Summary

Chapter 1: Introduction

The present study is the result of positive observations obtained in the therapeutic management of patients diagnosed with

“primary (or idiopathic) coxarthrosis”.

The conventional medical treatment of these patients often proves to be quite restricted. Therapeutic strategies are unfortunately frequently limited to surgical interventions (corrective osteotomy, or the subsequent implantation of artificial hip joints) and sometimes to conservative physiotherapeutic measures. Treatment models focusing on osteopathic, and thus biochemical objectives, allow for completely new approaches, not only for the author in his capacity as therapeutic caregiver, but more importantly, for the patients themselves.

A few basic terms related to arthrosis:

The term arthrosis refers to the degeneration of superficial articular cartilage, which causes painful swelling in the joint. The cartilage of the hip joint has a thickness of approximately 5-6 mm, and is generally thinner in older patients. When joints are exposed to excessive forces and stress, the protective mechanisms of the synovial fluid and cartilage become insufficient. As a consequence, the cartilage is damaged, and its thickness erodes. The surface area roughens, the collagen fiber network disintegrates, and the lubrication of the cartilage diminishes.

Additional inflammatory phenomena release enzymes, which attack the remaining healthy cartilage. With the progressive destruction of cartilage substance the degeneration process evolves to a point where the actual bones of the joint may become exposed.

Current therapeutic management generally consists of administering drugs complementing the healing process or the treatment of symptoms such as pain and loss of joint function. Early surgical intervention may relieve defective joint positions which lead to mechanical overstrain, or may restore function through the implantation of artificial joints, whereby the latter of course requires the natural joint to be sacrificed.

An **osteopathic approach** inherently strives to minimize or reduce the potential loss of function long before any surgical intervention becomes necessary, and to restore a normal physiological or biomechanical joint function.

The present paper focuses on two basic questions:

a) Can an osteopathic, holistic treatment approach positively influence clearly defined subjective and objective parameters?
b) Can these parameters improve further with the administration of glucosaminosulfate (GAS, 500 mg three times daily) and methyl-sulfonyl-methane (MSM, 800 mg once daily), in the combination with osteopathic treatment?

Causal factors mentioned in the medical literature include:

- congenital defects of the joints (e.g. a malformation of the hip joints);
- valgus or varus position of the knees, resulting in an unbalanced weight distribution;
- excess weight, excess stress on the joints caused by occupational factors (heavy labor) or a one-sided weight distribution;
- injuries incurred by professional athletes;
- inflammations;
- metabolic disorders;
- lack of exercise, or the forced immobilization of a joint, entailing degenerated cartilage tissue and a reduced weight bearing capacity.

The **causal associations in an osteopathic approach** are far more complex and may include:

- defective alignment of the foot joints (Chopart's joint), with an ascending lesion over the peroneus muscle group on the biceps femoris, therefore leading to a posterior location of the homolateral os ilium;
- a bladder infection; or
- a dysfunction or blockage in the lumbar spine.

These are but a few examples of possible causes. This list is not inclusive, and more extensive documentation on other types of causal associations is found in the osteopathic literature.

A group of patients receiving osteopathic treatment in combination with glucosaminosulfate and MSM was included in the study for the following reasons:

Glucosaminosulfate has shown a beneficial effect in the treatment of patients diagnosed with severe arthritis, as reported in many studies, including a trial conducted in Milan, Italy.
The subjects of this 30-day double-blind trial were randomized to either 1.5 g of glucosaminosulfate or a placebo product. Study investigators examined the patients on a weekly basis to determine the type and severity of pain, sensitivity to touch, swelling of joints, and whether the subjects experienced any limitations in their active or passive mobility.
The findings were striking:
General symptoms occurred less frequently in the group of patients treated with glucosaminosulfate, as compared to the placebo group (73% vs. 41%). In the glucosaminosulfate group, symptoms were reduced by half in a mere 20 days, as compared to 36 days in the placebo arm. Of the patients receiving glucosaminosulfate, 20% became completely symptom-free, compared to 0% of the 40 patients in the placebo group.

Cartilage samples taken from patients in the glucosaminosulfate group and examined by electron microscopy bore a striking resemblance to healthy cartilage. In contrast, the samples of patients in the placebo group bore the characteristics of damaged cartilage affected by arthritic degeneration.

The study investigators concluded that glucosaminosulfate helps regenerate damaged cartilage and, in most cases, restores normal joint function in arthritic patients. Other studies revealed similar findings (see “The Arthritis Cure”, by Dr. Jason Theodosakis, Mosaik-Verlag 2/2000).

Chapter 2 of this paper contains basic information on glucosaminosulfate and MSM.

Chapter 2: Fundamentals

2.1. The biomechanical structure of the hip joint

Because the hip joint's mobility is muscle-controlled, any treatment or intervention in this area must also take into account the muscular structures. In terms of mechanical and structural forces, however, the hip joints are "bone-controlled", as can be seen from the hip socket's clearly defined articulation with the femoral head (in contrast to the shoulder joint).

Even the slightest imbalance in muscular forces applied on the hip joint has an immediate impact on the pelvic tilt, and thus on the spinal column. The direct functional relationship between pelvis and spinal column has been established. More particularly, the balance function can be ascribed to the muscular structures of the upper thigh (the active element) and the iliotibial band (the passive element).

Size of contact areas:

The acetabulum completely encapsules the femoral head; however, not the entire surface area of the femoral head is completely covered by the acetabulum. Only a relatively small surface area of the femoral head, approximately 12 cm^2, is in direct contact with the hip socket.

Cover measurements of the femoral head:

The cover determines stability or instability of the hip joint. On its frontal plane, the external cover measures approximately 30 degrees (Wiberg centre-edge angle), while the internal cover measures approximately 30 to 40 degrees.

On the sagittal plane, the anterior cover is approximately 30 to 35 degrees, bearing the potential for an anterior subluxation. The posterior cover is approximately 90 degrees, offering good stability and no danger of luxations. Due to the imbalance in cover ratios and the unstable weight distribution, the stability on the sagittal plane is first and foremost dependent on the balanced coordination of muscular structures.

In general, one distinguishes between two types of coxarthrosis:

1. **Expulsive coxarthrosis**: an anterior subluxation develops externally, negatively affecting walking ability, affecting the 11th and 12th thoracic vertebrae. The results are a loss of abduction and rotations, as well as a fibrosis of the piriform muscle
2. **Penetrating coxarthrosis**: A posterior internal subluxation; a lateral tilt of the pelvis, a flexion of the pelvis (anterior tilt) and a fibrosis of the psoas muscle. Often leads to problems in the second hip joint.

The intra-articular pressure in the hip joint:

The intra-articular pressure is the result of the equation between gravity and the body's muscular counter-activity, compounded by other forces, such as those of articular capsules, tension forces of ligaments and other muscular structures. Various mathematical measurement models exist, but they neglect of number of key factors. In this three-dimensional system most forces are unknown entities, and therefore the actual intra-articular pressure of a hip joint cannot be determined with scientific accuracy.

