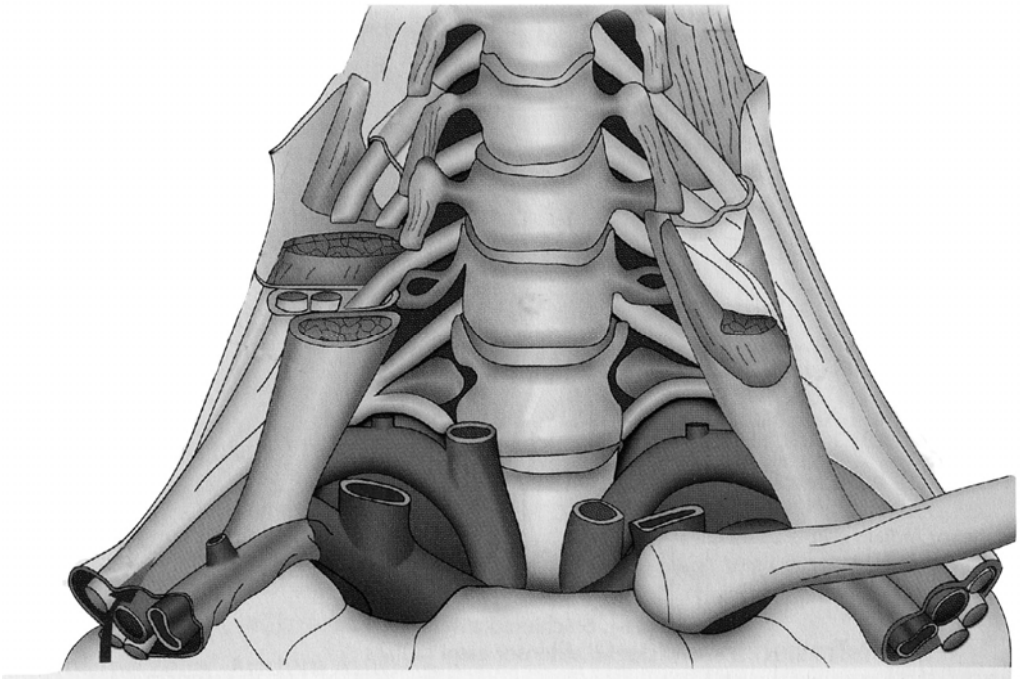
master thesis university course

CERVICOBRACHIALGIA

Efficiency and Effectiveness of Osteopathic Treatment in Comparison with Conventional Ultrasound Therapy

Master Thesis for Obtaining the Degree of "Master of Science in Osteopathy" at the Donau Universität Krems



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1 Abstract

By means of a controlled application study I wanted to find out whether the pain symptoms of cervicobrachialgia can be reduced through osteopathic treatment. Further I was interested in comparing the effectiveness of osteopathic treatment with that of conventional electrotherapy, i.e. ultrasound treatment.

The starting point is a thorough discussion of the theory of pain and the signs and symptoms of cervicobrachialgia as well as the application of ultrasound. The next section takes a closer look at osteopathic treatment and assessment methods.

Since this paper concentrates in particular on the lower cervicobrachial syndrome with pain radiating into the shoulder and arm, the focus lies on the brachial plexus, which innervates the arms and shoulders, also because some of the applied treatment techniques involve a direct hand contact in this region.

The analysis of the data in the osteopathic group showed a clear reduction of the pain's intensity especially in the SF-36 and VAS, which resulted also in a better vitality and mental health. Even though a decrease of the pain's intensity, as well as an improvement of vitality and mental health could also be observed in the ultrasound group, the change was less pronounced. All other items have improved fairly similarly.

These results show that osteopathic treatment seems to be more effective compared with ultrasound therapy.

2 Introduction

I am interested in studying the condition of cervicobrachialgia more closely because in my practice the number of patients suffering from pain in the neck-shoulder-arm region has been continually increasing over the past few years.

Due to the fact that many patients are referred to me with the diagnosis cervicobrachialgia by general practitioners who cooperate with me, I am regularly confronted with this pain syndrome. Thus I have decided to take a closer look at the effectiveness of osteopathic treatment for this kind of complaints.

The condition cervicobrachialgia is also known as cervical syndrome, cervical pain syndrome or neck-shoulder-arm syndrome. It is a sensory, motor and vegetative-trophic disorder in the regions of the neck, shoulder girdle and upper extremities.

With this study, which is a controlled application study, I want to find out whether the pain symptoms of cervicobrachialgia can be reduced with osteopathic treatment. In addition I want to compare the effectiveness of the osteopathic treatment with that of ultrasound treatment, which is a conventional electrotherapy method.

The common symptoms of the condition are hypertone muscles and functional restrictions of movement in the neck and shoulder regions, headaches, and pain radiating into the arms and thorax.

On a continuous basis these symptoms favour bad postures due to wrong weight-bearing and increased inactivity, and thus cause complaints in the area of the cervical spine. The consequence is that the muscles become weaker, the elasticity of the postural muscles is reduced and the mobility of the joints decreases. This can limit the patients in their function and cause further injuries of the structure and thus painful complaints.

Since pain is a major symptom in cervicobrachialgia I would like to facilitate the understanding by talking about pain, its definition and classification more in detail.

3 Pain

According to the “International Association for the Study of Pain (IASP)” pain is defined as:

“An unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage.” (http://www.iasp-pain.org/terms-p.html)

This 20-year old definition of pain by the International Association for the Study of Pain (IASP), which is still valid today, describes the impact of an experience, whose cause may be unknown, but which – potentially – can cause damage to the person’s physical integrity.

Pain is not a disease as such. It is a symptom which is dependent on the influence of multiple physical, mental and social factors. (Wieden, Sittig 2005)

Pain is a quality of sensory input, which is specific but can be caused by a number of different kinds of stimuli. It is a very important factor in the concept of a person’s perception of the internal and external world because of its enormous influence on the vigilance-controlled reaction of the organism and its immediate effect on the wellbeing of the organism. More than other modalities it is thus characterized by the fact that everybody perceives the intensity of pain differently. Everybody’s reaction to pain is individual due to the fact that it is influenced by the person’s constitution and governed by conditioned learning. Indolence, therefore, does not mean that the peripheral pain perception is inhibited it simply indicates that the central mechanisms to suppress pain are channelled and highly reactive, or that the emotional significance of the pain is put into perspective by cognitive processes.

Pain cannot only be perceived with different intensities and individually variable effects on a person’s wellbeing and behaviour, pain also has a multi-facetted perceived quality which requires that the affected person and the practitioner are well able to differentiate in order to analyse the pain quality. Even a quantitative evaluation of pain is difficult and involves a high degree of inaccuracy.

For the purpose of diagnosis, therapy and prognosis, however, it is very important to have a precise pain biography and topology in order to analyse the current state and development of the condition. Pain should always be seen as an accompanying or main symptom of a disease whose identification is more important than merely eliminating the pain symptoms. (Dittll 1992)

3.1 Forms of Pain

We differentiate between acute pain, chronic pain and nociceptive pain. In the following section I want to discuss all three categories in detail.

3.1.1 Acute Pain

Acute pain is a sign of tissue damage and cell death. It has the function to warn of further physical damage and thus a protective function. Acute pain will decrease when the healing of the wound starts once the noxious stimulus is absent. The localisation of acute pain is clearly determinable. (Wieden, Sittig 2005; Huber, Winter 2006)

3.1.2 Chronic Pain

Chronic pain has already lost its warning and protective function. Its intensity does no longer correlate with the causative stimulus. It is disconnected from the triggering event and becomes an independent condition. Often several organ systems are affected in this case. (Huber, Winter 2006)

3.1.3 Nociceptive Pain

Unlike the feeling of pain, which is defined as subjective sensory perception or emotional experience, nociception is seen as objective, neuronal process. If nociceptive stimuli which can have different forms (mechanical, biochemical or thermal) exceed a certain threshold, they will activate free nerve endings, the so-called nociceptors. (Huber, Winter 2006; Wieden, Sittig 2005)

3.2 Onset of Pain

Concerning the onset of pain it is important to differentiate between peripheral and central mechanisms. In both cases the so-called neuronal plasticity plays a major role. In general this term describes the ability of the nervous system, to transform its structure and function through a multitude of physiological and biological changes in its peripheral nerves, the spinal cord and also in cortical regions of the brain (“pain memory”). Due to sensitizing and desensitizing mechanisms this may trigger altered responses of the nervous system to pain stimuli. (Huber, Winter 2006; Wieden, Sittig 2005)

3.2.1 Peripheral Mechanisms of Pain Onset

First I would like to describe the peripheral mechanisms of pain onset according to Huber, Winter (2006) and Dittl (1992). In the peripheral mechanisms of pain onset the nociceptors play a major role. Nociceptors are the sensory nerve endings, which perceive stimuli that threaten the integrity of the body. They can be found most frequently in the skin, muscles, periosteum, capsules, viscera and in the walls of vessels and hollow organs.

We differentiate between unimodal nociceptors and polymodal nociceptors. Figure 1 illustrates the structures and processes in the nociceptive system.

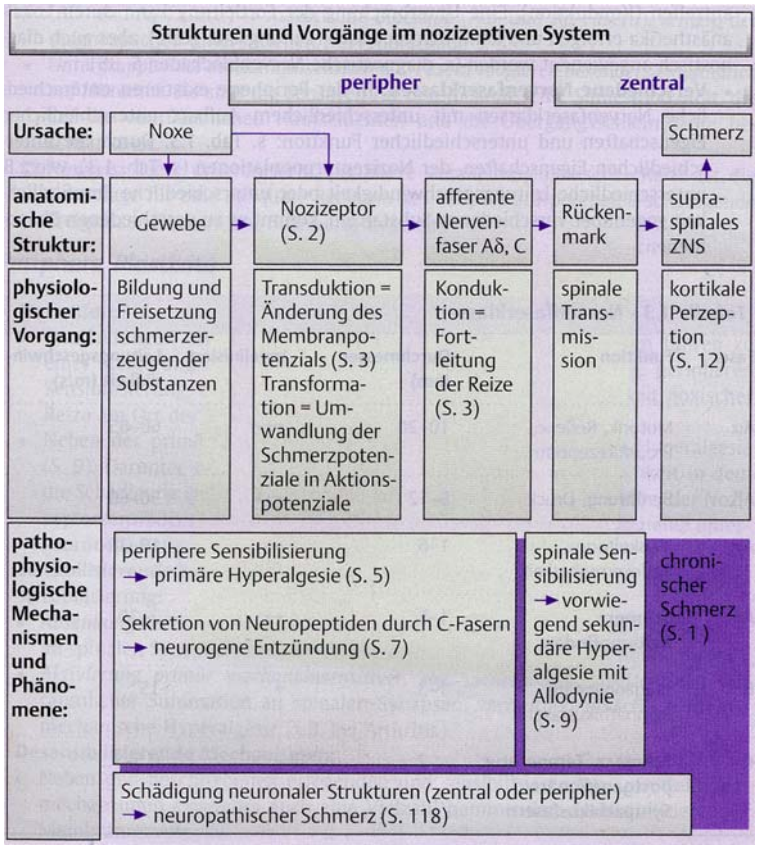


Fig. 1 Overview, structures in the nociceptive system (cf. Annex for the English translation of Fig.1)

The unimodal nociceptors react only to specific noxious stimuli. Such unimodal nociceptors are e.g. cold-, heat-, mechano- or chemo-nociceptors. Polymodal nociceptors react to more than one kind of stimulus.

Transduction, transformation and conduction are additional important factors in the peripheral mechanisms of pain onset.

Transduction designates a change in the membrane potential. The conversion of sensor potentials into action potentials is called transformation. In all parts of the peripheral and

central nervous system the transmission of nociceptive impulses (conduction) from the transformation sites takes place in the form of regenerative action potentials. (Huber, Winter 2006, Dittl 1992)

Another important factor in the peripheral mechanisms of pain onset is the diversity of nerve fibres. In the periphery there are various categories of nerve fibres with different structures, characteristics and functions (cf. Table 1 below).

Due to the different characteristics of the nociceptor populations, e.g. different speed of conduction or different sensitivity with regard to various inputs, a variety of phenomena may occur.

There are nociceptors consisting of small, myelinated fibres, nociceptors with small, non-myelinated fibres and nociceptors with large fibres.

Nociceptors consisting of small myelinated fibres, A-delta-fibres, are nociceptors which cause a clear, sharp, cutting or stabbing, clearly localized pain, which occurs immediately after the stimulus and is called “first pain“. Theses nociceptors can primarily be found in the skin.

Nociceptors consisting of small non-myelinated fibres, C-fibres, are nociceptors causing a dull, burning, pulling or drilling pain, which occurs and also disappears slower and is called “second pain”. They can mostly be found in joints (joint capsules, ligaments), tendons and internal organs. (Frisch, 1998)

There are also large nerve fibres, A-beta fibres, which react sensitively to pressure and ischemia. If pressure or an ischemia lasts for a certain period of time, the sensitivity to soft tactile stimuli is reduced first because the large A-beta fibres are compromised first.

The table below shows a detailed list of the various categories of nerve fibres and their function, diameter, myilinazation and speed of conduction. (Huber, Winter 2006)

Faser	Funktion	Durchmesser (µm)	myelinisiert	Leitungsgeschwindigkeit (m/s)
Aα	Motorik, Reflexe, Propriorezeption	10–20	+++	60–85
Aβ	Berührung, Druck	5–12	+++	30–60
Aχ	Muskeltonus, Reflexerregbarkeit	1–6	++	10–30
Aδ	**Schmerz, Kaltempfinden**	1–5	++	2–30
B	präganglionäre Sympathikusfasern	1–3	+	15
C	**Schmerz, Temperatur, postganglionäre Sympathikusfasern**	< 2	–	0,5–1,5

Table 1 Nerve fibre categories (cf. Annex for the English translation of Table 1)

3.2.2 Primary and Secondary Hyperalgesia

We differentiate between primary and secondary hyperalgesia.

- Primary hyperalgesia: According to Huber, Winter (2006) und Dittl (1992) inflammatory processes or other pathological tissue changes lead to an increase of the nociceptors' sensitivity (peripheral sensitization). This leads to an increase in the response to noxious stimuli at the site of the tissue damage. The phenomenon is called primary hyperalgesia.
- Secondary hyperalgesia: describes a decreased pain threshold in the adjacent unaffected tissue. In contrast to primary hyperalgesia, secondary hyperalgesia plays a minor role in the sensitization of nociceptors.

Again we differentiate between two kinds of nociceptor sensitization. (Huber, Winter 2006; Dittl 1992)

On the one hand the sensitization can be a lowering of the pain threshold and an increase in the response to stimuli with a temporal summation at the spinal synapses; e.g. a heat hyperalgesia can be caused by sunburn.

On the other hand it can be an activation of primary mechanosensitve nociceptors with a spatial summation at the spinal synapses; e.g. a cause of mechanical hyperalgesia can be arthritis.

In the desensitizing mechanisms there exist a number of inhibitory desensitizing mechanoreceptors. The most important endogenous inhibition is generated by peripheral opioidreceptors. Inflammatory processes provoke an increase of the axonal transport of opioidreceptors in the periphery, where they are discharged at the nociceptor endings. Via these receptors both endorphins and opioids applied in therapy can counteract a nociceptror sensitization.

