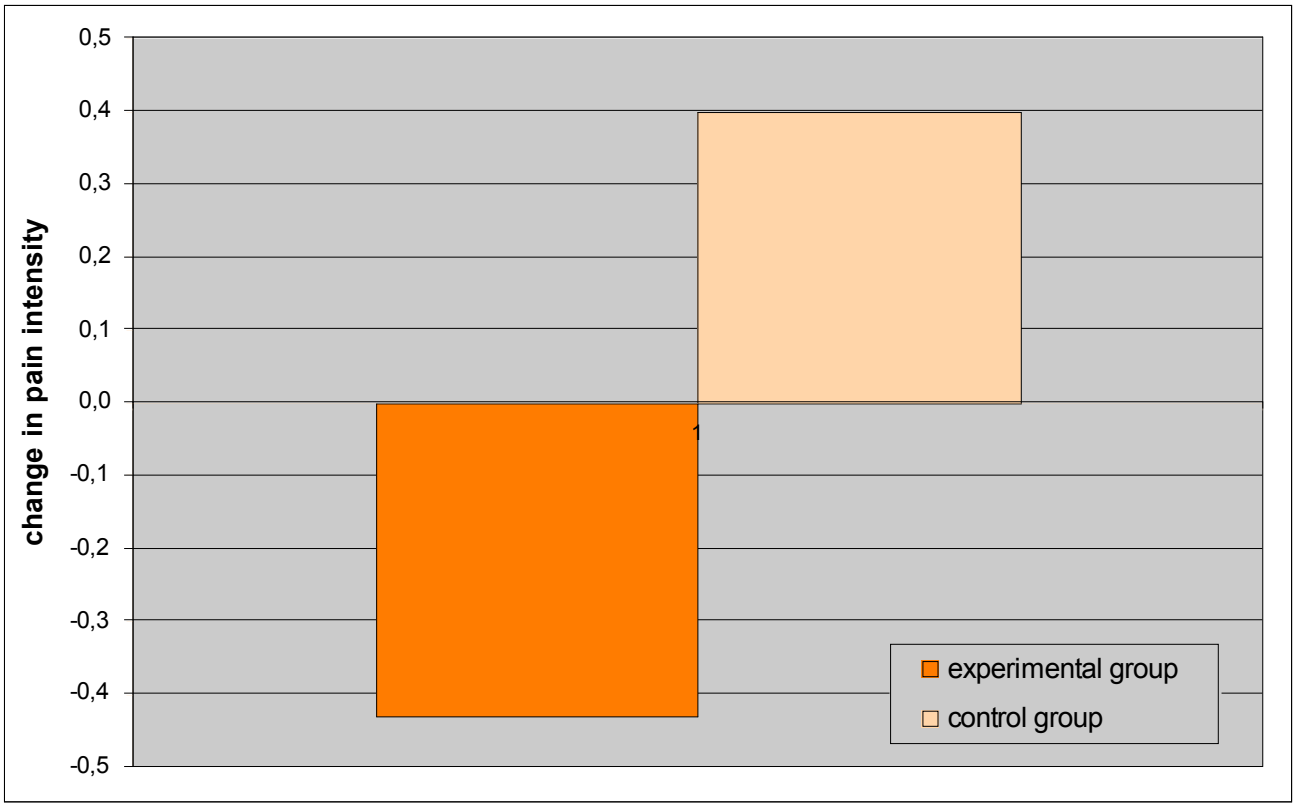
Table 14

Descriptive statistical values concerning the change in the pain intensity by groups

Group	N	M	Md	SD	Min	Max
Experimental group	7	-0.43	-1.0	1.27	-2	2
Control group	5	0.40	0.0	1.14	-1	2

Figure 12

Changes in the pain intensity (children's perception) between the first and second rating by groups



4.4.4. Changes in the pain intensity – control group therapy

Seven children of the control group also received a series of osteopathic treatments after the study period. After the therapy we also wanted to evaluate whether the treatment had a positive effect on the “growing pains”. The table below presents the descriptive values of the seven children in the first and second rating and shows that the mean pain intensity slightly decreased with the change being marginally not significant (t=2.09; p=.082).