Weight transfer from femur to pelvis:

The weight transfer is manifested in the directional alignment of the spongy structures from the femoral cortical sleeve to the sacroiliac joint. In general, one distinguishes between two basic directions:

a) lateral cortex of the thighbone diaphysis to the inferior end of the coxofemoral joint, to the superior end of the sacroiliac joint
b) medial cortex of the thighbone diaphysis to the superior end of the coxofemoral joint, to the inferior end of the sacroiliac joint

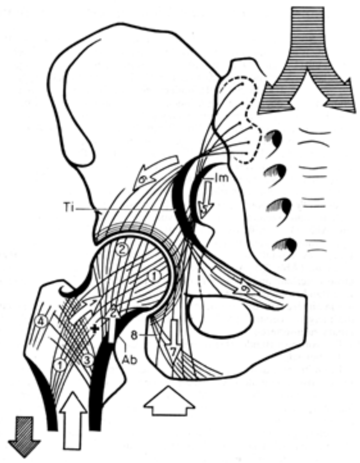

Figure F 1: Stress curve of spongy structures
Kapandji, Band 47, Side 21

The close direct relationship between the hip joint and the sacroiliac joint strongly affects the weight or stress distribution in the joints.

Pressure distribution in the acetabulum:

In terms of physiological stress forces, a theoretical mathematical model (using the “finite element method” to assess structural tensions) showed that the entire intra-articular pressure is not only limited to the superior section of the acetabulum, but is also exerted along the inferior portions. Experimental studies have confirmed this finding.

Foramina obturatoria

These two passages are of critical importance in the diagnosis of coxarthrosis because they strongly influence the medial area of the coxofemoral joint. The two passages are located neither on a sagittal nor a frontal plane, but run diagonally from lateral-ventral-cranial to medial-dorsal-caudal. The openings are positioned more or less horizontally and are closed off by the obturator membranes. Essentially similar in their structure to eardrums, these elastic membranes support the perineum in absorbing abdominal pressure differences.

There are two reasons for the large size of the foramina obturatoria :

- larger membranes are more elastic and exert an improved buffer function;
- the pubic bone thus achieves better elasticity (the superior ramus of the pubic bone moves similar to a torsion rod).

The obturator membranes are connected to the internal and external obturator muscles. Both the obturator nerve and the femoral nerve transverse the membrane. Found in its immediate vicinity are the tendon of the long adductor muscle, the femoral artery, the ovaries and the bladder. These close local relationships make it necessary to always co-examine the organs of the small pelvis and the obturator membranes when assessing hip disorders.

2.2. The pelvic region in analogy to the cranium:

Sutherland likens the “cranial bowl” to the “bowl” of the pelvis. Both structures “give life” to something, i.e. the mind, or spiritual life, emerges from the upper “bowl”, whereas physical life emerges from the lower. Similarly, he compares the gyri of the brain to the windings of the intestine, and the scalp’s hair to the villi of the intestine. Each neurotransmitter, each hormone finds its equivalent in substances present in the intestinal tract.

The examination of an embryo around the 12th to the 15th day of development reveals that the three bones of the os ilium exert stabilizing forces similar to the bones of the os temporale in the cranium. Os ilium, os temporale and scapula possess three ossification centers appearing simultaneously.

2.3 . The three fascial systems:

1. Superficial system:

Like a fine network of spider webs, the superficial fascial system surrounds the entire body, and is found in bones, tendons, muscles and joints. The system can be divided into an anterior and a posterior segment, and three major components: the cranium, the shoulder girdle and the pelvis. From its origins at the pelvis, this fascial system runs from the ligaments of the sacroiliac joint and continues along the spiral-shaped ligaments of the hip joint. Thus, for example, the hip joint is centered and held in place by internal rotation, but also pushed into the hip socket. This in turn causes the ipsilateral ligaments of the sacroiliac joint to exert tension, while the contralateral ililumbal ligaments absorb the tensile forces.

2. **Visceral organic system:**
   Originating at the cranial base (anterior segment of the sphenoid bone), the system covers the soft tissues of the neck area, the thoracic organs (via the clavicle and the fascia posterior sterni), the diaphragm (stomach, colon transversum, pericardium, etc.), and continues across the anterior segment of the spinal column until it reaches the pelvis.

3. **Intracranial system:**
   This system connects to the cranium (dura mater), primarily via the 1st and 2nd vertebrae, and to the pelvis. The fibers of the fasciae run diagonally, creating shorter and longer horizontal connections. They are essentially aligned in a three-dimensional pattern.

All three fascial systems connect to the cranium and to the pelvis, all three systems therefore bear influence on the coxofemoral joints via the pelvis. Consequently, osteopathic therapy can be administered via all three fascial systems.

2.4. Physiological features of articular cartilage

The connective tissue of articular cartilage is present in all synovial joints of the human body. In synovial joints, the bone ends are covered by hyaline cartilage. Articular cartilage is the white, translucent, and shiny lining of the bone, which can reach a thickness of up to 6 mm in the hip joint. It serves as a protective buffer layer, absorbs compression and tensile forces, and, together with the synovial fluid, reduces friction forces.

Four zones of articular cartilage are distinguished:

- **Zone I**: the superficial cartilage area (ca. 5% of the layer's thickness) absorbs shear forces and reduces friction. On its surface are found a thin layer of extra-cellular matrix as well as a layer of collagen fibrils running parallel to the cartilage surface area. Zone I is covered by a very thin lining, the synovial fluid, which is also called "lamina splendens". Compared to the other zones, the matrix's ability to bind water is markedly superior in Zone I.

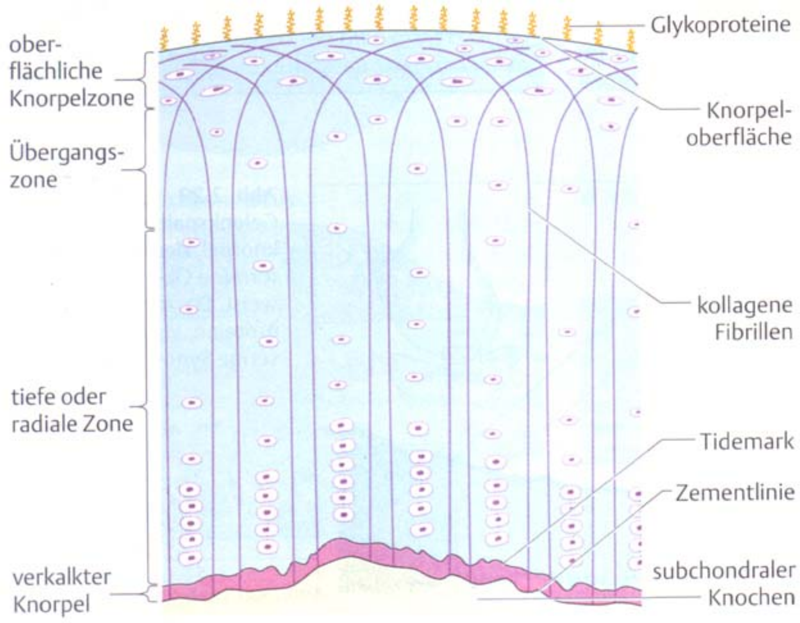

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Figure F 2: : Zone classification of articular cartilage
Frans van den Berg

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- **Zone II**: The transitional zone (ca. 15%) contains collagen fibrils in the shape of arcades. This layer is also host to chondroblasts, which are rounder and more active than the cells present in Zone I.