3.2.3 Neurogenic Inflammation

Another aspect of peripheral mechanisms of pain onset are neurogenic inflammation processes, which I would like to describe in the following section according to Huber, Winter (2006); Dittl (1992).
The term neurogenic inflammation designates a sterile tissue inflammation with vasodilatation, extravasation, mast cell granulation and histamine secretion caused by the stimulation of peripheral pain-transmitting nerve fibres.

Pathophysiology describes the process as follows: C-fibres release neuropeptides. Via axonal transport they reach the nociceptive nerve endings, where they are stored and released if a relevant stimulus occurs.
These neuropeptides mainly are substance P, calcitonin and neurokinin.

3.2.4 Central Mechanisms of Pain Onset

In this section I would like to describe the central mechanisms of pain onset according to Huber, Winter (2006); Dittl (1992).
I will differentiate between spinal reception and transmission of stimuli from the trunk and the extremities and the spinal reception and transmission of stimuli from the face and cranium.

a) The spinal reception and transmission of stimuli from the trunk and extremities can be identified on the basis of tactile and nociceptive afferences from the trunk and extremities which have a specific termination pattern in the posterior horn of the spinal cord (cornu posterius medullae spinalis). The posterior horn is subdivided in several laminae (I-X). There are neurons with nociceptive input, which end in laminae I,II,V,X. And there are neurons without nociceptive but with tactile input, which end in laminae IV,V. The interneurons, which

are neurons that serve as interfaces between afferent and efferent neurons, are located in laminae II and III.

b) In the case of spinal reception and transmission of stimuli from the face and cranium the nociceptive impulses travel via the nucleus of the trigeminal nerve.

The figure below illustrates the transmission of pain impulses from peripheral to central sensory neurons in the Rexed's laminae of the spinal cord.

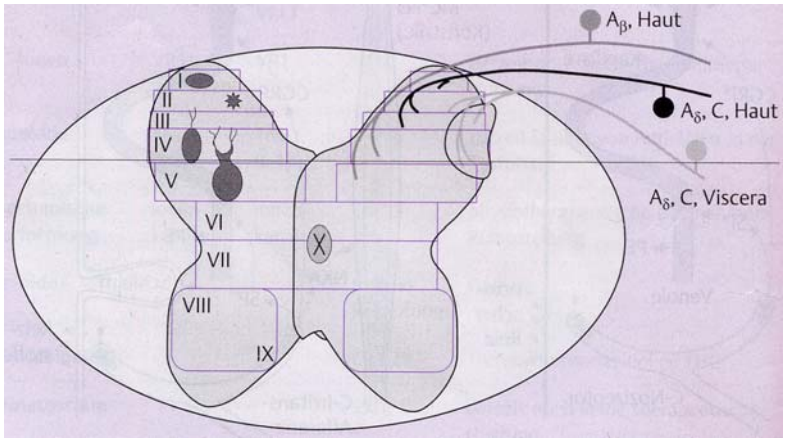


Fig. 2 Transmission of pain impulses (cf. Annex for the English translation of Fig.2)

I would like to refer to Huber, Winter (2006) and illustrate the transmission of pain by means of a clinical example.

- The neurons in the posterior horn of the spinal cord receive nociceptive impulses from both the dermal and visceral afferences. This viscerosomatic convergence is seen as the origin of the transmitted pain.
- The transmitted pain is ipsilaterally relayed further within a spinal segment or to the proximal adjacent segment. This is the reason why noxious stimuli of a visceral organ can be felt as pain in an area of skin or muscles.
- These are important indicators for the purpose of diagnosis: e.g. pain radiating into the inner region of the left upper arm in the case of myocardial ischemia.

3.3 Spinal Sensitization

The definition of spinal plasticity according to Huber, Winter (2006); Dittl (1992) explains that in the case of a longer nociceptive input the activity of neurons can be increased and the

neurons of the posterior horn change from a resting into an aroused state. We talk about a spinal sensitization. This spinal sensitization is characterized by a secondary hyperalgesia.

A secondary hyperalgesia can have the following clinical patterns:
a) Allodynia is a stimulus of touch or slight pressure (A-beta fibres), which is perceived as painful. The C-fibres are stimulated as well, which causes a sensitization of the neurons of the posterior horn, which in turn causes an increased input of the A-beta fibres.
b) Hyperalgesia is a mechanical stimulus (A-delta fibres) which is perceived as painful. Also in this case the stimulation of C-fibres causes a sensitization of the neurons of the posterior horn, which in turn increases the input of A-delta fibres.

Among the central mechanisms of pain onset we differentiate between sensitizing and desensitizing mechanisms according to Huber, Winter (2006); Dittl (1992).

a) As regards the sensitizing mechanisms the most important transmitter substances at the synapses are the amino acids glutamate and asparate. If a nociceptive input lasts for a longer period of time, certain mechanisms lead to a sensitization of the posterior horn. Postsynaptic receptors are activated; the intra-cellular Ca concentration and phosphorylation of intra-cellular proteins is increased.
b) In the case of desensitizing mechanisms, a number of inhibitory systems counteract the sensitizing mechanisms.
   We differentiate between segmental and descending inhibition.
   The descending inhibition has its origin in the grey matter of the midbrain. It displays a very high concentration of opiate receptors and has an inhibiting effect via serotonergic and noradrenergic nuclei.

3.4 Transmission of Pain Impulses and Processing in the Cortex

In the following section I would like to give a short overview of the transmission of pain impulses and their processing in the cerebral cortex.

Figure 3 illustrates the ascendant and descendent pathways of nociception and pain processing. (Huber, Winter 2006)

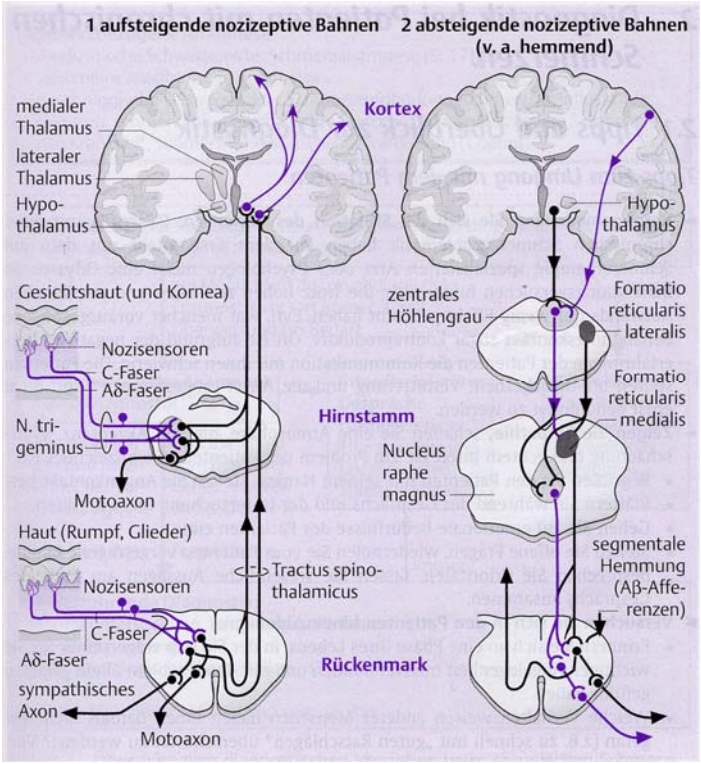


Fig. 3 Ascendant and descendant nociceptive pathways (cf. Annex for the English translation of Fig.3)

1. Tractus spinothalamicus lateralis (neospinothalamisches System):

Verlauf	**Funktion**
Hinterhornneurone von Lamina I, II und V → ventro-posteriore (ventrobasalen) Kerne des Thalamus, dort Umschaltung auf das 3. Neuron → Projektionsfelder S1 und S2 des somatosensorischen Kortex; dort findet sich eine exakte somatotopische Gliederung in Form eines umgekehrten „Homunkulus“	dient hauptsächlich der Lokalisierung und Differenzierung von Schmerzreizen

2. Tractus spinothalamicus medialis (paleospinothalamisches System):

Verlauf	**Funktion**
hauptsächlich Hinterhornneurone der Lamina I und II → mediale Kerne des Thalamus und Formatio reticularis des Mittelhirns → Projektion ins Vorderhirn (Inselregion, frontaler Kortex) und in limbische, subkortikale (Amygdala) und kortikale (Gyrus cinguli anterior) Kerngebiete	dient der Bewertung und emotionalen Verarbeitung von Schmerzreizen

Table 2 Pathways of the Tractus spinothalamicus (cf. Annex for the English translation of Table 2)

The pathway of the spinothalamic tract is important for the transmission of pain. It is part of the anterolateral system. Complex motor reactions are relayed at the spinal cord level, e.g. flight reflexes, defence movements. The brainstem controls vegetative reactions, e.g. heart rate, increase of blood pressure, pupil dilation, and exudation.

4 Cervicobrachalgia

This paper deals with the condition cervicobrachialgia with pain radiating into the shoulder-arm regions. During my work I always had the following question in my mind: Can my osteopathic treatment improve the cervicobrachialgic symptoms of pain? I will come back to this question later.

4.1 Definition

The term cervicobrachialgia or cervical syndrome is a collective term for a number of different impairments of function in the cervical region, where the most important symptoms are pain and restriction of movement, often in combination with functional deficiencies of nerves.
The term designates sensory, motor and vegetative-trophic dysfunctions in the regions of the neck, the shoulder girdle and the upper extremities. (Pschyrembel 2002, S. 1814)

In the area of the neck, the narrow link between head and trunk, arthrogenic, myogenic, vasal, neurogenic and vegetative dysfunctions may occur.

4.2 Classification of the Cervicobrachial Syndrome

According to Ebner (1993); Gerber (1998); Cotta (1993); Lewit (1992) the clinical picture linked with the syndrome is very complex thus you find different kinds of classification of the cervicobrachial syndrome.

I will differentiate between the upper, middle and lower cervicobrachial syndrome, and present the classifications according to the origin of the condition and how it developed.

4.2.1 Upper Cervical Syndrome

Complaints which originate at the segments C1 – C4 and radiate from the upper neck into the suboccipital region and into various areas of the head right into the forehead (face) fall into this category. Due to muscular and neural interconnection the ventral region of the neck and throat with the larynx is also affected. Degenerative changes can cause a defective position of vertebral joints, axial deviation and a constriction of the vertebral artery and

sympathetic chain in the uncovertebral region. This can lead to headaches which can manifest in different forms. I would like to mention the most common forms:

-) Tension headaches are the most frequent form.
-) Cervicogenic headaches with a restriction between C1/C2.
-) Hypermobility headaches accompanied by instabilities.
-) Vasomotor headaches, which can cause a narrowing of the vertebral artery.
-) Migraine cervicale with a diencephalic disturbance of the vascular regulation – can have an effect on the patient's eyes and cause hemicranial headaches and vegetative complaints like nausea and retching.
-) Cervicogenic dizziness – the cervical spine can have an effect on the vestibulum through its influence on the vertebral artery and on the position of the head.
-) Globus pharyngeus (the sensation of a lump or discomfort in the throat) – can be caused by a dysfunction on the upper cervical spine which negatively affects the muscles of the pharynx.
-) Tinnitus (ringing in the ears) or acute hearing loss: there is a connection between the cervical spine and ear; the symptoms can be caused by an irritation of the vertebral artery and the adjacent plexus.

4.2.2 Middle Cervical Syndrome

This category includes syndromes which have their origin at the segments C3 – C5.
Sometimes the middle cervical syndrome and its segments are counted towards the categories of either the upper or the lower cervical syndrome.

4.2.3 Lower Cervical Syndrome

This category includes syndromes which originate at the segments C5 – C8 with radiating pain into the neck, shoulder and lateral upper arm regions, and the ventral or dorsal thorax.

Pain and disturbed sensitivity extend over the respective dermatoms. The muscles are only partly affected because their innervations pass via the brachial plexus and thus through several spinal nerves. Hypotrophia and loss of power can appear in the associated (segment-indicating) muscles. (e.g. deltoid muscle [M. deltoideus] for a dysfunction at the level of C5).

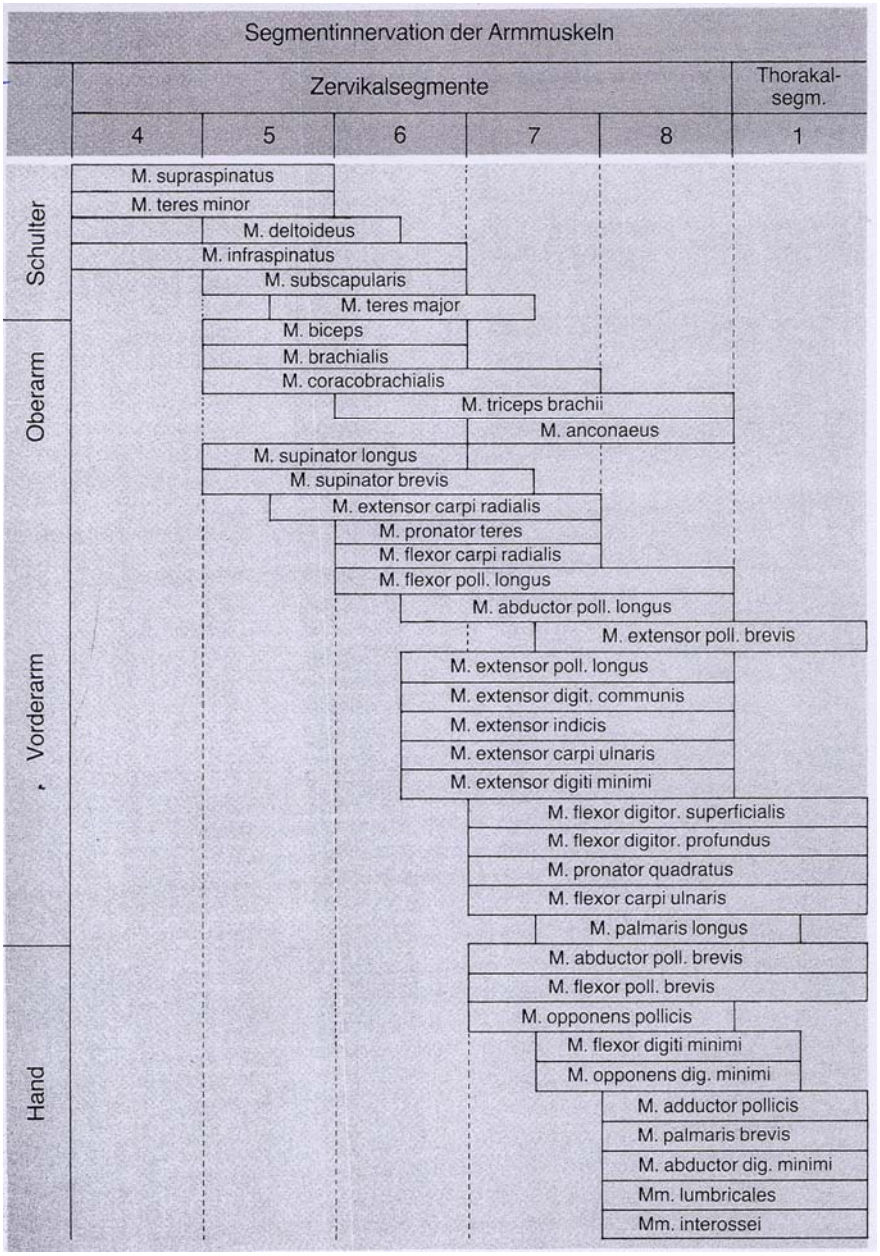


Fig. 4 Segmental innervation of the arm musculature (cf. Annex for the English translation of Fig.4)