Table 15

Descriptive statistical values concerning the pain intensity of the first and second rating

Rating	N	M	Md	SD	Min	Max
First rating	7	7.86	7.00	1.77	6	10
Second rating	7	6.43	7.00	2.15	4	9

The changes in the values from the second to the third rating after the therapy are, however, statistically significant (t=3.55; p=.012). The mean pain intensity decreased from 6.43 auf to 3.29.

Table 16

Descriptive values concerning the pain intensity of the second and third rating

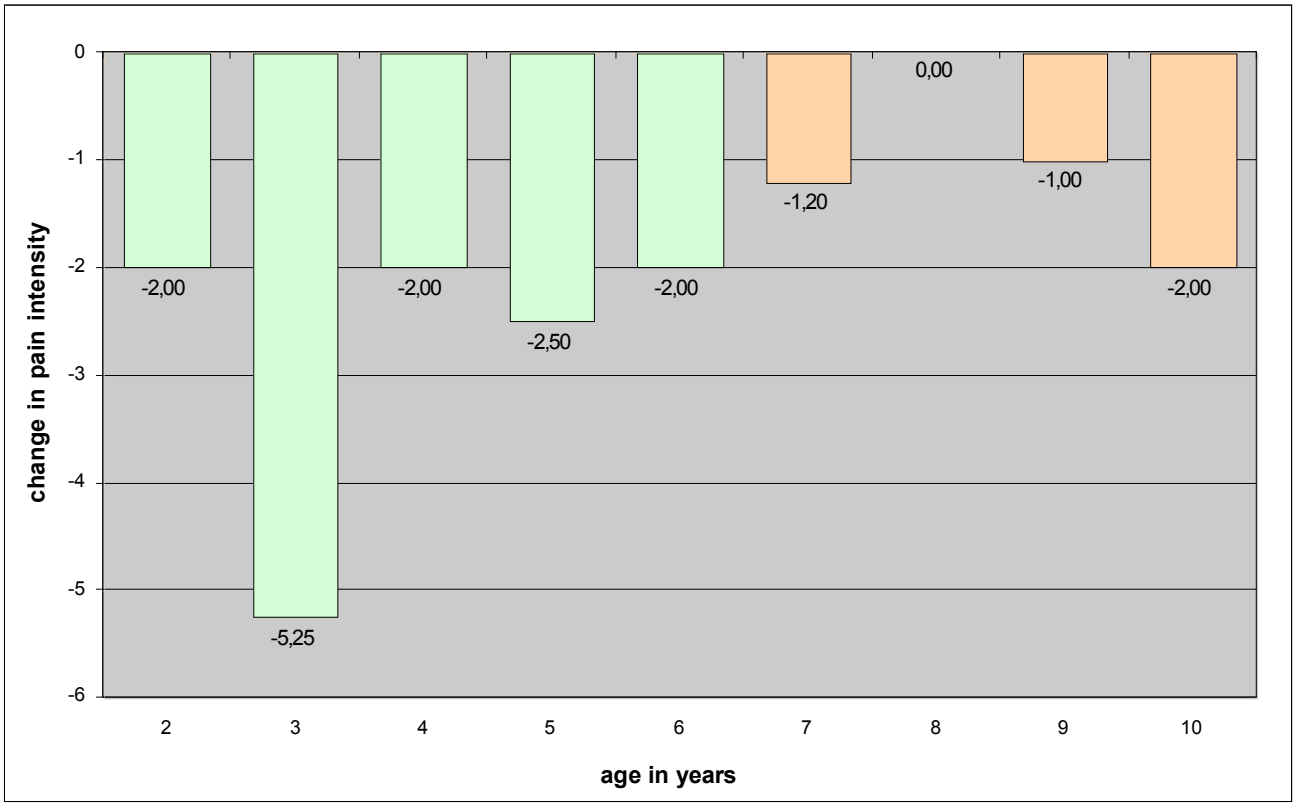
Rating	N	M	Md	SD	Min	Max
Second rating	7	6.43	7.00	2.15	4	9
Third rating	7	3.29	4.00	2.43	0	6

4.4.5. Changes in the pain intensity by age groups

This section looks at whether the effect of osteopathic treatment is related to the age of the children. To analyse this, the changes between the two ratings and the age of the children in the experimental group were correlated. The analysis showed a significant correlation between the two variables: the older the child the smaller the decrease of the pain intensity after the therapy (r=0.57, p=.035).