- **Zone III**: The deep cartilage zone (ca. 40-60%) is the thickest of all 4 zones. It absorbs the bulk of compression forces. This layer contains chondroblasts, which are grouped in clusters or chains. Proteoglycans and glucosaminoglycans have a higher affinity to bind strongly to those collagen fibrils with a larger diameter and which run vertically to the cartilage surface.

- **Zone IV**: The calcified cartilage layer (up to 30%) connects articular cartilage to the bone. The demarcation line between deep and calcified cartilage is called tidemark or “blue line” (owing to the high mineral content which stains blue when exposed to one of the tints commonly used in histological examinations). The lower line is formed by the so-called cement line, and borders on the subchondral bone substance.

2.4.1 Cells of articular cartilage

These are chondroblasts and chondrocytes, the latter being less active or inactive cells. Chondroblasts, the more active cells, are responsible for the synthesis of matrix components. The endoplasmic reticulum of chondroblasts is more pronounced than that of chondrocytes; mitochondrions also occur in larger numbers. Chondroblasts require a certain minimum amount of oxygen for synthesis, although they are capable of anaerobic glycolysis. Therefore they are also found in avascular tissue with a lower pH value. The potential for regeneration and healing is inferior in avascular tissue, compared to vascularized tissue, but certain processes of regeneration do occur, as has been shown in various studies (Mitchell 1976, Mitchell 1980, Woo 1991).

2.4.2 Cartilage matrix

The cartilage matrix consists of water and macromolecules, i.e. various types of proteins:

- 50% of collagen fibers, or fibrils, i.e. primarily proteins of collagen type II (compression as typical and most regular load force)
- 35-50% non-collagen proteins, connective and similar proteins, and
- 15-20% proteoglycans and glycosaminoglycans.

The basic substance of articular cartilage consists of a central chain of hyaluronic acids, and, bound to these by connective proteins, proteoglycans (collagen types IX and XI). The proteoglycans are formed by a central chain of various proteins and bound to various glycosaminoglycans. These possess a powerful negative charge, enabling them to enter a very stable connection with water. A sleeve of water is formed around the glycosaminoglycans and proteglycans, which is necessary to absorb deforming compression forces. The functional integrity of articular cartilage thus depends on the stability of this water sleeve.

Glycosaminoglycan binds to water, but also to $Na+$ and Ca_2+ ions, producing a strong osmotic pressure, also known as Donnan osmotic pressure, which attains a value of 0.35 mPa in cartilage tissue.

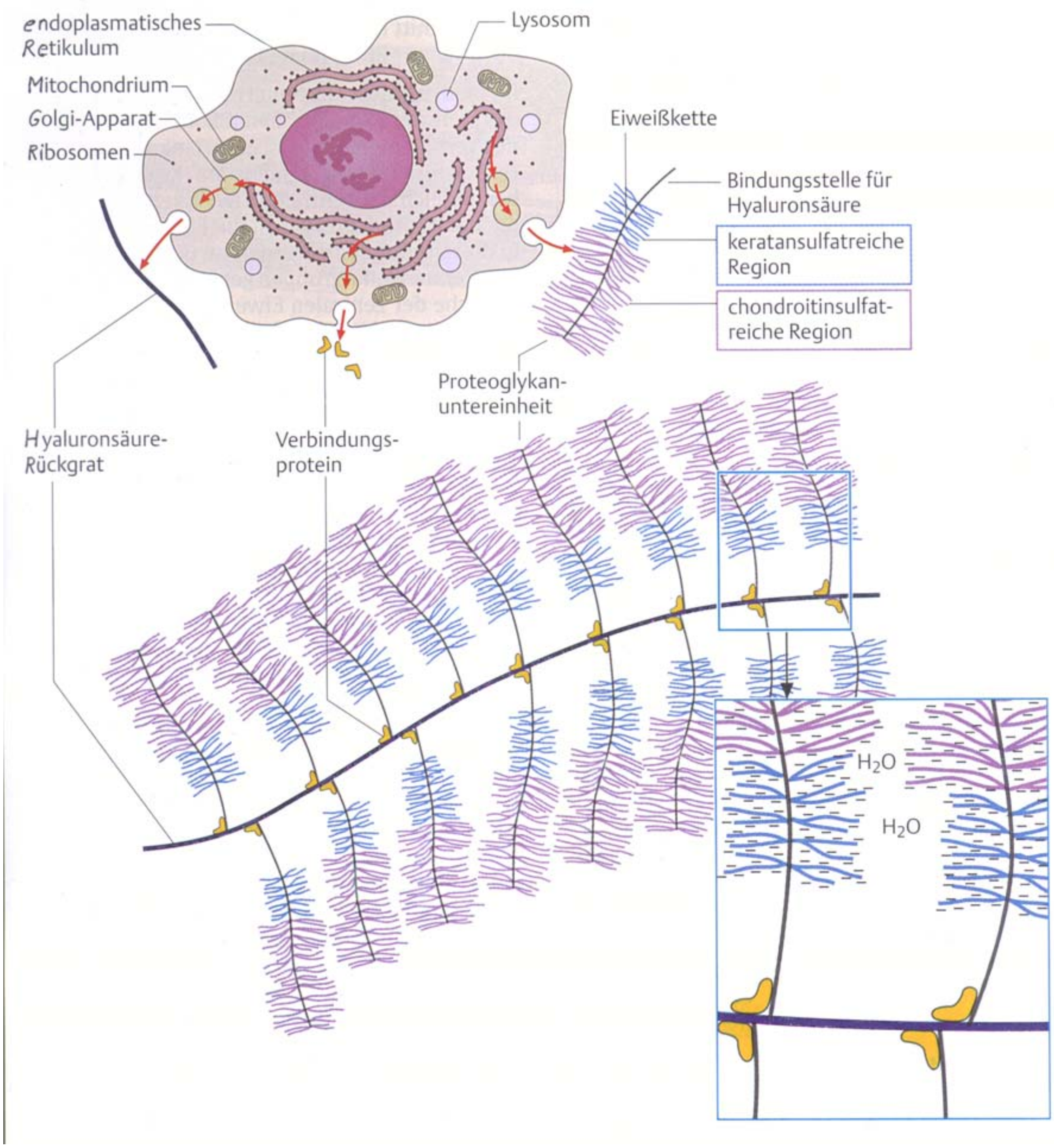


Figure F 3: Synthesis of proteoglycan aggregates in articular Cartilage (Frans van den Berg, Angewandte Physiologie)

The network of collagen fibers controls the amount of water being absorbed by the matrix. Under certain patho-physiological conditions, such as during the early phase of an arthrosis, this network begins to disintegrate and the tissue absorbs too much water, causing cartilage tissue to swell.

Approximately 70% of the entire water content in cartilage tissue are involved during intervals of changing loads or stresses on the joint. In this context, the cartilage's permeability is of primary importance (the size of the cartilage tissue pores ranges from 3 to 6 nm).

The binding of basic tissue to collagen fibrils is higher in the deep cartilage zone, as compared to the superficial layer, which enhances the stability of the collagen fibers. Due to the sophisticated interaction of all its components, articular cartilage manifests an optimal ratio of elasticity and stability.