Figure 4 shows the segmental innervation of the muscles in the arm and the associated cervical segments. (Mumenthaler 1990)

Table 3 lists the radicular syndromes. (Mumenthaler 1990)

Segment	Sensibilität	Kennmuskel	Muskeldehnungsreflexe	Bemerkungen
C 3/4	Schmerz bzw. Hypalgesie im Bereich der Schulter	partielle oder totale Zwerchfellparese	keine faßbaren Reflexstörungen	partielle Zwerchfellparesen C 3 liegen mehr ventral, C 4 mehr dorsal
C 5	Schmerz bzw. Hypalgesie lateral über der Schulter, etwa den M. deltoideus bedeckend	Innervationsstörungen im M. deltoideus und M. biceps brachii	Abschwächung des Bizepsreflexes	
C 6	Dermatom an der Radialseite des Ober- und Vorderarmes, bis zum Daumen abwärts ziehend	Paresen des M. biceps brachii und des M. brachioradialis	Abschwächung oder Ausfall des Bizepsreflexes	
C 7	Dermatom lateral-dorsal vom C 6-Dermatom, zum 2. bis 4. Finger ziehend	Parese des M. triceps brachii, des M. pronator teres und gelegentlich der Fingerbeuger; oft sichtbare Atrophie des Daumenballens	Abschwächung oder Ausfall des Trizepsreflexes	Differentialdiagnose gegen das Karpaltunnelsyndrom: Beachtung des Trizepsreflexes
C 8	Dermatom lehnt sich dorsal an C 7 an, zieht zum Kleinfinger	kleine Handmuskeln, sichtbare Atrophie, besonders im Kleinfingerballen	Abschwächung des Trizepsreflexes	Differentialdiagnose gegenüber der Ulnarislähmung: Beachtung des Trizepsreflexes
L 3	Dermatom vom Trochanter major über die Streckseite zur Innenseite des Oberschenkels über das Knie ziehend	Parese des M. quadriceps femoris	Ausfall des Quadrizepsreflexes (Patellarsehnenreflex)	Differentialdiagnose gegen die Femoralislähmung: das Innervationsareal des N. saphenus bleibt intakt

Table 3 Radicular syndromes (cf. Annex for the English translation of Table 3)

4.3 Origins of a Cervical Syndrome

The cervicobrachial syndrome can also be classified according to its origin. [(Gerber (1998); Cotta (1993); Mumenthaler (1998)] In this case, the determining factors for the classification are the localisation and radiation of the pain.

4.3.1 Local Cervical Symptom

The pain sits locally in the region of the cervical spine and does not radiate. The symptoms occur due to segmental disturbances. Movement-related pain occurs because of an antalgic

posture and the restriction of movement, which cause the formation of tendomyoses, myogeloses or irritations of the joint capsule.

4.3.2 Radicular Cervical Syndrome

In this case we observe a sharp and clearly delimited pain radiation due to a compression of the nerve root. The intensity of the radiating pain is greater than the pain in the region of the cervical spine.

The areas which are most commonly affected are the regions of C5/ C6 and C6/ C7. The regions which are irritated run along the dermatoms that are associated with the nerve roots C6 and C7. Segmental syndromes are named after the affected nerve root. The number indicates the lower vertebral body of the dysfunctional vertebral unit. The pain occurring in the dermatoms of the respective nerve root (radiation into the arm) is often linked with dysesthesia, disturbed sensitivity, hypesthesia, paresthesia, rarely hyperesthetic zones due to longer lasting compression. We also observe nocturnal pain with tingling, paresthesia and hyperesthesia in the dermatoms.

The dermatoms attributed to radicular syndromes with radiation down into the hand have overlappings in the regions of the upper arm and forearm. All share a dorsolateral pain band and region of paresthesia around the shoulder and upper arm.

Loss of power of the segment-indicating muscle groups does not occur so often. It has to be clearly distinguished from a loss of power due to the pain.

A differential diagnosis has to involve a differentiation between a radicular lesion, a peripheral lesion or an evulsion. Neurophysiological examinations are important to clearly define the presenting complaint (MRT, CT, X-ray in all four planes, etc.).

4.3.3 Pseudoradicular Cervical Syndrome

This form of cervical syndrome describes complaints which are caused by degenerative changes of cervical segments. The quality of the pain is usually described as dull and diffuse.

A clear classification is difficult because often many symptoms occur at the same time, overlap or change during the course of the complaint. Besides a painful restriction of movement of the cervical spine these symptoms include hypertension in the muscles of the shoulder and neck area, headaches, dizziness, symptoms affecting the spinal cord, irritation

of the cochleovastibular nerve [N. cochleovestibularis] and various functional dysfunctions, which can originate at internal organs.

We can differentiate between the following causes of a pseudoradicular cervicobrachial syndrome:

- Local cervical syndrome: the symptoms are confined to the cervical region.
- Cervical facet syndrome: the complaint starts at the joint capsules of the vertebral segments.
- Occipital neuralgia: The problems are concentrated in the area of the neck and occiput involving an irritation of the greater occipital nerve [N. occipitalis major].
- Acute wry neck (torticollis): this is a special form of the local cervical syndrome with a bad position and restriction of movement of the cervical spine. The condition is rarely painful and is not accompanied with neurological deficits. The acute wry neck can generally be observed in children and adolescents and usually disappears within a few days.
- Cervicocephalic syndrome: This is a kind of cervical syndrome that is accompanied by headaches, acute dizziness and disturbances of hearing, seeing and swallowing.

Neurophysiologic examinations like MRT, CT, x-rays of the cervical spine and manual examinations, etc. are necessary to make an exact diagnosis.

4.4 Form of Development

The syndromes can also be classified according to how they develop.
The cervical syndrome is categorized following its aetiology (Cotta 1993; Gerber 1998; Mumenthaler1998).

4.4.1 Traumatic

The complaints are caused by an acute trauma of the cervical spine (fracture, dislocation, distorsion).

4.4.2 Degenerative

The complaints occur because of the natural wear and tear of the structures, e.g. intervertebral discs, bones, muscles and ligaments which are involved in changes in the cervical spine.

Example:
A radicular syndrome usually is caused by a compression of the nerve root due to a disc herniation or protrusion.

According to Dittl (1992) the cause of a pseudoradicular syndrome is to be found in the facet joints.

4.4.3 Tumourous

The symptoms are caused by bone tumours and metastases.
The muscles become hypotone and the cervical spine takes on an uneconomic posture.

4.4.4 Functional

The cause lies in the whole locomotor system. Due to wrong weight-bearing and inactivity the body adopts an antalgic posture and the muscles change, which causes the complaints in the area of the cervical spine.

4.5 Therapeutic Measures

In this chapter I will discuss the treatment of radicular and pseudoradicular syndromes which belong to the category lower cervicobrachial syndrome.

4.5.1 Treatment of a Radicular Syndrome

In the treatment of radicular syndromes we have two treatment options: conservative therapy or surgery. (Huber, Winter 2006)

a) A conservative therapy involves on the one hand the administration of medication in the form of analgesics, neurotropes, vitamins and infusions, or, on the other hand, therapeutic local anaesthesia in the form of infiltrations. Also physiotherapy and measures of physical medicine play a role in conservative therapy.

b) Indications for surgical interventions are relatively rare.
Only serious neurological deficits represent an immediate indication for surgery.

Otherwise an operation is only the last resort for a long and persistent problem (e.g. a cervical disc prolaps with myelopathia, a therapy-resistant cervicobrachial syndrome, an instable cervical unit after a trauma to the cervical spine).

4.5.2 Treatment of a Pseudoradicular Syndrome

According to Huber, Winter (2006) a pseudoradicular syndrome is commonly treated with conservative methods.

These conservative methods include the administration of certain medications, which, however, only treat the symptoms to complement the physical measures. Medications include B-vitamins (neurotropic effect), antiphlogistics, etc.….

Another measure would be the treatment with local injections, where either certain trigger points or directly the local muscles are infiltrated. Subcutaneous whealing is another conservative measure to treat the pseudoradicular syndrome.
Further conservative measures include heat treatments, massages and the wearing of a cervical collar. Sometimes patients are prescribed electrotherapy (ultrasound), a form of therapy which I will discuss in detail in my paper.
Extension, which can be used therapeutically and is achieved through traction with a Glisson's loop, sometimes brings relieve in cases of muscle or joint-induced degenerative conditions of the cervical spine. Important are isometric tension exercises and physiotherapy. Manual therapy also includes a differentiated examination of the joints and vertebral column. I will look in particular at osteopathic techniques and the effectiveness of osteopathic treatment in this context. If necessary, psychotherapy measures can be included as well.

Also prophylactic measures, which can be applied because of the chronic and recurring character of the cervical syndrome, play a major role according to Huber, Winter (2006):

Strengthening of the shoulder and neck muscles through isometric tension exercises should become a daily routine.
The rules of "back school" education programs also apply, i.e. excessive rotation movements of the spine, drafts, hypothermia and bad positions of the head should be avoided.
Another important factor is the adaptation of one's workplace.

4.6 Visceral Pain

The following forms of visceral pain can be linked with the clinical picture of cervicobrachialgia. The cervical region and the internal organs are connected via the sympathetic chain. It runs as a chain of ganglia along the spine on both sides from the base of the skull down to the coccyx bone. The cervical part of the sympathetic chain has almost no connection with the cervical spinal cord. It receives fibres from the 8th cervical segment and the upper thoracic segments. The cervical share of the sympathetic chain consists of 2 to 3 ganglia. The lowest one very often is merged with the first thoracic ganglion to form the ganglion stellatum. Due to this connection, dysfunctions in the region of the cervical spine can also affect the internal organs.

The diaphragm is innervated by the phrenic nerve [N. phrenicus] (C3 – C5), which comes from the cervical plexus [Plexus cervicalis]. It forms sensory branches [Rr. pericardiaca] to the pericardium and pleural branches [Rr. pleurales] to the pleura mediastinalis and pleura diaphragmatica. After its passage through the diaphragm sensory Rr. phrenicoabdominales supply the peritoneal layer covering the diaphragm, the liver, gallbladder [Vesica fellea] and pancreas. Its terminal branches merge with the celiac plexus [Plexus coeliacus] (Mumenthaler 1998). A compression of the nerve roots in the cervical region can provoke an elevation of the diaphragm.
Having looked at the definition of the cervicobrachial syndrome, its development, causes and treatment methods in chapter 3, I would now like to discuss the electrotherapy measure of ultrasound, its definition, biophysical characteristics, technical considerations, physiological effects, practical application, indications and counter-indications.

5 Electrotherapy

In this controlled application study I will compare the application of an electrotherapeutic approach, i.e. ultrasound treatment, with an osteopathic treatment in the case of the clinical picture presented by the condition cervicobrachialgia. I can still well remember the time when I trained as physical therapist, where we applied ultrasound therapy to treat cervicobrachialgia. I also use this method now in my practice. In this study I was interested in examining whether ultrasound can contribute to reduce the pain symptoms considerably. Before comparing the two methods, I would like to describe the ultrasound method and its effects.

5.1 Definition and History of Ultrasound

“Sound” means acoustic vibrations and it can be classified in three categories according to its frequencies. Infrasound comprises the frequency range up to 16 Hz and cannot be perceived by the human ear. Audible sound is defined as the frequency range that can be perceived by the human ear. In a person with unimpaired hearing this frequency range normally lies between 16 Hz and 20 000 Hz. The term ultrasound designates acoustic vibrations with a frequency above 20 kHz, which again cannot be perceived by the human ear. (Fig. 4.1). (Fialka – Moser 2005).

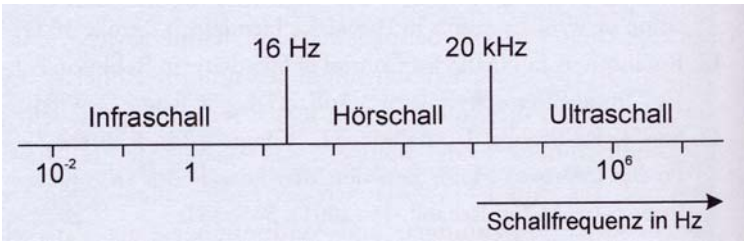


Fig. 5 Classification of sound (cf. Annex for the English translation of Fig.5)

The development of ultrasound methods goes back to J & P Curie, who provided evidence for the piezoelectric effect of quartz crystals in 1880. They found out that a quartz crystal which is exposed to a mechanical strain, i.e. compression or distortion, acquires an alternating electrical charge at its surface.

The first functioning ultrasound device for humans was constructed by Pohlmann in 1939. It was applied for the treatment of ischialgia, plexus neuralgias and arthritic pain. (Fialka – Moser 2005).

5.2 Biophysical Characteristics of Ultrasound

The transmission of sound waves is only possible in a medium, not in a vacuum. Ultrasound travels in the form of longitudinal compression waves. The mass particles of the medium are arranged periodically around their resting position in the direction of the propagation of the ultrasound wave. The ultrasound waves activate the molecules in the adjacent material, e.g. body tissue, to swing rhythmically around their resting position in the respective frequency. This generates a very small pendulum movement around the resting position. The particle acceleration can amount to 100 000-times the earth’s gravitational acceleration.

The increasing and decreasing density of the particles in the medium entails a change in the pressure in the medium/tissue. Acoustic impedance, reflection and absorption characterize

the physical behaviour of ultrasound in various media. Air between the sound head and the surface of the body causes a reflection of the ultrasound waves. This can be avoided through the use of coupling media like gel, oil etc. Absorption is important for the ultrasound waves' dispersion in the tissue and is responsible for the generation of heat (Fialka - Moser 2005).

A sound wave with the frequency of 1 MHz penetrates bone as far as 0.5 cm, muscle tissue cross-fibre 2 cm and longitudinal to the fibres 5 cm, adipose tissue 8 cm. (Knotte, Lehmann, 1990). The depth of penetration depends on the frequency and is reduced to the eightfold in frequencies ranging from 0.8 MHz to 3.5 MHz.

In the therapeutic application of ultrasound attention is paid to a high degree of energy transmission into the tissue through absorption with a therapeutically beneficial great penetration depth. In general, ultrasound waves with a frequency ranging between 750 kHz and 1 MHz – 3 MHz are applied.
In the human body the physical phenomena generate a specific spectrum of heat distribution. Deeper structures, which are close to bones, become particularly warm. (Fialka - Moser 2005)

5.3 Technical Specifications of a Therapeutic Ultrasound Device

An ultrasound device used for treatment is composed of a generator which produces a high energy field with a frequency of 0.5-3.5 MHz. The sound head has the same frequency and converts the ultrasound with an intensity of up to 3 W/cm2. There are sound heads for high-frequency ultrasound, which have a strongly convergent sound field. Sound heads for low-frequency ultrasound have a divergent sound field and are not very commonly used in therapy at the moment (Fialka – Moser 2005)

5.4 Physiological Effects of Ultrasound

The primary effect of ultrasound on the human body is quite complex. Its therapeutic value cannot directly be attributed to the sound but to the conversion of the ultrasound in other forms of energy. The generation of heat through absorption probably is the most important and so far the most comprehensible mode of action of ultrasound. Besides this thermal reaction a number of mainly mechanical reactions also play a role in the effectiveness of ultrasound therapy.