Figure 13 illustrates the correlation between age and change in pain intensity. It presents the mean change of the pain intensity after treatment by age. The illustration shows that in older children the success of osteopathic treatment is smaller than in younger children.

Figure 13
Changes in pain intensity by age



Consequently, the children were divided into two age groups to verify by means of a t-test whether the difference in the changes is statistically significant. In the children

aged 6 and younger the pain intensity after treatment decreased by 4.57 on average, while for the children aged 7 and older the mean decrease was only 1.00. Thus the difference in the mean values of the two groups is statistically significant (t=2.70; p=.020).

Table 17

Descriptive statistical values concerning the changes in pain intensity by age groups

Age group	N	M	Md	SD	Min	Max
6 years and younger	7	-4.57	-4.00	1.81	-8	-2
7 years and older	7	-1.00	-1.00	3.00	-6	3

The effect of the therapy seems to be correlated with the age of the child in question since the success of the treatment is significantly better in children aged 6 and younger.

4.4.6. Changes in the pain intensity by gender

The experimental group was also analysed with regard to gender-specific changes to find out whether the changes in pain intensity were different for boys and girls. The table below shows that on average the pain intensity decreased more strongly in girls than in boys. However, the difference is statistically not significant (t=1.02, p=.326).

Table 18

Descriptive statistical values concerning the changes in pain intensity by gender

Gender	N	M	Md	SD	Min	Max
male	6	-1.83	-3.00	3.19	-5	3
female	8	-3.50	-3.50	2.88	-8	1

The patients' gender can thus be regarded as factor that can be responsible for a different decrease in the pain intensity even though the difference was statistically not significant in the experimental group.

4.4.7. Correlation between the changes in pain intensity and change of body height

The experimental group was also analysed with regard to a correlation between the changes in pain intensity and changes in body height before and after the therapy. The correlation between the two variables was 0.40 and thus has no statistical significance (p=.162).

The change in the pain intensity does not seem to be related with the change in body height, i.e. if a child does not grow that much, this does not necessarily mean that it experiences less pain.

4.4.8. Correlation between the parents' rating of the pain and the children's perception

It has already been mentioned that in 12 cases both the parents and the children assessed the pain intensity. Consequently, it was analysed in how far the parents' ratings correlated with the children's pain perception.
In the first rating (before the intervention) the correlation between parents and children was 0.36 (p=.250) which is statistically not significant. This suggests that the pain is perceived quite differently by the parents and the children themselves. Also the result of the second rating did not show a statistically significant correlation between the parents' estimates and the children's perception (r=0.33, p=.295).
A surprising correlation could be identified between the parents' rating of the pain intensity before the intervention and the children's rating after the intervention (r=0.62, p=.030). The stronger the pain was rated by the parents before the

intervention, the stronger the pain was classified by the children after the intervention.
The same correlation (but less pronounced) could also be detected between the children's rating before the intervention and the parents' estimates after the intervention (r=0.0.48, p=.114).

4.5. Osteopathic conclusion concerning the treatment of children with "growing pains"

Even though the recorded osteopathic findings and treatment techniques have not been statistically analysed in detail, I would like to mention some particularities, interesting issues and correlations.
Among the 27 children who finished the study three children had an extraordinarily long birth, in the case of five children medical complications occurred during birth and seven children were born through Caesarean section. From an osteopathic point of view this meant that in more than half of the children it was important in the treatment to consider the birth process and the tension patterns that possibly resulted from it. (Deoora, 2006; Frymann, 2007, p.297; Liem, 2001, p.476)
In 22 of 27 children either brothers or sisters or one or both parents suffered or suffer from "growing pains". Naish et Apley (1951) and Calabro et al (1976) describe a family predisposition as being quite common, which could also be confirmed in this study.
To consider the emotional factor in "growing pains" postulated by Naish et Apley (1951) the following issues reported in the case history have to be mentioned: According to the parents eight children had problems sleeping as babies or infants. Six children had the tendency to somatize stress. Two children in this study had some psycho-emotional issues according to the evaluation of the osteopath. In addition to the already mentioned factors birth and emotional aspects it is also interesting that in 19 of 27 children craniosacral findings were present in the beginning. All the things that have been mentioned so far and also the following examination findings are subjective. They were recorded before the first treatment. The most common osteopathic findings concerned restrictions of movement or end-of-range pain in the hips. These problems could be found in 20 children. Other