2.4.3. Water content regulation in articular cartilage

Like all tissues of the human body, cartilage responds to physiological stimuli. These impulses are required to activate synthesizing cartilage cells, and thus to regulate the tissue's water content. The quality of the synthetic activity depends on the quality of nutrients absorbed through the synovial fluid and the subchondral bone, on the matrix composition and permeability, as well as on positive/negative stress stimuli acting on the cartilage tissue.

2.4.4 Synthesis

Throughout adolescence until the end of the growth phase, synthetic activities occur at a relatively high rate, and diminish with advancing age. Articular cartilage can only fulfill its function as long as new, extracellular components compensate for the physiological degeneration of cartilage tissue. The constant turnover of proteoglycans and glycosaminoglycans occurs fairly quickly. The turnover of hyaluronic acid requires 2-4 days, that of glycosaminoglycan 7-10 days. Collagen fibrils are rejuvenated at a markedly lower rate.

2.4.5 Nutrients

In order to synthesize proteoglycan, glycosaminoglycan, as well as collagen and non-collagen proteins, cells require primarily oxygen, amino acids, and glycose. Through diffusion and osmosis, these substances are transported from the synovial fluid and the subchondral bone to the cells. The blood supply to the subchondral bone and the joint capsule determines the quality and quantity of available nutrients.

The composition of the synovial fluid, which is produced by the joint capsule, dictates the quality of nutrients made available to the cartilage tissue. In other words, the quality of the synovial fluid has significant bearing on the regeneration of articular cartilage; or else, the quality of nutrients available to the cells of cartilage tissue depends on the qualitative composition of the synovial fluid.

Load or stress changes stimulate the transfer of oxygen and nutrients through the cartilage, and cause variations in the electric charge of the tissue, enhancing piezoelectric activity. Electric signals trigger the synthesizing activity of cartilage cells, which are stimulated to organize and structure collagen molecules and fibrils within the tissue, aligning them in a pattern conducive to the maximum ratio of stability and elasticity.

2.4.6. Pathophysiology

Development of degenerating disease and arthrosis:

Various hypothetical explanations exist for the occurrence of degenerating phenomena in articular cartilage and the development of arthrosis. Cartilage degenerates with advancing age, during the forced immobilization of a joint, or due to anatomic changes, which are described in the respective chapter on anatomy. In pathophysiological terms, degenerated cartilage is causally associated with:

- a decreased rate of synthetic activity in the matrix
- a shortening of hyaluronic acids and chondroithin sulfate chains
- decreased amounts of chondroithin sulfate and
- an increased amount of keratan sulfate.

The lack of physiologic stress stimuli, as well as chronic lack or excess stress exerted on the cartilage, result in an inferior nutrition quality, a lowered matrix synthesis rate and ultimately the loss of matrix.

With a loss of matrix, the cartilage tissue can no longer bind enough water, which weakens its resistance to mechanical deformation, and thus exposes the collagen fiber network to increased stress loads. The consequence is damage to the collagen fibrils. Once the fibrils contained in the transitional zone are damaged, swelling develops in the superficial cartilage layer. Once this layer degenerates, tears and holes appear in the cartilage tissue, and the stress on the subchondral bone increases.

Arthrosis develops when the protective layer of the bone mass is damaged or destroyed as a result of loss of function in the cartilage tissue.

Possible causes of arthrosis:

- age-related damage to cartilage
- trauma-induced immobilization
- chronic lack of or excess strain (arthrosis developing from the superficial cartilage layer)
- a variation in the tidemark, a thickening of the mineralized cartilage zone and thinning of the soft cartilage tissue (arthrosis developing from the bony substance)
- calcification of soft cartilage through increased vascularization and increased pH value, responsible for increased bone production. Possible reason for a tidemark variation.

X-ray images of an arthrosis in its early phase reveal the decreasing spatial measurements between joints. At a later point, marked changes on the surface of articular cartilage occur, which can, however, only be assessed by arthroscopy. Regeneration of cartilage tissue occurs when the joint, and thus the cartilage, receives an adequate amount of physiological stress stimuli. It is doubtful whether the parallel degeneration of the subchondral bone has a detrimental effect on this principle.

Joint lubrication reduces to a minimum the friction forces that occur when joint surfaces move either in synchrony or against each other. Proper lubrication keeps joints healthy for life. There are two types of joint lubrication:

- surface lubrication through glycoproteins which attach to the superficial cartilage layer,

- the lubrication by means of a fluid lining where small amounts of water are “grasped” and embedded between the two non-congruent joint areas (Frans van den Berg, “Angewandte Physiologie” (Applied Physiology), Thieme Verlag 1999).

2.5. Innervation of the coxofemoral joint in context:

In general, the hip joint and all organs of the small pelvis respond to motoric and vasomotoric nerve fibers (Th9 – S4). Parietal lesions in this area may therefore have an effect on all organs of the small pelvis and thus on the coxofemoral joint. In turn, these vertebra segments may have a direct parietal influence on the coxofemoral joint (Lason, Peters, “Das Becken” (The Pelvis), 2000).

2.6. Glucosaminsulfat and M.S.M.

Following is a brief outline on the mechanisms of action of glucosaminosulfate (GAS) and methyl-sulfonyl-methane (MSM):

Glucosaminosulfate:

Glucosamine is a basic building block in the formation of bones, cartilage, tendons and ligaments, eyes, skin, nails, and arteries. Glucosamine stimulates the formation of glycosaminoglycan (GAG), the main component of collagen, which supports and connects the skin, arteries, and bone and cartilage tissue. Glucosamine’s positive impact on the connective tissue has been evident in the successful treatment of varicose veins, hemorrhoids, and the healing of degenerated cartilage. Glycosaminoglycan is also a main ingredient of the synovial fluid, which keeps the joint mobile and provides nourishment to the cartilage tissue. With advancing age, the body’s capacity of synthesizing glucosaminosulfate from dietary sources diminishes. This renders collagen fibers fragile and prone to inflammation – conversely, inflammations may also destroy collagen.

This degeneration causes swelling, stiffness and deformation of joints. The degenerating causes of arthrosis have their origin at the basic substance of cartilage. Clinical studies conducted in Europe and North America have shown that the long-term treatment of chronic joint diseases with glucosaminosulfate produces an anti-inflammatory effect, and relieves pain and swelling. Since glucosaminosulfate stimulates new growth of cartilage tissue, damaged cartilage tissue in the joint and in the spinal column can be repaired, and the protective buffer around joints restored. Maintaining synovial fluid at healthy levels protects healthy cartilage tissue from damage (preventive measure).