It could be proven that ultrasound can cause hyperaemia, boost the metabolism, improve the elasticity of collagen fibres, alter pain, and even provoke inflammatory reactions or tissue necrosis. Therapeutic ultrasound also has a secondary effect on the blood circulation and the metabolism of all tissues. Some researchers were able to prove an increased cell activity and higher proliferation rate of fibroblasts in vitro and in animal tests on wound healing. (Knoch, Knauth 1984; Byl 1992). They assume that the acoustic vibrations change the permeability of the cell membranes of fibroblasts which can facilitate an increased supply of calcium to the cells.

5.5 Practical Applications

In my experience it is important that there is no air between the sound head and the patient's skin. The direct exposure to ultrasound waves is applied with a direct contact to the patient's skin. To ensure a good contact a gel is used as coupling medium. Phonophoresis, a special form of direct exposure to ultrasound waves can be used also. Phonophoresis enhances the penetration and absorption of topically applied drugs (lipophile molecules) via the skin taking into account pH dependency.

5.6 Indications for Ultrasound Application

The spectrum of benefits of ultrasound therapy ranges from its application in conditions of pain, like degenerative diseases and excessive strain syndromes of the locomotor system, neurological and rheumatoid diseases to impaired would healing. (van der Heijden et al.1997; van der Windt et al. 1999; Welch et al. 2001)

The table summarizes the most common indications for the use of ultrasound.
In the picture the treatment regions are clearly marked.
Fig. 4.9

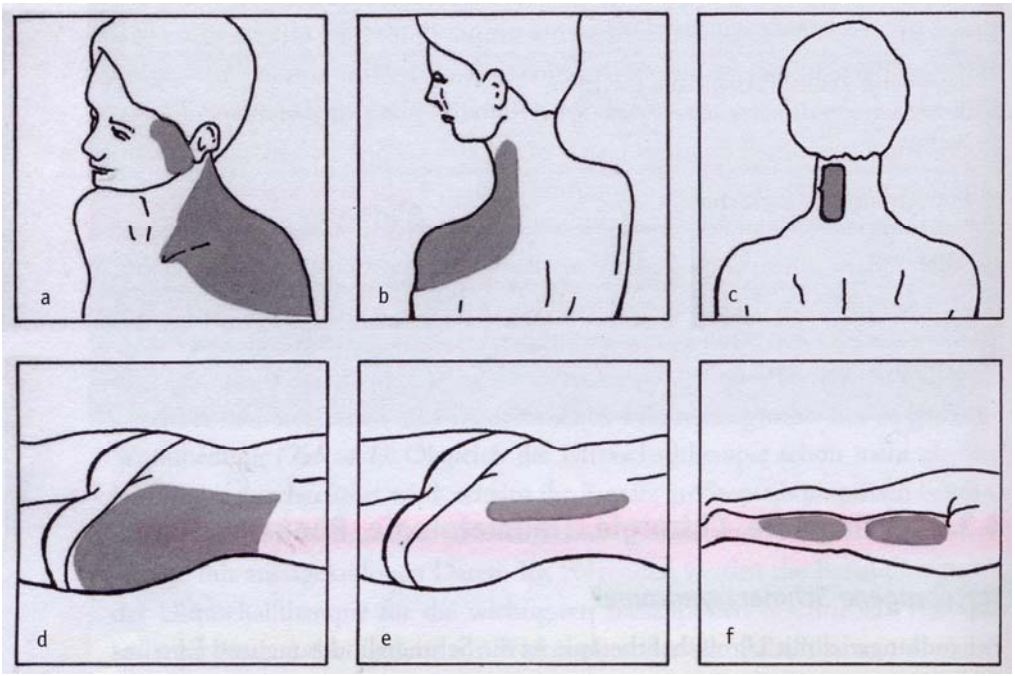


Fig. 6 Treatment regions for a cervicobrachial syndrome a-c; and lumboischialgia d-f;

5.7 Counter-indications for the Application of Ultrasound

Basically an ultrasound therapy should not be carried out in cases where the application of heat/warmth is counter-indicated. This holds especially for acute infections, thrombophlebities, hemorrhagic diathesis, etc. Special counter-indications for ultrasound therapy involve direct treatments of the eyes, the uterus in pregnant women, the testes and structures of the central nervous system. The treatment of these organs with ultrasound even of very low intensity can cause the formation of cavitations and ensue tissue damage and tissue death. In patients who are prone to haemorrhages the mechanical force of the ultrasound can provoke increased bleeding. (Fialka – Moser 2005)

This is a list of specific counter-indications:

- Eyes
- Uterus in pregnant women
- Cardiac pacemaker, heart defibrillator
- Anaesthetic areas
- Areas with vascular insufficiency
- Spinal cord after laminectomy
- Malign tumours
- Predisposition for heamorrhages

5.8 Possible Prescription and Methods to Evaluate the Effectiveness of Ultrasound Treatment

A possible prescription can be ten treatment sessions within a period of six weeks with an intensity of 0.3 W/cm^2. The intensity in the example is quite low; it can vary according to the individual patient and clinical picture. The duration of the treatment can range between five and fifteen minutes depending on the prescription.
The effectiveness of ultrasound treatment can be assessed through a visual analog scale (VAS) where the patient indicates the pain intensity.

6 Osteopathic Treatment

In my paper I will focus on the lower cervicobrachial syndrome with radiation into the shoulder-arm region.
Thus I will put special emphasis on the brachial plexus [Plexus brachialis], which innervates the arms and the shoulder girdle, and is formed by the anterior branches of the lower four cervical nerves (C5-C8) and to a large extent also by the first thoracic nerve (D1). The brachial plexus is affected by many different dysfunctions in the region of the scalene gap and many of the treatment techniques have a contact in the region of the plexus. The following section will thus focus on the brachial plexus.

6.1 Anatomy and Pathways of the Brachial Plexus

The plexus is located deep in the posterior cervical triangle. The fibres of the spinal nerves C5-C8 run between the anterior and posterior transversospinal muscles [M. transversospinalis] along the transverse processes of the vertebral column. The first thoracic spinal nerve (D1) runs on the ligament just behind the pleura dome right to the ribs. The spinal nerves C5 to D1 pass through the scalene gap between the medial scalene muscle [M. scalenus medius] and the first rib together with the subclavian artery [A. subclavia] and merge into three main trunks (primary trunks).

Fig. 7 illustrates the location of the spinal nerves and their passage through the scalene gap.

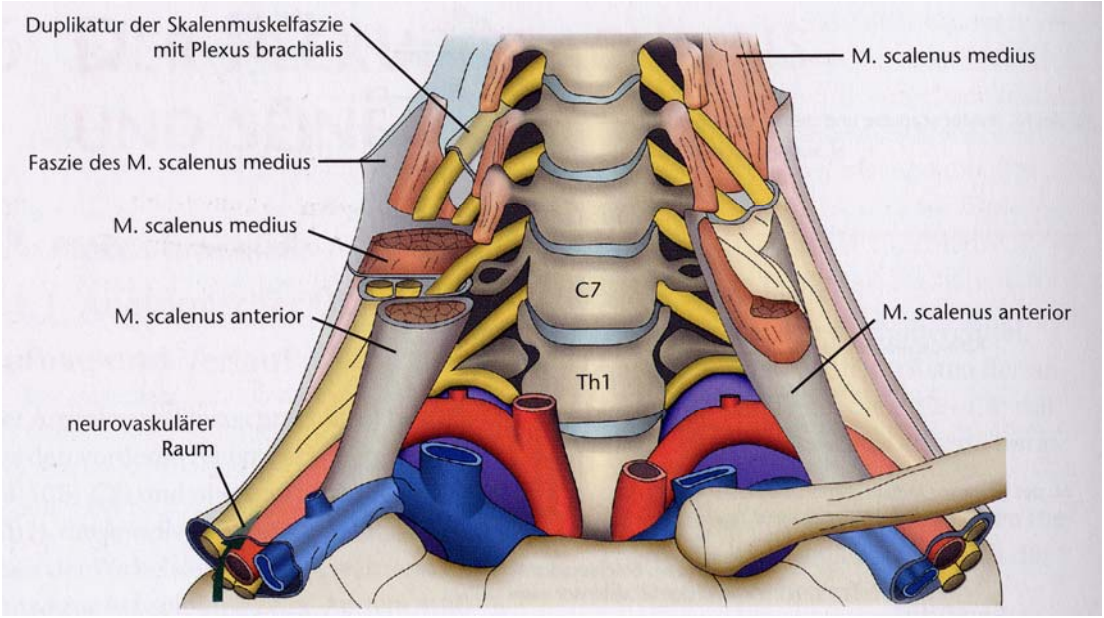


Fig. 7 Scalene gap (cf. Annex for the English translation of Fig.7)

As mentioned above I want to consider the passage of the three main trunks in detail.
The first main trunk is called Truncus superior. It is formed by the Rami anteriores of C5 and C6, and to a certain extent by branches of C4. The second main trunk, the Truncus medius, is formed by the Ramus anterior of C7. The Truncus inferior, finally, is formed by the Rami anteriores of C8 and D1. It is located above the first rib.

The branches of the three main trunks form two parts of the brachial plexus: the supraclavicular part and the infraclavicular part, which I would like to describe in detail. The supraclavicular part of the brachial plexus runs in a caudolateral direction together with the subclavian artery and reaches the axilla after passing behind the clavicle to form the infraclavicular part of the brachial plexus, which again divides into three secondary trunks (fasciculi). These are called fasciculi lateralis, fasciculi medialis and fasciculi posterior. (Barral, Croibier 2005)

6.2 Location of the Brachial Plexus

The supraclavicular part of the brachial plexus is located behind the superficial cervical fascia in the supraclavicular fossa. It is covered by the sternocleidomastoid muscle [M. sternocleidomastoideus], the pretrachial fascia [Fascia praetrachealis] and the omohyoid muscle [M. omohyoideus].

The infraclavicular part of the brachial plexus is located behind the superior border of the clavicle. It is separated from the clavicle by the subclavian muscle [M. subclavius] and its fascia and expands over the first rib and the superior serratus muscle [M. serratus].

In the axilla the brachial plexus is located behind the pectoral muscles and in front of the tendon of the subscapular muscle [M. subscapularis]. Below the clavicle also the subclavian artery turns towards the axilla to cross it with a number of nerves like the two branches of the median nerve [N. medianus]. In relation to the subclavian artery the brachial plexus is situated more cranially and posteriorly.
In the axilla the subcalvian artery has a connection with the brachial plexus.

It is interesting from an osteopathic point of view that a compression of the scalene gap first affects the subclavian vein [V. subclavia], then the artery and only at the end causes an impairment of the brachial plexus. For that reason the Adson-Wright test is very important. A positive finding in the Adson-Wright test means that not only the subclavian artery but also parts of the brachial plexus are compressed.

Important landmarks to find the brachial plexus are the transverse processes of the vertebral segments. Another landmark is the supraclavicular triangle. The brachial plexus extends in the posterior part of the triangle until the posterior scalene muscle [M. scalenus posterior]. In the infraclavicular region the brachial plexus reaches to the first rib. Also the lesser and greater pectoral muscles [M. pectoralis minor, M. pectoralis major] are important landmarks, because the brachial plexus passes between these two muscles. (Barral, Croibier 2005)

6.3 Biomechanics of the Brachial Plexus

From a biomechanic point of view the brachial plexus is surprisingly elastic. It can stretch several centimeters, e.g. when the neck is bent to one side and the arm on the other side is moved posteriorly and into abduction.

6.4 Treatment of the Brachial Plexus

According to my experience a treatment or manipulation of the brachial plexus has to be carried out very gently to protect the adjacent tissues. The fact that a (careless) manipulation of the brachial plexus can cause a cervicobrachial neuralgia represents an actual danger and shows how strongly the brachial plexus can be influenced.

6.5 Indications

I will describe the indications for a manual treatment of the brachial plexus in the case of cervicobrachialgia according to Barral, Croibier (2005). First of all the network of nerves of the cervical and brachial plexus with all their branches should be examined and if necessary released, i.e. if they are tender or have a limited elasticity.

If a patient suffers from such serious pain in a cervicobrachialgia so he/she can hardly be touched, it is sometimes helpful to mobilize the ipsilateral sciatic nerve. Even a small release is usually enough to carry on with the treatment of the plexus itself.

For pleuropulmonal conditions, no matter whether they are the consequence of a trauma, surgical intervention or infection, it is recommendable to treat the brachial plexus. The fact that bony deformations can occur at cervical segments and the ribs due to an increased unilateral tension of the pleurocervical ligaments shows what forces come into play.

Referred visceral pain usually comes from organs in the thorax (like heart or lungs). Often there is relation with the liver, oesophagus or cardia. From a clinical point of view bilaterally radiating pain often points towards the connection with the thorax, pleura and bronchii, while pain radiating to the left side is a hint for a connection with the cardia, stomach and heart. Pain radiating only to the right side can highlight a connection with the liver and right colon angle.

The numerous anastomoses of the brachial plexus with the cervical plexus explain why pain in the shoulder, elbow or even wrist regions can occur in cases of pleuropulmonal or hepatic problems. If certain nerves (axillary nerve [N. axillaries], median nerve [N. medianus], radial nerve [N. radialis], ulnar nerve [N. ulnaris]) are irritated or have a reduced elasticity, a treatment of these nerves will have an effect on the phrenic nerve [N. phrenicus].

The phrenic nerve is a descending branch of the deep cervical plexus. It is a motor-sensory nerve and consists of fibres from C4, with the participation of fibres from C3 or C5. It has a connection to the subclavian nerve [N. subclavius], the ganglion stellatum, vagus nerve [N. vagus], hypoglossus nerve [N. hypoglossus] and the cervical parts of the sympathetic chain. The sensory fibres of the phrenic nerve innervate the thymus gland, pericardium, diaphragm, Glisson’s capsule, adrenal glands and the superior peritoneum. Its main function consists in supporting the diaphragmatic respiration.

6.6 Additional Examinations

In addition I carry out the following examinations and tests: observation, active and passive movements of the head and neck, palpation, translatory gliding, muscle tests, neurological tests, and diagnostic examinations. With all these tests I carry out a very clear and detailed examination of the locomotor system according to Frisch (1998).

6.6.1 Observation

Through observation the practitioner can notice visible deformations in a static position and functional disturbances in movement. In the sitting position a change in the cervical spine and a defective position of the head due to anatomical changes of the joint surfaces of a vertebra or due to antalgic postures in the case of vertebral restrictions or disc problems is clearly visible. When lying down the patient very often adopts a position which eases the strain on the cervical spine and the head and thus the dysfunction is less or not at all visible.
The practitioner has to observe the form of the neck, position of the head, and the form of the head and face.
The observation is carried out with the patient sitting and in supine position.

6.6.2 Active and Passive Movements of the Head and Neck in Three Planes

Active and passive movements of the head and neck are tested in three planes.
The movements of the head are tested in flexion, extension, side-bending and rotation.