common findings were abnormal arches of the feet in 19 children (not the same 19 children with the craniosacral findings), dysfunctions or restrictions of movement in the spine in 18 children and shortening of muscles in the lower extremities in 14 children. A very concrete finding was a bilateral or unilateral anterior talus in 14 children, who were not the same 14 children with muscle shortening. In 10 children we could detect a clear deviation of the body symmetry. The same number of children (10) had visceral findings and 9 children had an increased tension of the Membrana interossea cruris on both sides or unilaterally. In 9 children the ability to stand on one leg was abnormal for their age. The iliosacral joints were restricted only in six children.

In this study osteopathic treatment represented a black box. This means that the children were treated according to the findings with osteopathic techniques appropriate for the dysfunctions that were subjectively noticeable on the particular day of examination. The above mentioned findings already indicate that the therapy often involved craniosacral treatment as well as treatments of the spine, hips and talus. To be more precise, a craniosacral approach was chosen for 22 children, the spine was treated specifically in 18 children, while the talus was treated in 16 children and the hips in 15 children. A detailed description of each treatment would go beyond the scope of this paper. But according to the explanations in chapter 2.5 the emphasis in the therapy was put on increasing the pain threshold, correcting the position of the feet and leg axes, reducing the pull of the tendons on the periosteum of the lower extremities in particular though increasing the tone of the muscles, improving the situation of the bones (in particular the tibia) themselves through interosseous techniques and influencing the emotional aspect positively though craniosacral treatment. All these things were considered in the treatment of each child if they were relevant in the particular case.

The treatments applied in the framework of this study tried to follow the words of Fryman (1998, p.155) *“Every child has a different clinical problem and a unique structural and functional status. Thus every child requires an individual therapy within the framework of osteopathic care (…)”*.

5. Discussion

This study focuses on the question whether osteopathy represents a good treatment option in the case of “growing pains” in children. The chosen study design was a controlled clinical application with an experimental group and a control group. The analysis of the two outcome measurements pain intensity and frequency was based on a questionnaire developed by the practitioner and a study period of three months.

The results can be summarized as follows:
The pain intensity changed significantly in both the experimental group and the control group. Even though the decrease of the pain intensity was more pronounced in the experimental group than in the control group, the result only indicates a tendency.
The changes in the pain’s frequency showed a highly significant difference for the overall sample, but only the changes in the experimental group were statistically significant. Nevertheless the difference of the changes in the pain frequency in the two groups again only shows a tendency.
The interpretation of this quite surprising result can lead to the conclusion that “growing pains” seem to have an emotional component which must not be underestimated. Maybe the fact that one “enters into a treatment model” is already sufficient so that questionnaires, case history, evaluation and conversation with the parents already bring about a change of the problem. Maybe the parents can handle the problem in a calmer way and the children have the feeling that something is done about their pain. Naish et Apley (1951) have already pointed out that “growing pains” have an important emotional component.

After the study period seven children of the control group received a series of osteopathic treatments in the same way as the children of the experimental group. Between the first two ratings (i.e. before the treatments) the decrease of the pain intensity was marginally not significant. In the third rating, i.e. after the treatments, the mean pain intensity decreased from 6.43 to a value of 3.29, which represents a statistically significant reduction. This result shows that the osteopathic intervention

clearly influenced the pain intensity in a positive way, even though an improvement could already been observed before the treatments. The seven children “entered in a treatment model” already three months before the first treatment, thus the improvement observed in the third rating is definitely attributable to the osteopathic treatment and not to a mere emotional influence. Possibly a within-subject-design to evaluate the effect of a treatment in the case of “growing pains” would be a good means to assess the specific effectiveness. Evans (2003) was able to demonstrate the correlation between intervention and effect by means of such an A-B-A-B design. With this design the author examined the effectiveness of shoe wedges and ortheses in children with “growing pains”.