Methyl-sulfonyl-methane (MSM)

MSM is a sulphur molecule present in the earth's atmosphere, in plants, and in animal and human organisms. Sulphur is imperative for the healthy function of the human organism. It is an important element in the formation of connective tissue, in particular tissue rich in proteins (erythrocytes, muscles, skin, hair, finger and toe nails). It is found as a main component in enzymes, it enhances detoxification processes and protects the cell protoplasm from contaminants. Sulphur-containing amino acids such as methionine and cysteine are responsible for the formation of proteins, and thus for cell growth and cell rejuvenation. Even small amounts of MSM reinforce the positive effect of amino acids. The anti-oxidant properties of cysteine are ascribed to its sulphur content. MSM is the main component of dimethyl sulfoxide (DMSO), which is found in lignin, a substance occurring in the cellulose fibers of wood. Positive trial findings obtained at the DMSO Clinic of the Oregon Health Science University in Portland, Oregon led to DMSO's successful application as an analgesic in human and veterinary medicine in the treatment of arthritic symptoms since the early eighties. The preparation's unpleasant taste, however, caused many patients to end therapy prematurely. Consequently, by eliminating the odor-producing dimethyl sulfite (DSM), scientists were able to produce an odorless variant. MSM provides biologically active sulphur, and is considered an ideal painkiller, a finding confirmed in many clinical studies. The analgesic effect of MSM is attributed to the fact that it blocks the transmission of pain signals along C nerve fibers to the brain. In patients suffering from inflammation and swelling, MSM prevents collagen-forming fibroblasts from proliferating and causing painful pressure on nerve fibers and tissue. During the healing process, MSM also improves blood circulation in damaged tissue. All these properties make MSM a recommended choice in the treatment of:

- osteoarthritis
- rheumatoid arthritis
- fibromyalgia
- back pain
- sprains and pulled muscles
- complaints related to the skeletal muscles
- tendonitis
- bursitis.

Osteopathic therapy strives to treat the coxofemoral joint through intermittent compression, i.e. alternating traction and compression loads, as well as centralizing techniques, and the manipulation of the ilium, in order to reduce excess strain caused by a defective anterior or external cover. Cranio-sacral and fascial techniques are used to manipulate the intra-cellular condition of cartilage tissue.

Chapter 3: Methodology

3.1. Study design

The present study was designed to ensure ease of reproduction by a single investigator. No complex technical methods of measurement were required, bearing in mind relative simplicity and cost-effectiveness. For a variety of reasons (financial, legal, small regional hospital) the author was not in a position to conduct a controlled study. The control was assured by numerous repeated measurements.

The pre- and post-treatment examination of study subjects by a neutral osteopath familiar with the test sequence, but blinded to the type of treatment and cohort randomization of patients would have been desirable. Unfortunately this was not possible due to local and temporal constraints.

In an effort to conduct measurements neutrally, blank pages were used to enter data on each trial sequence to avoid bias caused by earlier test results.

The study was conducted with two patient cohorts:

The 28 test persons were divided into two groups with 14 test persons each.

Out of the group without nutritional supplements, 6 test persons dropped out after the 2nd treatment (5 because of complete analgesia, for one test person the reason for dropping out is unknown). This group included **8 patients who received only osteopathic treatment**.

Out of the group with nutritional supplements, 2 test persons dropped out (one person relocated and the other person because of complete analgesia). This second group, with **12 subjects, received osteopathic treatment plus glucosaminosulfate (500 mg three times daily) and MSM (800 mg once daily administered in the morning)** during the entire course of this study.

A control group without treatment could not be realised, because of the lack of test persons. The control was assured by numerous repeated measurements.

3.2. Inclusion criteria for patients

General practitioners and orthopedic specialists in the greater Bad Ischl area (Austria) were briefed on the study concept. All 28 patients participating in the study were referrals for inclusion by these physicians.

A middle study design was selected for this thesis, i.e. all female and male test persons were at least 20 years and maximum 50 years old during the study period.

None of the female and male test persons was allowed to show factors which could cause a secondary arthrosis, like:

- one-sided strain on the joints
- extremely heavy labor
- body weight over 10% of healthy weight
- extreme sports activities
- post-traumatic immobilization of joints

- congenital joint malformation, such as varus or valgus position of the knees
- prior inflammatory diseases, such as Morbus Perthes
- age-related arthrosis.

3.3. Methods

First treatment session:

- Patient documentation
- Anamnesis including assessment of hip x-ray image (not older than 3 months)
- General and specific osteopathic examination
- Documentation of pre-treatment study objectives
- Osteopathic treatment
- Documentation of post-treatment study objectives

Second to sixth treatment sessions:

- Osteopathic examination
- Documentation of pre-treatment study objectives
- Osteopathic treatment
- Documentation of post-treatment study criteria

Time interval between treatments:

- One week interval each between first, second and third treatment
- Two weeks interval each between fourth, fifth and sixth treatment

No further x-rays were obtained at the end of the treatment series because the treatment time interval was deemed too short to reveal any visible improvements.

3.4. Study criteria

a) Mobility of the motor apparatus:

1. General active flexion in a standing position:

Test description: With knees extended, the patient bends down to touch the ground. The distance between fingers and ground is measured and documented, as well as any bend-forward phenomenon. If an evasive movement occurs, the patient is instructed to descend both hands evenly. Should a difference in finger-ground distance still occur, the higher value is taken as measurement.

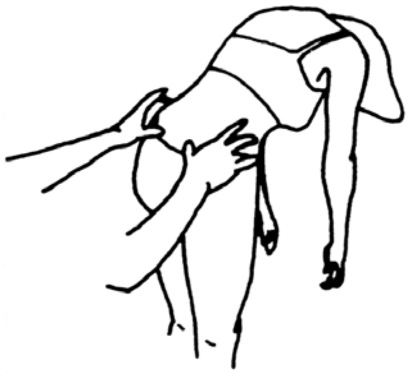


Figure M 1: Bend-forward test

2. Patrick Kuber Test:

Test description: The patient is instructed to lie flat on his back on a pad, and to rest the foot of the coxarthritic side of the body on the contralateral knee. The patient then lets the afflicted leg descend sideways. The therapeutic caregiver controls and immobilizes, if necessary, the contralateral ilium in order to prevent the pelvis from moving up. The distance between knee and pad is measured in cm.

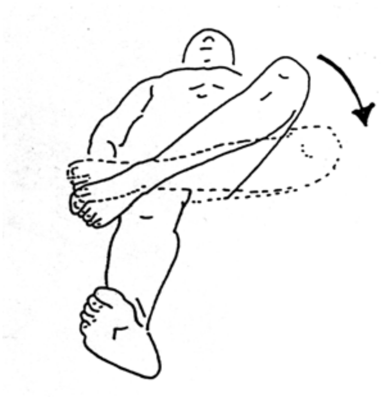


Figure M 2: Patrick Kuber test

3. Flexion in the coxofemoral joint:

The patient is instructed to lie on his back. The passive flexion in the homolateral os ilium is measured, whereby the contralateral leg must remain extended and flat on the pad. The angle of the hip flexion in relation to the afflicted joint in zero position is measured.
A goniometer with a leg length of 40 cms was used as protractor in order to avoid as much measurement errors as possible.

4. Interior and exterior rotations of the coxofemoral joint:

The passive exterior and interior rotations are measured with the patient in an upright sitting position, at both 90 degrees hip and knee flexion. The patient's pelvis must remain immobile, and is corrected by the therapeutic caregiver if necessary. The angle in relation to the vertical axis of the torso is measured.

b) General function during walking:

The patient documents the distance walked in meters, prior to the first and after the sixth treatment. The patient should not experience any feelings of pain more intense than at the beginning of each walking exercise.

c) **Pain assessment**

Using the WOMAC pain scale, the patient self-records any feelings of pain experienced while walking on a level plane prior to the first and after the sixth treatment, by entering the perceived pain intensity on a page containing a vertical scale of 100 mm in length. The higher end corresponds to 0 = no pain, the lower end indicates 100 = severe pain (according to VAS).