The examination also includes a provocation test of the vertebral segments and a provocation test of hypermobility, which I would like to describe in detail below:

a) The provocation test of the facet joints of the vertebral segments is a combined test of the structures of the cervical spine and is carried out with maximum extension and rotation.
At the side of the rotation the facet joints are provoked through maximum convergence and compression. In addition, also the nerve roots are challenged through a maximum narrowing of the intervertebral foramens [Foramina intervertebralia]. The test can also cause a compression of the vertebral artery [A.vertebralis] in the region of the atlanto-occipital articulation of the head on the opposite side of the rotation.

The test can indicate a disc protrusion or a restriction of the facet joints due to arthrosis; it can also highlight a possible impaired arterial supply of the vertebral artery.

b) The provocation test of hypermobility is carried out in the sagittal plane and involves that the head of the patient is pushed forward and backward as far as possible.
By pushing the head forward a maximum lordosis from C1 to C4 and a maximum kyphosis from C5 to C7 are achieved. The practitioner stabilizes the patient by contacting the sternum and reinforces the movement by gently pushing the back of the head in a ventral direction. By pushing the head back as far as possible a kyphosis from C1 to C4 and a lordosis from C5 to C7 are achieved. The practitioner stabilizes the patient with a contact in the upper thoracic region and reinforces the movement by gently pushing in a dorsal direction with a contact on the patient's forehead.

6.6.3 Palpation of the Cervical Spine during Movement

The palpation of the cervical spine during movement is a segmental test. The practitioner assesses the mobility of occiput/atlas and atlas/axis, as well as the mobility of the segments C2/C3, C3-C5 and the segments C6-Th3 through palpation. The segmental mobility of the cervical spine is tested in three planes, in a position which involves weight-bearing of the head and the working tone of muscles of the neck.

6.6.4 Translatory Gliding

Through traction, compression and gliding this method of examination will thoroughly assess the facet joints.

These tests are specific tests for the cervical discs, facet joints and passages of the nerve roots.

6.6.5 Muscle Tests

Other important examination methods for the cervical region are muscle tests.

Resistance tests of the cervical muscles assess the muscles' power. The practitioner takes up a contact on the patient's forehead or chin and asks the patient to push against his/her resistance. The starting position is an upright sitting position. Resistance is tested in flexion, extension, side-bending and rotation. The muscle groups which are tested for their power are: trapezius [M. trapezius], scalenes [Mm. sclaeni], levator scapulae [M. levator scapulae], sternocleidomastoid [M. sternocleidomastoideus], sublavian [M. subclavius].

6.6.6 Neurological tests

First, I would like to define the terms reflex and segment-indicating muscle.
A reflex is an involuntary reaction to a stimulus, which occurs outside the nervous system, but is conducted via the nervous system. (Frisch 1998)

Therefore we can differentiate between direct monosynaptic and indirect polysynaptic reflexes.

In the direct monosynaptic (i.e. without a relay neuron), proprioceptive reflexes, the receptors are located in the muscle, tendon or joint capsule itself.
In the indirect, polysynaptic (i.e. with relay neurons), exteroceptive reflexes the receptors are located outside the functional unit “joint-muscle”, i.e. they are located in the epidermis, dermis, blood vessels or inner organs.

The segment-indicating muscles are the few monosegmentally supplied muscles. Nevertheless, also motor dysfunctions of muscles which are innervated by two or more segments can be used to diagnose a segmental dysfunction if they can be related with the palpatory and segmental mobility findings.
Table 4 provides a list of reflexes and segment-indicating muscles in the cervical region. (Frisch 1998).

Segment	Reflex	Kennmuskeln	Auslösung	Reaktion	Peripherer Nerv
C_1 C_2	Keine Reflexe Keine Reflexe				
C_3–C_4		Zwerchfell			
C_4–C_6	**Skapulo-humeral-reflex**	Infraspinatus Teres minor	Schlag auf den medialen Rand der unteren Skapulahälfte	**Adduktion und Außenrotation des hängenden Armes**	N. supra-scapularis N. axillaris
C_5	**Bizeps-reflex – (Radiusperi-ostreflex –)**	Biceps brachii Brachioradialis Deltoideus	Schlag auf die Bizepssehne bei flektiertem Ellen-bogen	**Beugung im Ellenbogen**	N. musculo-cutaneus
C_6	**(Bizeps-reflex ∅) Radiusperi-ostreflex –**	Biceps brachii Brachioradialis	Schlag auf die Lateralseite des distalen Radius-endes	Beugung im Ellenbogen	N. radialis N. musculo-cutaneus
C_7	**Trizeps-reflex ∅**	Triceps brachii	Schlag auf die Trizepssehne bei flektiertem Ellen-bogen	**Streckung im Ellenbogen**	N. radialis
C_8	(Trizeps-reflex –)	Triceps brachii Kleine Hand-muskeln Kleinfinger-ballenmuskeln	Schlag auf die Trizepssehne bei flektiertem Ellen-bogen	Streckung im Ellenbogen	N. radialis
C_6–C_8	**Daumen-reflex –**	Flexor pollicis longus	Schlag auf die Sehne des Flexor pollicis longus	**Flexion im Daumenend-glied**	N. medianus
C_7, C_8	**Fingerflexo-renreflex –**	Flexor digito-rum superficialis Flexores carpi	Schlag auf die Beugesehnen am Unterarm	**Flexion der Finger bzw. des Handgelenks**	N. medianus N. ulnaris

Table 4 Reflexes and segment-indicating muscles in the cervical region (cf. Annex for the English translation of Table 4)

6.6.7 Diagnostic Examinations

Barral and Croibier (2005) put emphasis on a special diagnostic examination.

a) The Adson-Wright test is an important form of diagnostic examination in osteopathy.

A positive Adson-Wright-Test often means that not only the subclavian artery [A. subclavia] but also a part of the brachial plexus is compromised.

Execution of the Adson-Wright-Test: The patient sits opposite the practitioner with his/her forearm raised and his/her elbow propped up on the practitioner's knee. The practitioner feels the patient's pulse at his/her wrist with one hand, while exerting a compression on the patient's cervical spine by pushing onto the patient's head and rotating the patient's head in the opposite direction.
The rotation of the head has the effect of stretching all structures attached to the clavicle and first rib, e.g. subclavian muscle [M.subclavius], costo- and sternoclavicular ligaments [Lig. costoclaviculare, Lig. sternoclaviculare], conoid ligament [Lig.conoideum] and trapezoid ligament [Lig. trapezoideum] as well as the pleura. Fixations of one of theses structures

would entail a compression of the subclavian artery and vein [A. and V.subclavia] under tension or traction. The craniocervical compression has an effect on the joint surfaces of the cervical segments and the nerve roots. If the radial pulse becomes weaker or cannot be palpated anymore, a problem can be suspected in the region of the cervical spine or cervical nerve roots.

b) Another objective examination which is to be carried out systematically consists in the taking of blood pressure on both sides.

6.7 Treatment Techniques

I use the following techniques to treat my patients because they are efficient and have proven to be beneficial for the clinical picture of cervicobrachialgia. A major role is attributed to muscle and tissue relaxing techniques, techniques to free the first rib and techniques to treat the brachial plexus.

I start my treatment in the cervical and shoulder regions to relax the muscles with osteopathic techniques.

It is also important that joints like the sternoclavicular and acromioclavicular articulations and the first rib are free. In some patient's the first rib can be blocked. In this case it is advisable to first work on the tissues below to release them, and not work on the first rib right away. It is not possible to treat the brachial plexus before releasing problems of the ribs and muscles.

The treatment techniques described below are accompanied with pictures to illustrate the application of the respective technique. According to Barral, Croibier (2005) they have a beneficial effect on the clinical picture of cervicaobrachialgia.

- **In the region of the neck**

The patient is supine. The practitioner supports the patient's neck with one hand and palpates the pulse below the clavicle with the other hand. The right spot is located slightly laterally behind the posterior tendon of the anterior scalene muscle [M. scalenus anterior]. The palm of the hand cups the natural curve of the shoulder. The pulsating of the subclavian artery [A. subclavia] can be felt 2-3cm from the medial border of the SC-joint. To find the brachial plexus the thumb has to be moved slightly cranially and posteriorly. While exerting a slight pressure with the thumb just next or directly onto the tender spot the other hand side-

bends the cervical spine to the opposite side. In the Listening test of the tissues the thumb is usually pulled in a caudal and lateral direction. To reinforce the stretch effect the cranial hand can also move the shoulder in a caudal and lateral direction.

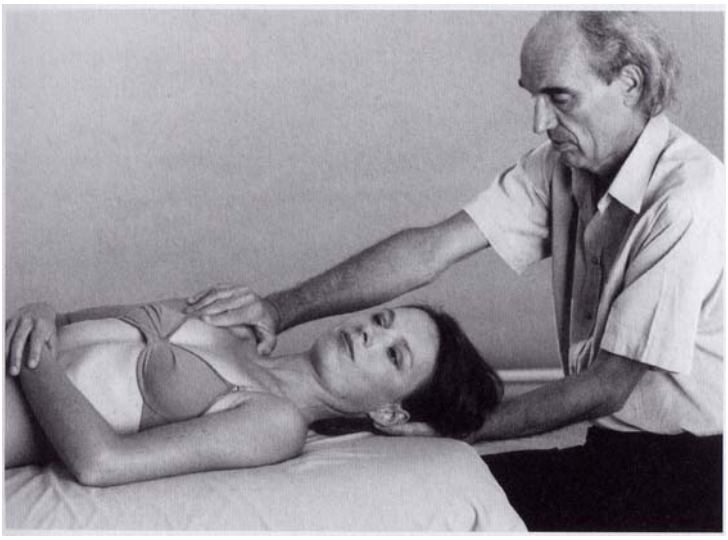


Fig. 8 Manipulation of the brachial plexus in the region of the neck

- **Infra- or retro-clavicular**

The patient is in side-lying position with the side that is to be treated uppermost. The practitioner stands behind the patient. He/she moves one arm underneath the patient's arm to place the thumb below the clavicle and the index and middle finger just reaching behind the clavicle. With the other hand the practitioner pushes the patient's shoulder in an anterior direction. Only once the anteriorization is completed he/she moves the shoulder cranially. In this position the index or middle finger can be moved into the scalene gap more easily to search for a tender or tight spot. Also the subclavian muscle [M.subclavius] is treated with the shoulder in this position. The practitioner glides with the index or middle finger along the posterior surface of the clavicle. This helps to find tender spots above or below, which then can be gently compressed while the brachial plexus is stretched caudally.

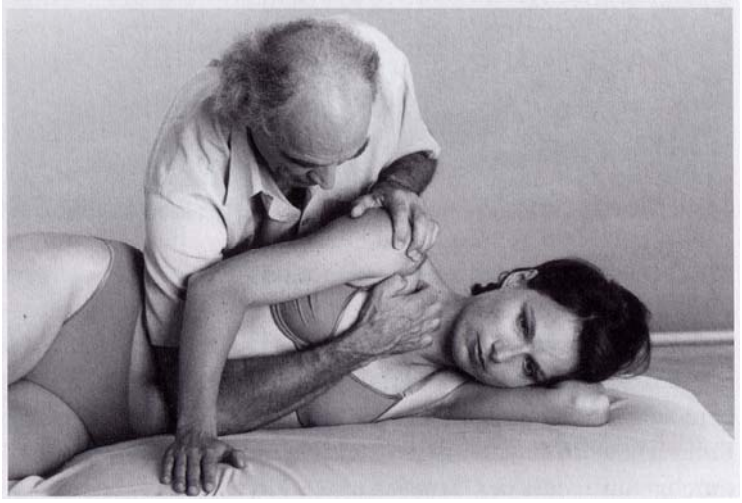


Fig. 9 Manipulation of the brachial plexus behind the clavicle

- **In the axilla**

In the axilla the brachial plexus is located behind the lesser pectoral muscle [M.pectoralis minor], which is the single shoulder muscle that does not attach to the humerus but to the ribs (origin: 3rd, 4th and 5th rib), runs to the coracoid process [Proc.coracoideus] and ends in the fascia. The patient is in side-lying position with the side that is to be treated uppermost. The practitioner stands behind the patient. First the practitioner moves the patient's shoulder anteriorly, then cranially. The practitioner then gently pushes his/her thumb in the axilla (towards the coracoid process).

This has the aim to affect the small tunnel, formed by the lesser pectoral muscle for the brachial plexus. The partly shortened or fibrous muscle fibres are released to give the brachial plexus more space.

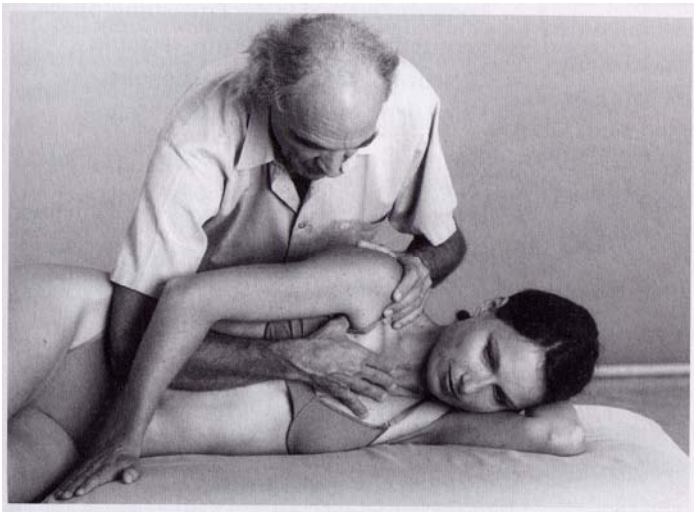


Fig. 10 Manipulation of the brachial plexus in the axilla

- **Combined treatment of the brachial plexus and the posterior cervical roots**

The patient is supine. The practitioner places one hand underneath the patient's head and palpates with the index finger between the vertebral plates [laminae arcus vertebrae] for the small sensitive knots of the posterior cervical roots. With the index finger the practitioner then executes a slight pressure on the nerve knots. As described above the practitioner then uses the other thumb to gently stretch the plexus in the region between the scalene gap and posterior surface of the clavicle. At the end both movements are combined in the direction of the Listening test; the direction of both contact points does not necessarily have to correspond.

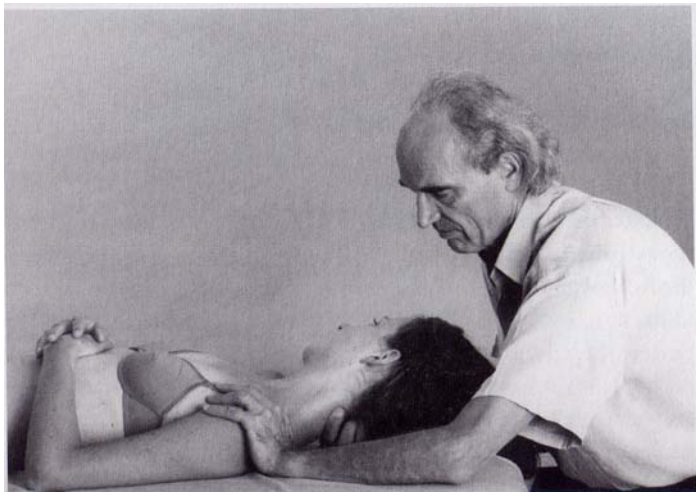


Fig. 11 Combined treatment of the brachial plexus and the posterior cervical roots

- **Combined treatment involving the region of the heart**

Fixations usually are unilateral. In exceptional cases there can be a connection between the region of the heart and the right brachial plexus. The treatment can be combined with the brachial plexus.