A significant correlation could also be detected between the two variables age of the child and decrease of pain intensity after the therapy. The older the child is the smaller the decrease of the pain intensity after the osteopathic treatment. In the children aged 6 and younger the pain intensity decreased on average by 4.75 while the average decrease was only 1.00 in children aged 7 and older. This result can be regarded as confirmation of Fryman’s statement (2007, p. 315): “*Nevertheless, a treatment is more effective the younger the child is.”* It would make sens to carry our further studies which look in particular at children under the age of seven years and children aged 7 and older. Older children might need more than three treatments to display a clear improvement in the clinical picture.
In this study design three treatments per child were chosen because of several reasons: First of all, children need less input than adults (Marris, 2006), secondly “growing pains” are a “functional problem” which needs less therapeutic stimulation than a structural problem (Carreiro, 2007) and finally, a healthy child (and children with “growing pains” normally are healthy) experiences very rapid change processes (Grundberg, 2006). Nevertheless, the question remains whether the number of three treatments was sufficient for all children (also the older ones) to clearly improve the clinical picture of “growing pains”. In this context Grundberg (2006) emphasizes the importance of the patient’s individual vitality with regard to processes of change. According to Grundberg some children first need a basic treatment which prepares the body and makes changes possible. The author also points out that treatment during a growth spurt is more effective than interventions that take place in the time when the child is not growing. Due to this assumption the effectiveness of the

osteopathic treatments in this study can vary from child to child. If we consider all these aspects, a general statement about the effectiveness of osteopathic treatment in the case of “growing pains” on the basis of this study is not possible.

This study is a single blind and not a double blind study. The test persons did not know whether they were attributed to the experimental or the control group. However, the study was carried out by the same osteopath who also evaluated, questioned and treated the children with the exception of two children in the experimental group who were treated by another osteopath due to organizational issues. The internal validity of the study would be better if the study supervisor and the practitioner were not one and the same person and thus the practitioner would not know to which group the individual participants belonged. This was not possible for economical reasons because the treatments were free and thus provided by the study supervisor. The arising costs were thus indirect while they would have been actual costs if other osteopaths had carried out the treatments. The two practitioners in this study followed a similar treatment concept, treated the children in the same practice and talked about the topic. Nevertheless, a larger number of practitioners would provide a more general conclusion about the effectiveness of osteopathic treatment in the case of “growing pains”. Thus the results of this study can hardly be regarded as generally representative for osteopathy.

It has to be pointed out that the osteopath who treated and questioned all but two children carried out the study during her last year of training at the Wiener Schule für Osteopathie (Vienna School of Osteopathy) and thus did not have a special training in paediatric osteopathy. The other osteopath who treated two of the children in this study finished his osteopathic training a few years ago and also does not have a special training in paediatric osteopathy. Osteopaths with more years of experience and special paediatric training would probably raise the treatment standard which also would help to make this study more generally representative for osteopathy.

A “tricky” issue was the pain rating by the parents. The assessment of pain can be regarded as complex topic which fills volumes of books. The rating of the children’s pain by their parents has to be taken with a grain of salt because pain is a very individual sensory experience (Mayer-Fally, 2007) and thus is best rated by the

person experiencing the pain. But since the children included in this study were aged between 2 and 12, it was necessary to find a way of pain rating that was the same for all participants. Thus a numeric scale was chosen where the parents could mark their estimates. In addition to the parents' assessment 12 children in this study (older than seven) had to evaluate their own pain perception on the Faces Pain Scale - Revised. The comparison of the parents' and children's ratings was very interesting. The pain intensity is perceived differently by the parents and the children. It was highly significant that the stronger the pain is rated by the parents before the intervention the stronger it is perceived by the children after the intervention. This correlation can also be observed between the children's perception before the intervention and the parents' rating after the treatment. In my opinion this confirms the social learning aspect in dealing with pain. Millner (2001) points out that a child is very much influenced by how the adults in his/her surrounding deal with pain. According to Millner this determines how a person experiences his/her own pain. Maybe this effect also exists the other way round, so that the parents' view changes when they notice that their child experiences pain differently than they actually thought.