WOMAC = Western Ontario and McMaster Universities
VAS = Visual Analog Scale

3.5. Osteopathic treatment technics

The author would like to emphasize once more that the objective of this study is not the examination of any particular type of osteopathic treatment. Rather, techniques are applied that are deemed appropriate for the correction of lesions diagnosed during the osteopathic examination.

1. **Structural techniques:**

   These consist mainly of centralizing the afflicted hip joint, and include pulsating techniques applied on the joint cartilage during each treatment during at least 5 minutes, in order to mobilize or correct the hypomobile structures, in particular the ilium or the obturator passages.

2. **Visceral techniques:**

   These are applied if hypomobility is diagnosed, and include mobilizing or lifting the bladder or uterus, or other organs and fasciae.

3. **Cranial techniques:**

   These are applied only for diagnostic purposes or to identify hypomobile structures.

Chapter 4: Results

Within the following part, both patient groups are systematically tested for differences. Emphasis is put on the fact whether the patient group with GAS and MSM shows significant differences to the patient group without GAS and MSM as to the average increase in efficiency while executing different tasks.

In addition, each patient group shall be tested for the average increase in efficiency from the first to the sixth treatment.

4.1.Comparison of the average increase in efficiency of both groups

Type of test	Patientgroup without GAS + MSM	Patientgroup with GAS + MSM
Improved finger – ground distance	**5.4 cm**	**6.6 cm**
Improved results, Patrick-Kuber-Test	**9.9 cm**	**5.8 cm**
Improved passive hip flexion	**13.8 degrees**	**12.9 degrees**
Improved exterior rotation	**9.0 degrees**	**9.25 degrees**
Improved interior rotation	**4.4 degrees**	**2.8 degrees**
Improved walking distance	**1,000 m**	**1,820 m**
Improvement, subjective pain assessment (WOMAC scale)	**2.2**	**3.0**

Table: R 1

Explanation of abbreviations:

GAS = glucosaminosulfate (500 mg three times daily)

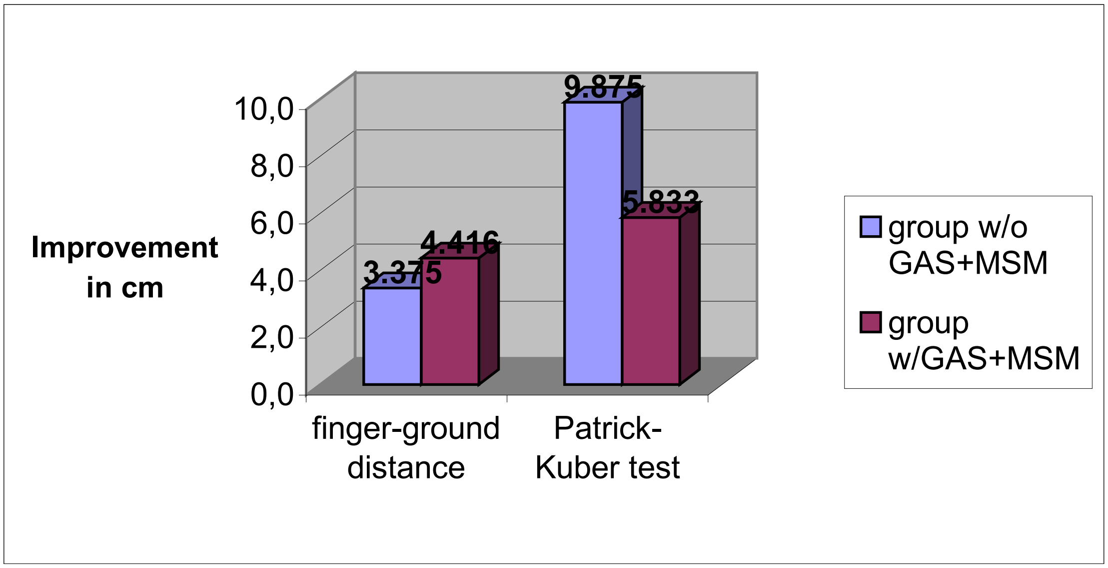
MSM = methyl-sulfonyl-methane (800 mg once daily)

The complete pre- and post-treatment data of individual patients are found at the end of this chapter.

In order to examine both groups for significant differences, the t-test for independent sampling was taken as test procedure. As the test results show different units, a t-test is conducted for each task as a significance check. As null hypothesis it is assumed that the taking of dietary supplements does not significantly change the efficiency.

The following charts summarise those tasks with the same units.

Finger-ground distance and Patrick-Kuber test



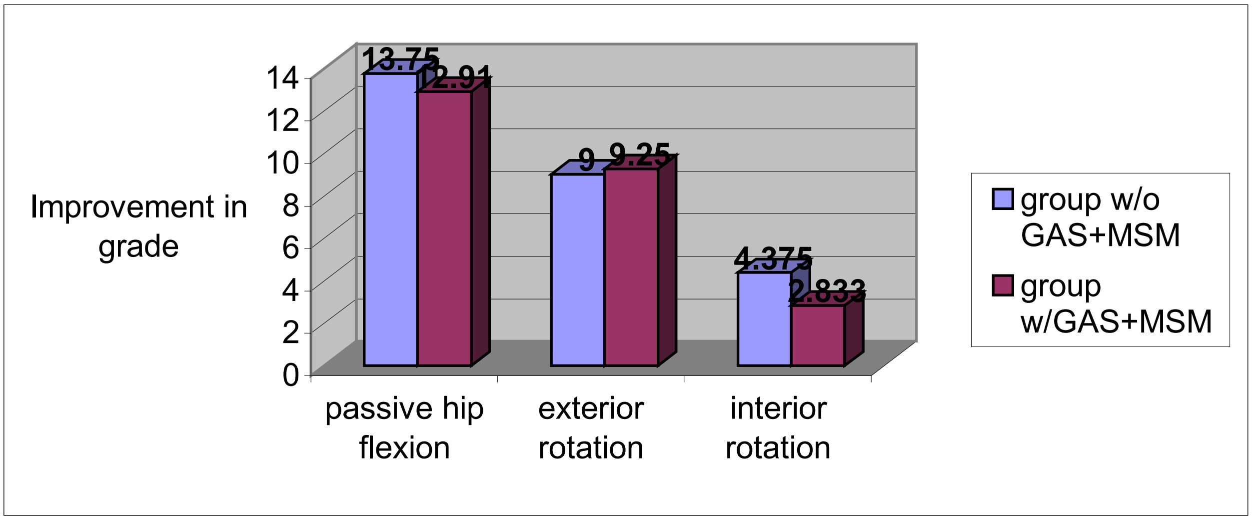
During the comparison of both patient groups as to an increase in efficiency, no significant difference could be detected for the improved finger-ground distance. The calculated t-test did not show a significant value: $t_{err} = -.5$; $t_{tab} = 1.73 \Rightarrow \mathrm{I}t_{err}\mathrm{I} < t_{tab}$

This leads to assuming the null hypothesis, i.e. that both patient groups do not differ significantly in the increase in efficiency during the finger-ground test.