Heart and pericardium

While the left brachial plexus is stretched with the cranial hand, the other hand executes a precordial compression according to the Listening.

Mediastinum

The sternum is compressed with the caudal hand; in the release phase the Listening direction is reinforced. At the same time the cranial hand stretches the affected section of the brachial plexus.

Pleura and lung

The pleurocervical ligaments and the part of the plexus behind the clavicle can be treated with a thumb-technique (turning of the thumb). Lesions of the pleurocervical ligaments do not have to be linked with disorders of the pleura or lungs. Often they are caused by an injury of the arm or a whiplash trauma.

It is always important to make sure there is a balanced tension in both brachial plexi. Even when a patient only feels pain on one side, the other should always be examined as well. Surprisingly often a fixation on the asymptomatic side can be detected. The reason why both plexi can “destabilize” each other are their numerous anastomoses.

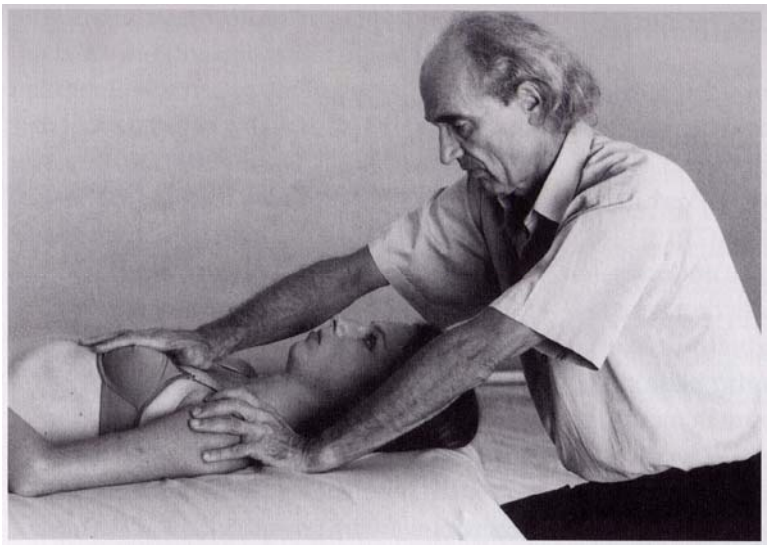


Fig. 12 Combined treatment of the brachial plexus and the region of the heart

- **Treatment of the phrenic nerve**

The treatment is carried out with the patient in supine position. The practitioner sits laterally behind the patients head. One hand stabilizes the patient's neck; with this hand the stretch of the phrenic nerve [N. phrenicus] can be reinforced through a rotation and side-bending of the head and neck. The thumb of the other hand pushes the sternocleidomastoid muscle [M. sternocleidomastoideus] near the clavicle or even behind the clavicle in a medial direction. If you can feel the subclavian artery [A. subclavia] you have to change the position of your fingers. Glide your thumb over the anterior scalene muscle [M.scalenus anterior] until you can feel a little bump – the phrenic nerve. The next step consists in compressing the nerve slightly and gently moving it in a cranio-caudal direction. Another possibility is to keep it pushed against the scalene muscle and to provoke a gliding action by moving the cervical spine.

Fig. 13 Manipulation of the phrenic nerve

All these techniques indicate that for my work, which focuses on the lower cervical syndrome, a treatment of the cervical plexus [Plexus cervicalis] with its descending branch of the phrenic nerve and the brachial plexus [Plexus brachialis] with its branches are very important to achieve a reduction of pain. Also the interconnections with the inner organs play a major role. The information gathered so far supports my original hypothesis.

My hypothesis is: It is possible to reduce pain in a cervicobrachialgia through osteopathic treatment. I will compare the osteopathic treatment approach with the results of an electrotherapeutic therapy with ultrasound.

7 Methodology

The following chapter focuses on a detailed description of the methodology within the framework of a controlled application study.

7.1 Study Design

Since I carried out a comparative study, I first had to divide the patients with the corresponding symptoms in two groups, each of which was treated with a different approach. The patients were referred to me by general practitioners who supported my work for which I am very grateful.

The first ten patients referred to me formed the so-called osteopathic group (Group A). The next ten patients formed the ultrasound group (Group B). This was a satisfactory solution for me which guaranteed a good work balance.

As already mentioned above the ten patients of group A were treated osteopathically. The treatment was executed as described under the heading “Osteopathic Treatment”, section 5.7 “Treatment Techniques“. The course of treatment of group A comprised four treatment sessions spaced over a period of six weeks. I evaluated the treatment progress by means of a pain questionnaire, the “SF-36 Health Survey”, which includes an interview sheet and a self-evaluation sheet. All ten patients received the interview sheet in the first week before the first treatment session and in the sixth week after the last treatment session, and we filled in the questionnaire together. During the four weeks in between the first and the last treatment

session all ten patients filled in four self-evaluation forms on their own. In addition the patients had to indicate their perceived pain on a visual analog scale (VAS) once a week.

In contrast to group A, the patients of group B were treated conventionally with the electrotherapy method of ultrasound.

I have chosen this treatment method because it is the usual therapy applied for the clinical picture of a cervicobrachialgia. The ultrasound therapy was applied as described under the heading “Electrotherapy – Practical Application”. Since the intensity of the applied ultrasound can vary, I prescribed a short ultrasound session (10 minutes) with an intensity of 0.3 W/cm2.

The course of treatment of group B comprised ten treatment sessions within a period of six weeks. The treatment progress was again evaluated by means of the “SF-36 Health Survey” questionnaire and the visual analog scale as described above.

7.2 Inclusion Criteria

In order to include the patients in my study the patients had to be referred to me with a general practitioner’s diagnosis of cervicobrachialgia. Clinical tests, including neurological and manual examinations of the cervical spine were important issues in my treatment approach, which needed clarification by a doctor. Other very important examinations for me were an x-ray of the cervical spine and an MRT or CT. To comprehend each patient’s individual situation of pain, the evaluation of the treatment progress through the “SF-36” questionnaire and the visual analog scale, which I will describe in detail below, were also very important.

7.3 Exclusion Criteria

To exclude patients with symptoms that did not fit into the study, a thorough examination and clarification of the situation were necessary. Exclusion criteria were: tumours, cervical ribs, aneurisms of the subclavian artery, surgical interventions in the area of the brachial plexus, pathologies and pain syndromes of the shoulder, underlying neurological conditions, dermatological and rheumatologic diseases.

7.4 The Health Survey Questionnaire

In order to facilitate the understanding of the assessment of the treatment progress and the comparison of the two treatment approaches I would like to describe the health survey questionnaire *"SF-36"* and the so-called visual analog scale (VAS), which were used in my study to evaluate the pain.

Health-related quality of life and subjective perception of health has only recently been included as evaluation parameters in the analysis of treatment measures. Health-related quality of life can be equated with subjective health indications and the term describes a mental construct which can be divided into four components. According to Bullinger (1994) these are the mental well-being, the physical condition, social relations and the functional competency of the persons who are questioned. The *SF-36* Health Survey includes 7 subject areas, so-called items, which overall include 36 questions. A summary of the individual items and their structure can be found in figure 14.

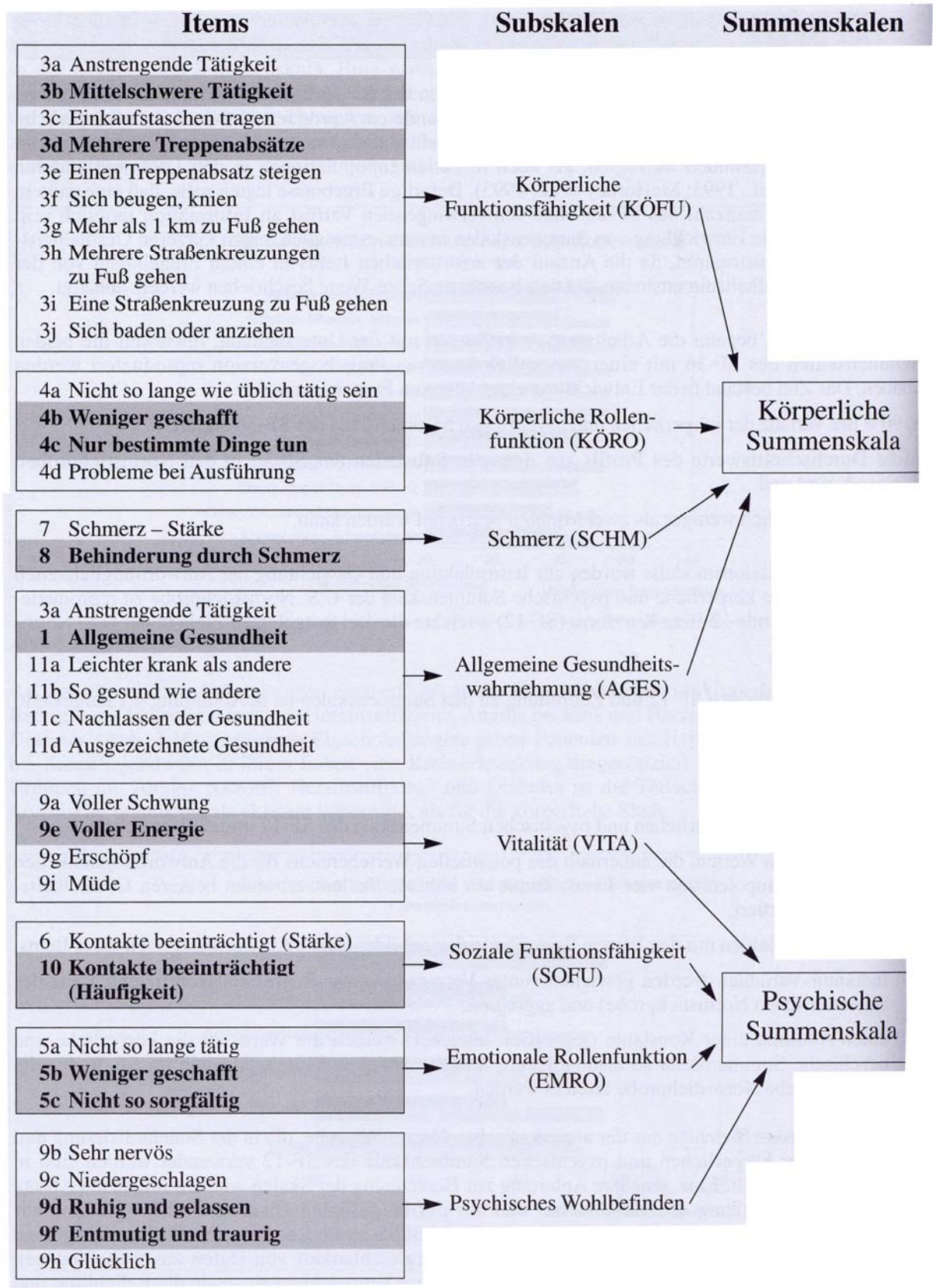


Fig. 14 Structure of the items of the SF-36 form (cf. Annex for the English translation of Fig.14)

To evaluate the pain situation I used the “visual analog scale” which complies with international standards. (Wieden, Sittig 2005)
The patients indicate their subjective perception of the most severe pain within a certain period of time (e.g. 1 week) on a horizontal line. My patients had to note down the pain within the period of one week. The patients marked the pain on the scale with a little line. The length of the visual analog scale was set with 100 mm. The left end has a smiling face and corresponds to 0 % pain (no pain). The right end shows a scowling face and corresponds to 100 % pain (maximum pain imaginable).

Figure 15 below shows an example of a “visual analog scale” which I used in my study.

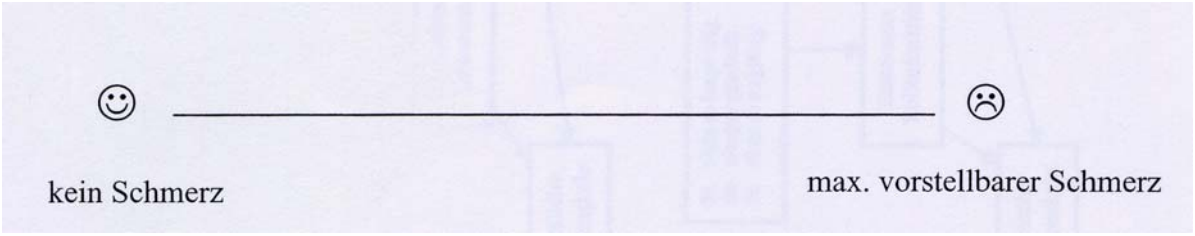


Fig. 15 Visual analog scale (cf. Annex for the English translation of Fig.15)

7.5 Results of the Study

This section of my paper deals with the analysis and evaluation of the data, gathered within the framework of the study by means of the questionnaire and during the osteopathic or electrotherapeutic treatment of the patients.
The results of the questionnaire (SF-36) and the visual analog scale were analysed with the aid of the computer program Microsoft Excel.

7.5.1 Group Division

From the overall of 20 patients who were referred to me in the period between February and June 2006, the first ten were put in the osteopathic group, the next ten in the electrotherapeutic group.

- Group A (osteopathic treatment): consisted of ten patients; seven women and three men
- Group B (electrotherapeutic treatment): consisted of ten patients; all ten were female.

The patients' age ranged from 22 to 68 years. 15 of the patients were employed at the time of the treatment. The patients' occupations included: teacher, doctor, secretary, dressmaker, shop assistant, and carriage driver. The other five patients were already retired and enjoyed a good balance of leisure time activities or practiced a lot of sports.

7.5.2 Results and Interpretation of the SF-36 Health Survey

6.5.2.1 Analysis according to Items

In the SF- 36 Health Survey questionnaire every question can be answered by attributing a numerical value:

Example: **Question 1**: How would you describe your general state of health?

Excellent = 1 Very good = 2 Good = 3 Fair = 4 Poor = 5

To determine which possible answer of the respective question was on average chosen most often in the group, the mean value of the answers of the ten patients was calculated for every question. Example:

Group A	Patient 1	Patient 2	Patient 3	Patient 4	Patient 5	Patient 6	Patient 7	Patient 8	Patient 9	Patient 10
Answers Question 1:	Good = 3	Very good = 2	Fair = 4	Good = 3	Good = 3	Fair = 4	Good = 3	Very good = 2	Good = 3	Fair = 4

Table 5 Example for the calculation of the mean value of a question

3+2+4+3+3+4+3+2+3+4 = 31 31/10= 3.1

In the example the mean value for Question 1 would thus be 3.1.

The next step in the analysis consisted in attributing the individual questions of the questionnaire to one of the 7 item categories. Based on the mean values of the individual questions, the mean value for each item was calculated.

Example: **Item "General Health"**:

- Question 1 = 3.1
- Question 2 = 4.2
- Question 11 = 3.8

3.1+4.2+3.8 = 11.1
11.1 / 3 =3.7
Mean value for the item category "General Health" = **3.7**

This calculation was carried out at the beginning and at the end of the treatment course. Thus two mean values were available for each item, the comparison of which illustrated the changes which could be achieved with the treatment.