Among the 12 children over 7 years seven children were in the experimental group and five in the control group. According to the children's perception the pain intensity decreased slightly in the experimental group, while it even increased slightly in the control group. However, this difference was statistically not significant. Probably a separate study focussing on children over seven with the children assessing their pain themselves would be more "valid". But for younger children it seems that there is no other solution than a pain rating by the parents. Due to the big difference in the children's age the pain rating in this study was a compromise. On the one hand the age range was chosen in order to have enough participants in and around Salzburg, and on the other hand to have a sample that covers the age range of "growing pains" described in the literature.

The majority of the 27 children experienced the pain one or two times per month in the evening or at night. Certain factors were influencing the occurrence of the pain. More than 85% of the children indicated both lower legs as localization of the "growing pains". On a zero-to-one scale for the pain intensity the pain was never rated below four. The average pain intensity was 6.9. Half of the children were given pain killers occasionally or very rarely against the "growing pains". If no pain killers were administered the pain lasted for more than 30 minutes in more than half of the

children. The brothers or sisters or one or both parents of 22 of the 27 children also suffer or suffered from “growing pains”.
According to the data collected in the study a brief definition of “growing pains” could be: *“Growing pains” are strong pains in the lower legs, which occur once or twice per month due to certain influencing factors and last more than 30 minutes with a predisposition often running in the family.”*
The basic question whether “growing pains” really are related to growth cannot be answered on the basis of this study. The majority of the children grew one or two centimetres during the three-month study period. No growth could be measured in two children. The changes in the pain intensity in the experimental group could not be correlated with the change in body height during the study period.

My osteopathic hypothesis concerning “growing pains” is that the sum of several factors or even only one specific factor can trigger the inherited “pattern” of this pain. In 19 participants of this study dysfunctions on a craniosacral level could be detected. 20 children had osteopathic dysfunctions of the hips, 18 children had dysfunctions of the spine and the same number of children had dysfunctions in the arches of the feet. The most common concrete finding was an anterior talus in 14 children. Based on these findings and the target parameters of this study the anatomical theory and emotional aspects seem to be the most plausible triggering factors of “growing pains”. I agree with the opinion of Oster et Nielson (1972) that “growing pains” could be a special emotional family pattern. In addition, I share the opinion of Noonan et al. (2004) who consider the periosteum as the tissue that is responsible for the pain. In my opinion it is nevertheless necessary to consider every child with “growing pains” in an unbiased way and to treat him/her in his/her totality. It would be wrong to cling to a particular theory on this topic.

The present study does not provide the basis for a clear conclusion whether osteopathic treatment is effective in the case of “growing pains”. The decrease of both the pain intensity and frequency was significant for the overall sample and a comparison of the two groups showed that the decrease in the experimental group was more pronounced than in the control group but the difference was statistically not significant.

This means that osteopathy can have an influence on “growing pains” but the problem can also improve if someone just shows interest in it by talking about it and asks to rate the pain like in the control group of this study. The question about the specific effectiveness of osteopathy in the case of “growing pains” thus cannot be answered clearly.

A statistically significant result for osteopathy is the decrease of pain intensity in the seven children of the control group who were treated after the actual study period and were then compared with themselves.

The central question whether osteopathy represents a good treatment option in the case of “growing pains” in children can still be answered positively. However, it would make sense to carry out further studies in a similar way. From an osteopathic point of view the results of a study with a larger sample, more therapists and maybe a larger number of treatments (depending on the age of the children) would provide more valid data.