However, in the case of the Patrick-Kuber test, the difference shown in the illustration points out that against the assumption, the patient group without dietary supplements achieves better results. Though the calculated t-test does not show a significant result: $t_{err} = 1.508$.

This result also leads to assuming the null hypothesis because there is no significant difference between both groups.

Passive hip flexion, exterior and interior rotation

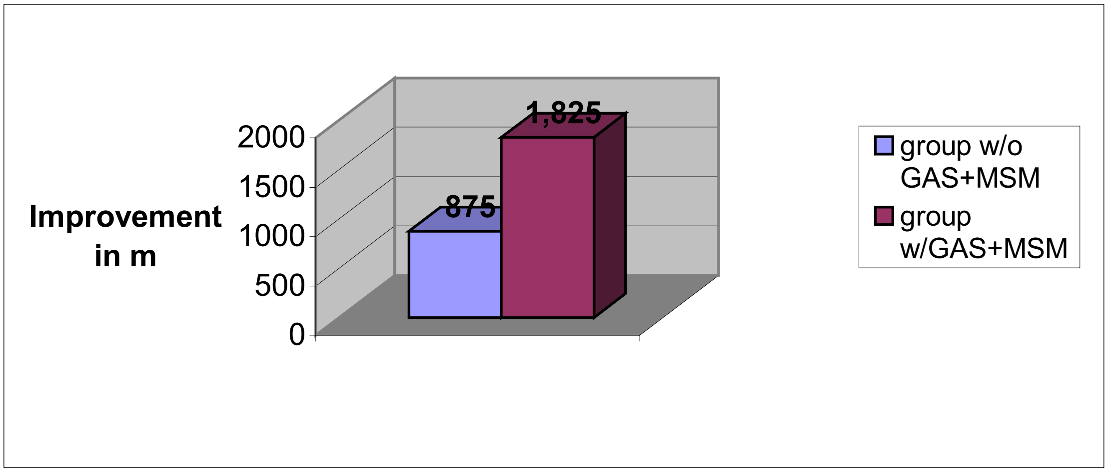


If we take a look at above repartition of efficiency of both patient groups, we notice that there is no significant difference between both groups. This fact could be confirmed statistically by the calculated t-tests:

Passive hip flexion $t_{err} = .411$
Extern rotation $t_{err} = -.058$
Intern rotation $t_{err} = 1.094$

These three tests did not show significant values, i.e. the increase in efficiency by taking GAS and MSM was not more important than without taking the supplements. If we take a closer look, we determine that the effect on the passive hip flexion and the interior rotation point at the opposite direction (please refer to the chart and the positive values of the t-test) and that in this case, the patient group without dietary supplements achieved a slightly higher efficiency than the group with dietary supplements.

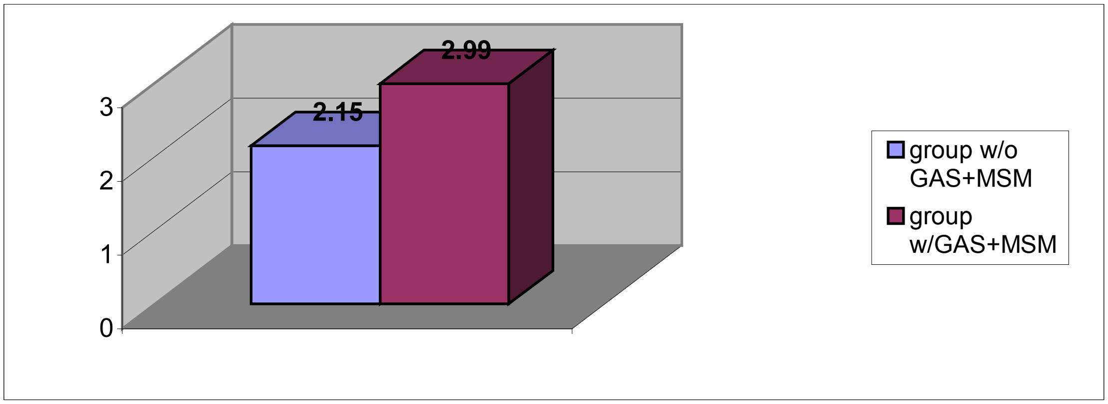
Walking distance



As to the walking distance, too, the difference between both groups as shown above and calculated by the t-test was not significant: $t_{err} = -.861$.

Again, the results lead to assume the null hypothesis.

Subjective pain assessment (WOMAC scale)



Concerning the subjective pain assessment (WOMAC scale), the illustration shows no significant difference which was also confirmed by the calculated t-value. The t-test did not deliver a significant value: $t_{err} = .505$.

The null hypothesis is assumed.

Summary of the results

Recapitulating, it was determined that none of the calculated t-tests delivered a significant value. From a statistic point of view, we had to assume for all seven test types the null hypothesis which means that there is no significant difference between both patient groups. We have to notice that for three test types, the effects even turned out to be contrary to the expectations. This means for the Patrick-Kuber test, the passive hip flexion and the interior rotation that the patient group without MSM and GAS showed a slightly better efficiency than the patient group with MSM and GAS.

Altogether it was determined that the taking of dietary supplements (MSM and GAS) within this short period of study of 8 weeks did not have considerable effects (neither positive nor negative ones) on the increase in efficiency.

4.2. Study of the increase in efficiency for both patient groups

Patient group without GAS + MSM

In order to examine an increase in efficiency for this group from the first to the sixth treatment, t-tests for dependent samples were calculated for all test types. According to the null hypothesis, the efficiency during the first treatment does not differ significantly from the efficiency during the sixth treatment.

Finger floor distance	$t_{err} = 1.903$
Patrick-Kuber test	$t_{err} = 2.170$
Passive hip flexion	$t_{err} = -5.601$
Extern rotation	$t_{err} = -6.000$
Intern rotation	$t_{err} = -3.123$
Walking distance	$t_{err} = -1.930$
Subjective pain	$t_{err} = 8.725$

However, all calculations delivered significant ($t_{tab} = 1.90$), some of them highly significant ($t_{tab} = 3.0$) values. This is why the null hypothesis has to be abandoned.

This means that the applied osteopathic treatment, as expected, in part significantly influences the efficiency.

Patient group with GAS + MSM

For this group, too, a t-test for dependent samples was calculated for each test type in order to examine the significance.

Finger floor distance	$t_{err} = 3.815$
Patrick-Kuber test	$t_{err} = 5.238$
Passive hip flexion	$t_{err} = -13.385$
Extern rotation	$t_{err} = -6.613$
Intern rotation	$t_{err} = -4.145$
Walking distance	$t_{err} = -2.110$
Subjective pain	$t_{err} = 7.946$

In this case, most calculations delivered **highly significant ($t_{tab} = 2.72$) values and one test a significant value ($t_{tab} = 1.80$).** Therefore, we also have to abandon the null hypothesis. This means again that the applied osteopathic treatment, as expected, in part significantly influences the efficiency.