Since the same calculation was carried out for both groups, the changes in the two groups for each item could be compared in group A and group B.

Unfortunately the numeric values attributed to the questions in the questionnaire could not be identically interpreted throughout. A high value in one question could indicate a situation of low pain, while a high value in another question could indicate intensive pain. To avoid

misunderstandings in the analysis and to make the understanding of the mean values per item easier, I want to explain the significance of the value for each item in the table below.

Item	**Interpretation of the item value**
Physical functioning	the lower the worse
Role-physical	the lower the worse
Bodily pain	the higher the worse
General health	the higher the worse
Vitality and mental health	the higher the worse
Social functioning	the higher the worse
Role-emotional	the lower the worse

Table 6 Interpretation of the item values

Physical functioning

This item describes the degree in which the patient's state of health allows physical activities like self-sufficiency, walking, climbing stairs, washing oneself or putting on clothes (Bullinger, Kirchberger 1998).

Figure 16 shows the mean values for the item "Physical functioning".

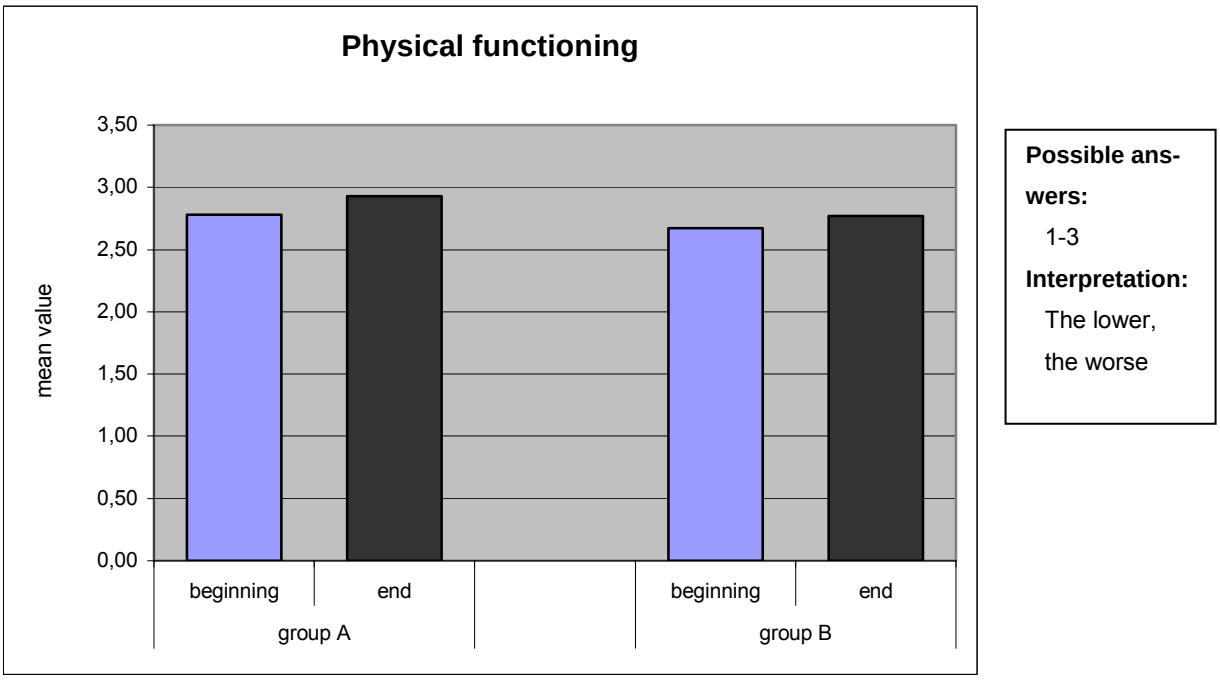


Fig. 16 Physical functioning

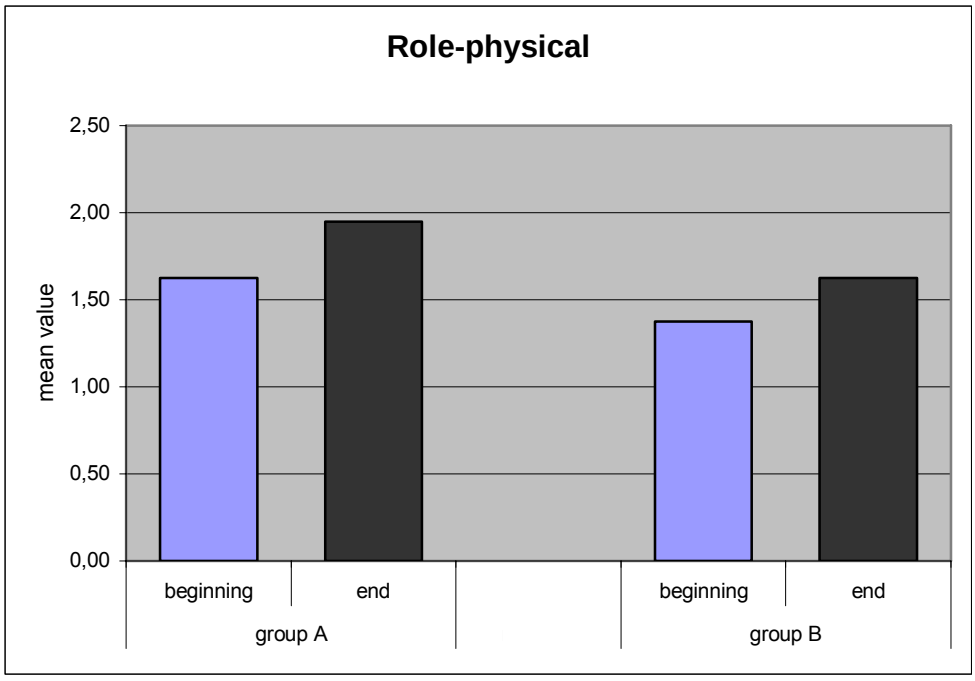
During the course of treatment I noticed that a reduction of pain can go hand in hand with an improved physical functioning.

At the end of the therapy I observed that in both groups (A and B) the physical functions in carrying out the described physical activities had improved.

Role-physical

This item describes in how far work or other daily activities are impaired by the patient's general state of health, e.g. to achieve less than usual, limitations with regard to the type of activity or difficulties in carrying out certain activities (Bullinger, Kirchberger 1998).

Figure 17 below illustrates the item "Role-physical".



Possible answers:
1-2
Interpretation:
The lower the worse

Fig. 17 Role-physical

Also this diagram clearly indicates that due to a reduction of pain in the course of both treatment approaches the difficulties in the various physical role functions improved in both groups A and B. However, the improvement was more pronounced in group A than in group B.

Bodily pain

This item describes the intensity of the pain and its influence on normal household or other work (Bullinger, Kirchberger 1998).

The diagram on the item "Bodily pain" below illustrates the results of this category.

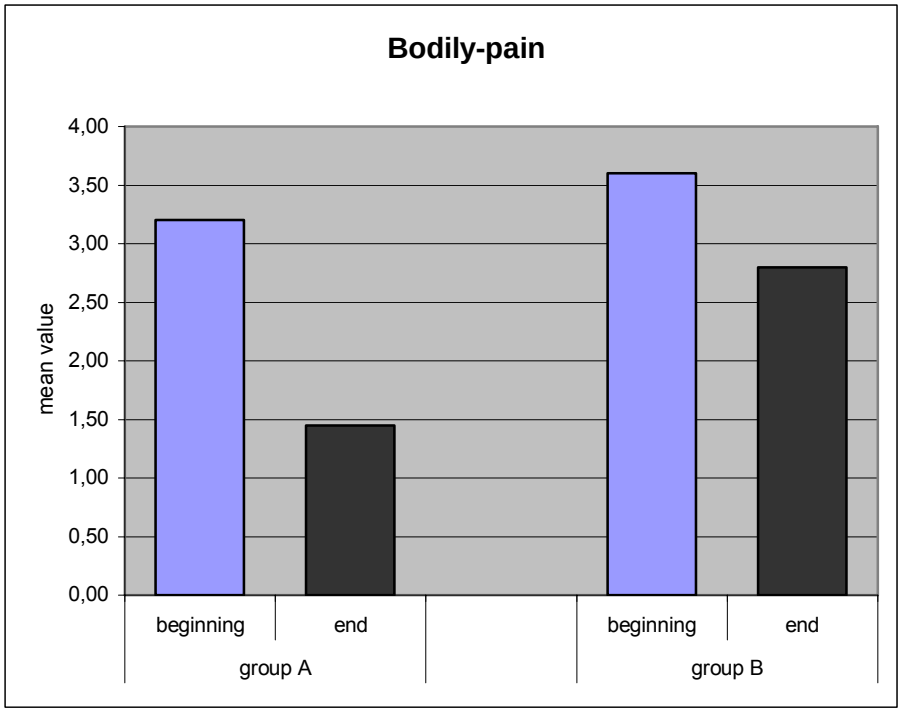


Fig. 18 Bodily pain

The diagram clearly shows that in both groups the pain could be reduced. The reduction of the pain is particularly pronounced in group A. this means that the degree of pain and the pain's influence on normal work could be particularly reduced with osteopathic treatment.

General health

The item General Health describes the patients' personal perception of their general health including their current state of health and future expectations, as well as their resistance with regard to diseases (Bullinger, Kirchberger 1998).

Figure 19 shows the diagram of the item "General health":

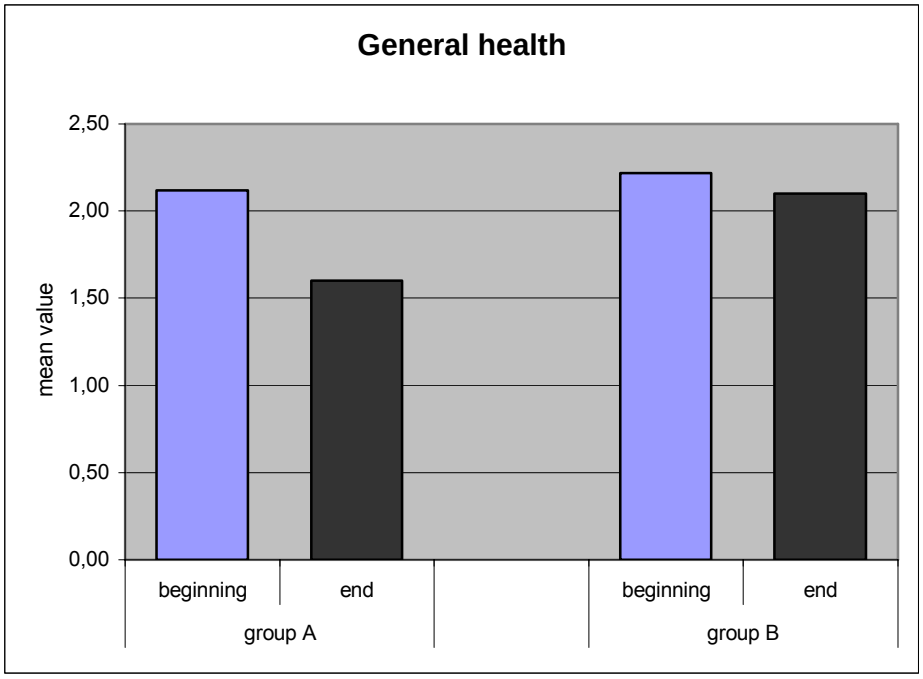


Fig. 19 General health

The diagram clearly illustrates that the patients in group A had clearly improved expectations for the future and also perceived their current state of health as better. In group B the patients' expectations with regard to their future state of health did not change very much. A comparison of the results of both groups shows a clear improvement in group A.

Vitality and mental health

The item vitality describes how much energy and drive or how tired and exhausted the patients felt. The mental health also includes characteristics like: calmness and composure, discouragement, sadness, nervousness, depressiveness and also the degree of happiness (Bullinger, Kirchberger 1998).

Figure 20 illustrates the results of the item "Vitality and mental health"

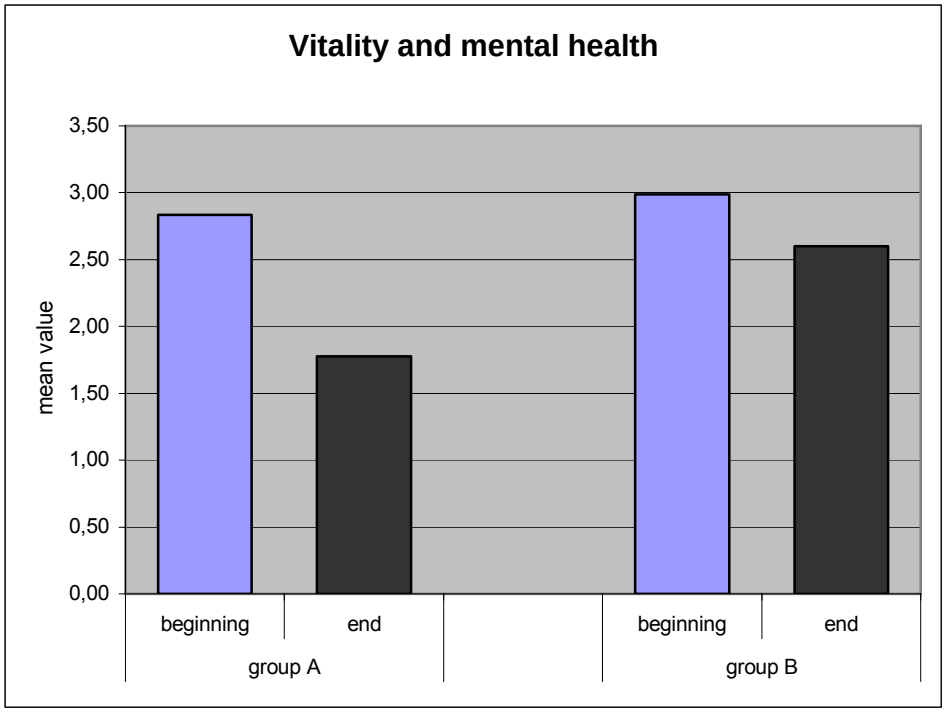


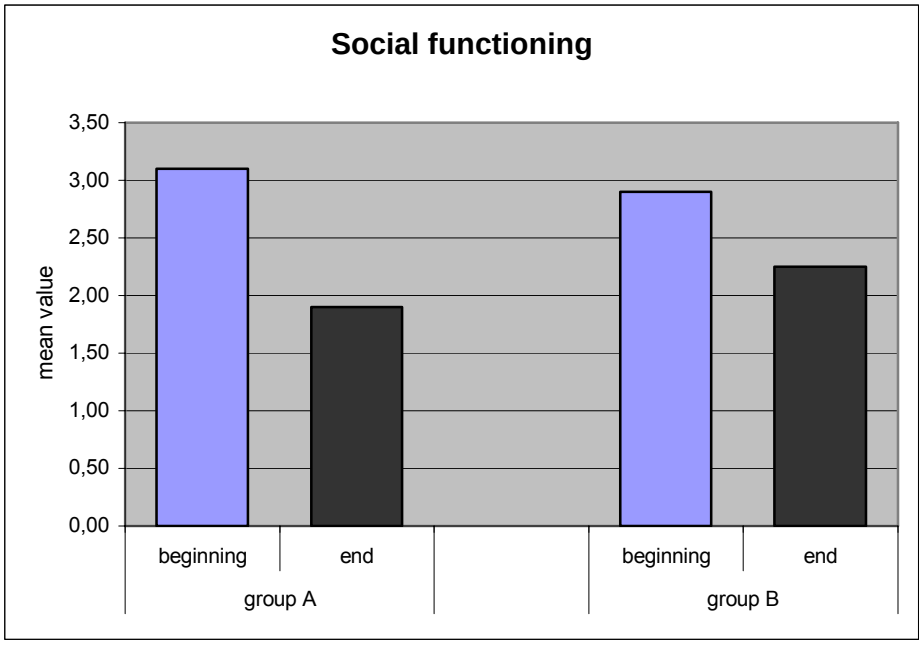
Fig. 20 Vitality and mental health

The results show that the patients in group A experienced a significant improvement of their vitality and mental well-being. Also the treatment with ultrasound achieved a better vitality and mental well-being of the patients in group B. In short, both groups experienced an improvement during the course of treatment, but the progress was clearly better in group A.