6. Annex

6.1. Osteopathic techniques applied in this study

Structural techniques:

Spine and ribs – mobilisation techniques
GOT of the spine and lower extremities
High velocity thrusts for the dorsal spine, lumbar spine, IS joint, hip and talus
Cervicodorsal lift
Soft tissue techniques in the regions of the cervical and lumbar spine
Sacral toggle
Trigger bands (fascia distorsion model) of the lower leg
Mobilisation of the Membrana interossea cruris
Stretching of the Ligg. sternopericardium and vertebropericardium
Decoaptation techniques for C0/C1
Mobilisations of femur, tibia, fibula, talus, calcaneus, cuboid, navicular bone, cuneiforms and toes
BLT techniques for the spine, IS joint and the whole lower extremities
Mobilisations and stretches of the diaphragm
Mitchell techniques for the muscles around the hip, ilium and tibia

Craniosacral techniques:

Direct techniques on the SBS
Intraosseous release of occiput, temporals, parietals, sacrum, tibia, fibula and talus
Frontal lift
BMT techniques on the cranium
Balancing of occiput and sacrum
Fluid techniques: fluid drive, lateral fluctuation
Providing a fulcrum
Releasing dural tension
Work on the midline

Visceral techniques:

Releasing tension of solar plexus

“Combing” of small intestine

Releasing tension of duodenum 2, 3

Inhibition of Oddi-sphincter

Improving motility of the kidneys

Stretch of the fascia of Toldt

Stimulation of the immune system by pumping techniques on the liver, spleen and thymus gland

Influence on the emotional situation:

Conversation with mother and child about the child’s birth

Conversation with the mother about positive aspects of the condition

Detailed information on “growing pains”

Homework: (within the framework of an osteopathic therapy depending on dysfunction, i.e. no standard stretching program)

Example:

Stretching of the hamstrings, quadriceps, gastrocnemius and toe extensors

Exercises standing on one leg

Postural training

6.2. Declaration of consent

Declaration of consent
to participate in the study “Growing pains in children – can osteopathy contribute to improve the clinical picture?”

Name of the child:.....

Dear parents!

Thank you for agreeing to participate in my study with your child. I would like to provide some general information on the therapy and the design of the study. Please take your time to read the following passages carefully and do not hesitate to ask further questions!

Information about the therapy:

Among other things manual therapy treats functional restrictions of movement in the joints of the extremities or spine with specific mobilisation or manipulation techniques. According to currently available studies severe side-effects of manipulations can be regarded as very rare if the techniques are applied by qualified therapists. Short-term reactions, however, cannot be excluded for any therapeutic intervention.

Information about costs:
To include and treat your child within the framework of this study a medical diagnosis of “growing pains” by a doctor, ideally your attending pediatrician is necessary.
If you consent to participating in this study, you will be asked to complete a questionnaire twice. I also would like to ask you to give me the time to carry out a thorough osteopathic examination of your child. Your child will receive three osteopathic treatments of 45 minutes each for free. Thus we would have to make four appointments to have enough time for the examination and evaluation as well as the completion of the questionnaires.

The participation in the study will not incur any costs!

I declare that I have read and understood the information provided above.

Date: Signature:

6.3. Case history and examination

Case history and examination sheet
for the study “Growing pains in children – can osteopathy contribute to improve the clinical picture?”

Name:

Name of the mother or the father:

Address:

Phone number:

Date of birth:

Attending doctor (who established the diagnosis “growing pains“):

Tests and examinations to rule out other causes with regard to “growing pains” (radiography, blood count, etc.)

Brothers or sisters:

“Growing pains” in the family:

Pregnancy of the mother

Birth:

Birth weight:

Birth size:

APGAR:

First weeks of life:

Breast feeding:

Allergies/intolerances:

Children’s diseases, infections, “weaknesses”:

Hobbies, sports:

Accidents, falls:

Complaints of the locomotor system (besides “growing pains”):

Abdominal pain, visceral:

Sensomotoric development:

Development of speech, cognitive development:

Seeing, hearing:

Handling of stress and strains:

Sleep:

Nutrition:

Statics

Postural type:

Symmetry:

Spine:

Leg axes:

Arches of the foot:

Size of feet measured with foot-measuring device:

Body height:

Weight:

Motoric tests

One-legged stance:

Gait:

Running:

Two-legged jumping:

One-legged jumping:

Low crawl, hands-and-knees crawl, “bear gait”:

Clinical tests

Reflexes: patellar tendon reflex
Achille’s tendon reflex

SLR:

FABER:

Meniscus tests, drawer test:

Mobility

Spine:

IS joint:
Hips:

Knees:

Feet:

Other joints:

Visceral:

Cranial:

Treatment approaches/ emphasis on:

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