4.3. List of osteopathic correlations

The following osteopathic lesions causally and biomechanically associated with primary coxarthrosis were diagnosed in individual patients:

Patient cohort without GAS + MSM:

Patient 1, m, 42y: sacroiliac joint blockage with left/left torsion in the sacrum
Patient 2, f, 29y: no verifiable cause
Patient 3, m, 34y: no verifiable cause
Patient 4, f, 38y: no verifiable cause
Patient 5, f, 39y: blockage in the lumbar spine(2nd and 3rd vertebrae)
Patient 6, f, 45y: prior salpingitis, os coccygis – flexion-lesion
Patient 7, f, 31y: descending (sygmoid) colon – adhesion
Patient 8, f, 50y: pelvic congestion, ptosis of the bladder

Patient cohort with GAS + MSM:

Patient 1, f, 26y: os ilium posterior – lesion
Patient 2, m, 46y: no verifiable cause
Patient 3, f, 33y: no verifiable cause
Patient 4, f, 44y: extreme tension in the obturator membranes
Patient 5, f, 32y: no verifiable cause
Patient 6, f, 44y: psychosocial conditions (occupational stress)
Patient 7, f, 47y: blockage in the lumbar spine, pelvic congestion following hysterectomy, fibrous and contracted musculature
Patient 8, m, 43y: no verifiable cause

Patient 9, f, 35y: no verifiable cause

Patient 10, f, 35y: no verifiable cause

Patient 11, f, 48y: severely fixated connective tissue, inadequate nutrition

Patient 12, m, 49y: severe connective tissue limitation in rotation, severe lack of exercise

In conclusion, it can be said that accompanying symptoms, or lesions, related to the diagnosis of coxarthrosis, are present in all study subjects.

Chapter 5: Discussion

A study dated August 1981 was for example found:
"Stress on the articular surface of the hip joint in persons with idiopathic coxarthrosis and healthy adults", Abt B, Altekruse M, Brinckmann P., 1981
A direct comparison with this study is however not target-oriented.

Extensive research of the print literature and sources available on the Internet revealed an abundance of trials on the subject of "arthrosis". However, no publication with the potential of serving as an analogy equivalent to this study, was found on the "conservative treatment of primary coxarthrosis". Professor Paul Klein also confirmed this finding. Therefore, the present study results should be compared and reviewed critically.

Selection of the elimination criteria:
None of the items listed on page 25 - 26 was allowed to be the reason for the coxarthrosis. This is why it was relatively difficult to find -in cooperation with the physicians- appropriated test persons who exclusively showed an idiopathic (primary) coxarthrosis according to the radiograph.

Selection of the inclusion criteria:
The high margin of the age ranging from 20 to 50 years can be criticised. It is sure that a margin ranging from f.e. 20 to 35 years only would have been the better choice in order to exclude an old-age arthrosis. Because of the very detailed anamnesis of each test

person, we can exclude an old-age arthrosis also for the test persons being between 36 and 50 years old.

Out of the 28 test persons at the beginning of the study, exactly half of them belonged to the age segment between 36 and 50 years who, however, were absolutely necessary for the two tested groups.

The goniometries were executed with the highest possible exactness. This is why, as mentioned in chapter 3, we used a goniometer (protractor) with a longer leg length of 40 cms each in order to keep the measuring errors as low as possible. Nevertheless, using goniometry, there is a tolerance of about +/- 3°.

As to the interior and exterior rotation when planning the measurement methods, we chose the dorsal position with 90 ° hip flexion. Due to the determined measuring errors, this position was abandoned, and the sedentary position was chosen as the instruction given to the patient to evenly strain the pelvis clearly increased the measuring exactness.

5.1. Clinical value:

The selected objective and subjective parameters can nicely document the every-day condition of each test person, thus the validity is given.

The reliabiltiy as well as the sensitivity of this study is also given according to the author.

It would have been desirable that for the treatment an uninvolved colleague would have done the tests. In this case, the results could have been analysed in an objective way. The author who works alone in a surgery was not in a position to always consult a colleague during the treatment period of 2 months. It can also be criticised that there was no control group which did not receive an osteopathic treatment during the same time. The control was, however, enhanced by numerous repeated measurements which clearly display the trend during the time of treatment.

This would not be recognisable only by the measurements executed before the first and after the last treatment.

5.2. Discussion of the results:

The improvement of the parameters within both groups, i.e. the data before the first and after the sixth treatment show a significant, mostly a highly significant increase.

If we take a closer look at the results of the test persons, there is however a clear difference whether there exists a lesion in addition to the cox-arthrosis.

For example, the test persons 11 and 12 out of the group with GAS + MSM arrived at the first treatment with strong connective tissue strains and fixed fascial systems, which could almost be cured a 100 %. These test persons showed a considerable improvement in almost all parameters after the sixth treatment. Especially in comparison with the test persons who did not have an additional lesion besides the primary cox-arthrosis (f.e. test persons 2, 3 and 9 out of the group with GAS + MSM and test persons 2 and 4 out of the group without GAS + MSM).

In this case, further studies, which would have to be conducted under corresponding elimination criteria as to additional lesions, would be interesting.

Chapter 6: Summary

The present clinical study on the assessment of primary coxarthrosis was based on the 2-month osteopathic treatment of two patient groups (8 and 12 study subjects). In addition to the osteopathic treatment, one patient group received glucosaminosulfate and methyl-sulfonyl-methane as nutritional supplements. The study objective was not to examine any single osteopathic technique, but rather osteopathic therapy and its results as a holistic treatment form.

The following parameters were evaluated in this study: four mobility parameters, i.e. finger-ground distance, passive hip flexion, the Patrick Kuber test, interior and exterior rotation in a sitting position. In addition, patients were asked to self-record walking distance and subjective pain assessment (WOMAC scale).

Results

The examination of the results within both treated groups, i.e. from the first to the sixth treatment, show significant, sometimes highly significant values. The osteopathic therapy is therefore clearly appropriate to successfully treat the clinical picture of primary coxarthrosis.

The comparison of both groups with and without dietary supplements did not reveal any significant difference. None of the calculated t-tests delivered a significant value. Hence we can conclude that in addition to the osteopathic treatment, a nutritional supplement with glucosaminsulfate and methyl-sulfonyl-methane does not result in an improvement of the tested parameters.

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ABSTRACT

Objectively and subjectively observed changes in patients diagnosed with primary coxarthrosis following osteopathic treatment with and without supplemental glucosaminosulfate and MSM.

Study objective:

- Can a holistic osteopathic approach improve clearly defined subjective and objective parameters?
- Can these parameters improve further with the supplemental administration of glucosaminosulfate (500 mg 3 x daily) and methyl-sulfonyl-methane (800 mg 1 x daily) in combination with osteopathic treatment?

Methodology:

Middle study design with two groups and numerous repeated measurements.

The patients receive 6 treatments each and are observed over a period of 2 months; evaluation of 4 mobility parameters, walking distance, pain assessment (WOMAC scale), diagnosis and treatment of lesions located in surrounding tissue (e.g. lesions in the lumbar spine, visceral lesions, etc.).

Results

The examination of the results within both treated groups, i.e. from the first to the sixth treatment, show **significant, sometimes highly significant values.** The osteopathic therapy is therefore clearly appropriate to successfully treat the clinical picture of primary coxarthrosis.

The comparison of both groups with and without dietary supplements did **not reveal any significant difference**. None of the calculated t-tests delivered a significant value. Hence we can conclude that in addition to the osteopathic treatment, a nutritional supplement with glucosaminsulfate and methyl-sulfonyl-methane does not result in an improvement of the tested parameters.