Social functioning

The social functioning item describes the degree in which the physical health or emotional problems have a negative impact on social activities (Bullinger, Kirchberger 1998).

The diagram below illustrates the results of the item “Social functioning”.



Possible answers:
1-5
Interpretation:
The higher the worse

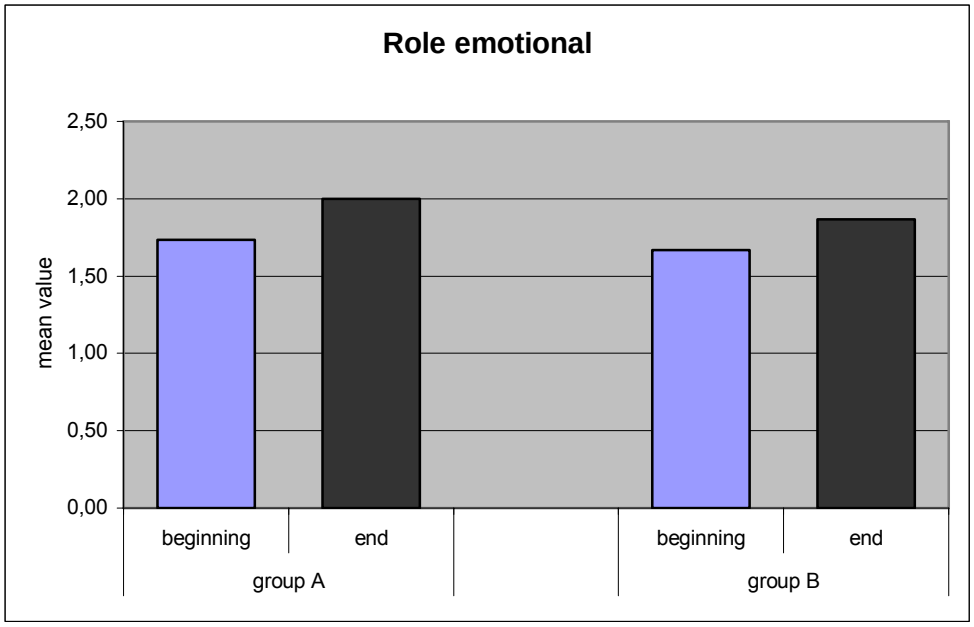
Fig. 21 Social functioning

The analysis of the answers to this item showed that both the patients of group A and group B were able to increasingly establish social contacts again. The reduction of their pain symptoms thus entailed a qualitative and quantitative improvement of their social activities. But also in this category the osteopathic treatment achieved better results than the ultrasound therapy.

Role-emotional

The item “role-emotional” describes in how far emotional problems negatively affect work or other daily activities; e.g. having less time, achieving less, not working as accurately as usual (Bullinger, Kirchberger 1998).

The diagram below illustrates the results of the item “Role-emotional”



Possible answers:
1-2
Interpretation:
The lower the worse

Fig. 22 Role-emotional

The diagram shows that the patients of both groups experienced an improvement of the item "role-emotional". Since in both groups the pain could be reduced by the treatment the patients of both groups found it easier to emotionally deal with work and other daily activities.

7.5.2.2 Evaluation of the outcomes of both groups

Group A - Osteopathic group

Group B - Electrotherapeutic ultrasound group

To summarize the results of the study all outcome values of the individual items before and after the respective treatment are shown in the diagram below. The item values were calculated on the basis of the numerical values attributed to the possible answers in the pain questionnaire which was used for the interviews and the self-evaluation.

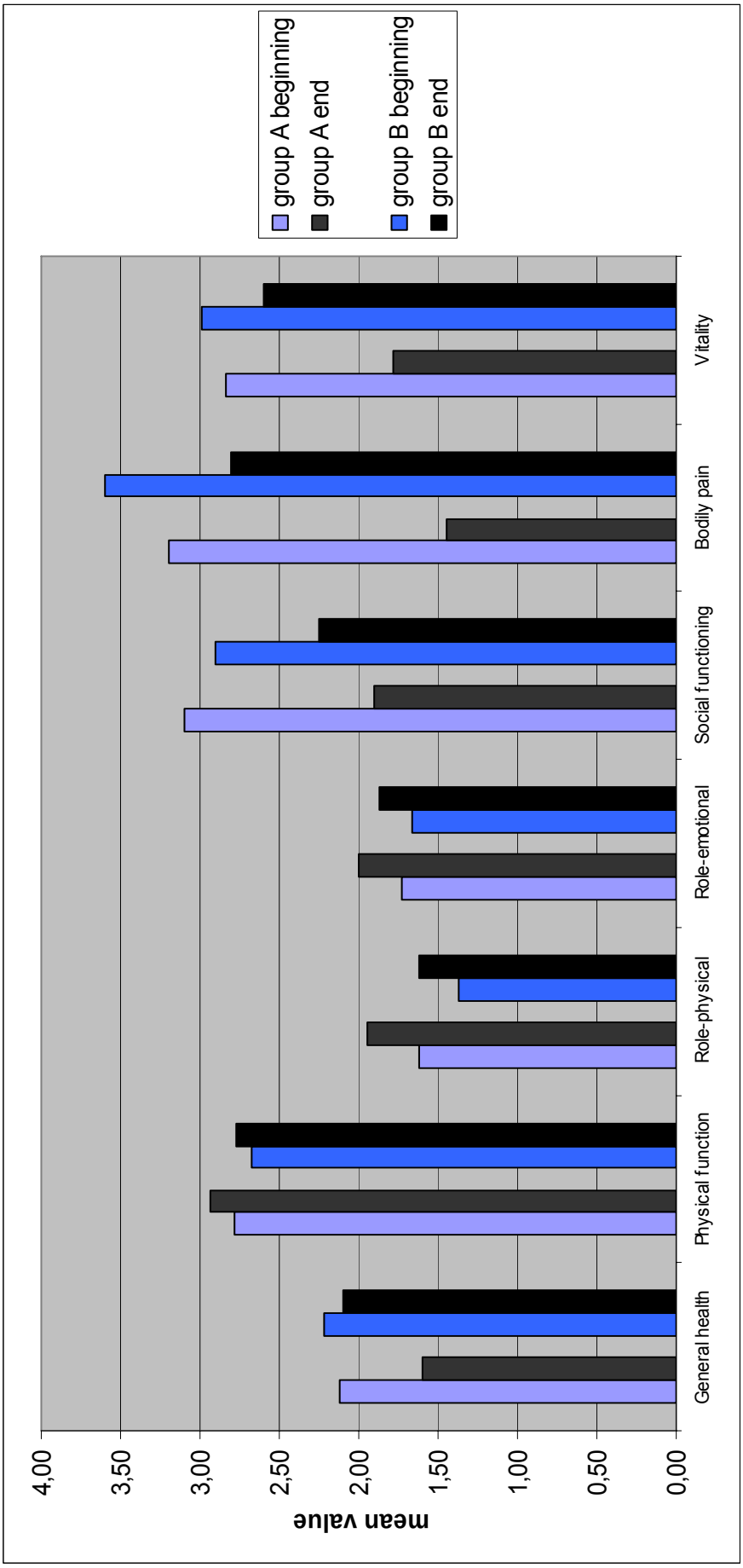


Fig. 23 Mean values of groups A and B at the beginning and end of the course of treatment

As described above the item values were calculated as mean values for each individual item in each group on the basis of the answers (numerical values) given by each individual patient at the beginning and end of the course of treatment. At first I analysed the results of group A, which I then compared with those of group B.

	group A			group B	
	beginning	end		beginning	end
General health	2,12	1,60		2,22	2,10
Physical function	2,78	2,93		2,67	2,77
Role-physical	1,63	1,95		1,38	1,63
Role-emotional	1,73	2,00		1,67	1,87
Social functioning	3,10	1,90		2,90	2,25
Bodily pain	3,20	1,45		3,60	2,80
Vitality	2,83	1,78		2,99	2,60

Table 7 Analysis of the individual items

1) The general health of group A was qualified with 2.12 at the beginning of the course of treatment and improved to a mean of 1.60 at the end of the course of treatment.
2) In the item physical functioning an increase from 2.78 (at the beginning of the course of treatment) to 2.93 (at the end of the course of treatment) could be observed.
3) The mean value of the item Role-physical changed from 1.63 (beginning) to 1.95 (end).
4) The item role-emotional of group A had a mean value of 1.73 at the beginning of the course of treatment and improved to a mean value of 2.00 at the end of the course of treatment.
5) A positive development could also be observed in the item social functioning from a mean value of 3.10 at the beginning of the course of treatment to 1.90 at the end.
6) The bodily pain at the beginning of the course of treatment was qualified with a mean value of 3.20 and improved significantly to a value of und 1.45 at the end of the course of treatment.
7) The patients' vitality and mental well-being also improved from 2.83 at the beginning of the course of treatment to 1.78 at the end of the course of treatment.

For means of comparison here the results of group B:

1) The general health of group B was calculated with 2.22 at the beginning of the course of treatment and 2.10 at the end of the course of treatment.
2) The item physical functioning improved only slightly from 2.67 at the beginning to 2.77 at the end of the course of treatment.
3) The mean value for the item role-physical was 1.38 at the beginning of the course of treatment and increased to 1.63 at the end of the course of treatment.

4) The mean value for the item role-emotional after the first evaluation by means of the questionnaire was 1.67 and changed to 1.87 after the course of treatments.
5) The social functioning improved from 2.90 at the beginning to 2.25 at the end of the course of treatment.
6) The mean value calculated for the item bodily pain amounted to 3.60 at the beginning of the course of treatment and improved to 2.80 at the end.
7) The vitality and mental well-being of group B was reduced from 2.99 at the beginning to 2.60 at the end of the course of treatment.

7.5.3 Analysis of the Data Obtained by Means of the Visual Analog Scale

To measure the pain experienced by the patients at a specific moment I used the already described visual analog scale at the beginning and at the end of the course of treatment.
I calculated the mean values of pain intensity for each group both at the beginning of the course of treatment and at the end. These are the results:
In group A the intensity of the pain could be reduced from 5.38 to 1.24. The pain thus improved by 4.14. The improvement with regard to the possible pain in percentage can be calculated for group A: (4.14/10) times 100 = 41.4%. The percentage for the improvement of the pain intensity with regard to the initial value in group A is (5.38-1.24)/5.38 times 100 = 76.95%.
In group B the mean value for the intensity of the pain could be reduced from 5.80 to 3.14, which shows that also in group B the pain improved (by 2.66). The improvement with regard to the possible pain in percentage can be calculated for group B: (2.66/10) times 100 = 26.6%. The percentage for the improvement of the pain intensity with regard to the initial value in group B is (5.8-3.14)/5.8 times 100 = 45.86%.

The diagram below shows the mean values of pain intensity before and after the course of treatment of both groups.

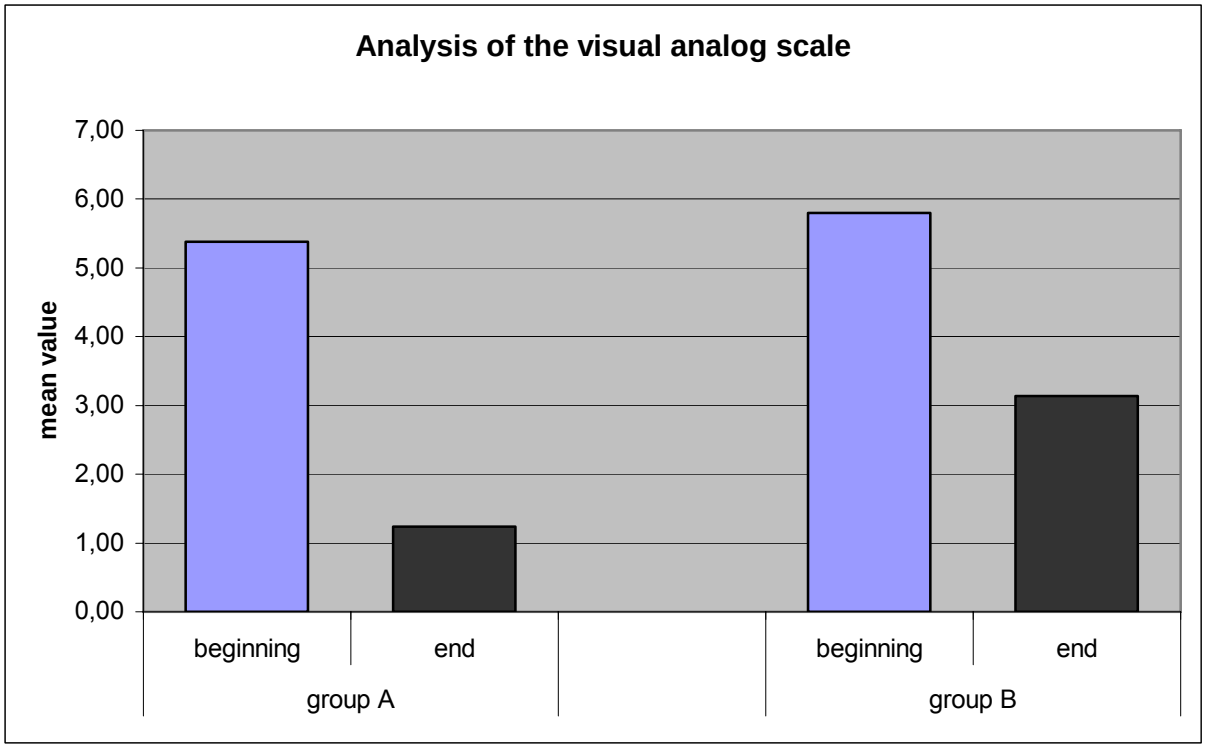


Fig. 24 Analysis of the visual analog scale

The diagram illustrates that compared with group A the patients in group B on average experienced a higher intensity of pain. Even though the pain intensity experienced by the patients in group B could be considerably reduced during the course of treatment, a much higher reduction could be observed in group A.

7.5.4 Discussion

7.5.4.2 Discussion of the Methodology

The following chapter contains a critical discussion of the methodology applied in the present study. In addition some important issues are explained in detail:

- The patients were referred to me with the diagnosis cervicobrachialgia by general practitioners in private practice who work in the vicinity and cooperate with me. Special attention was paid to the inclusion and exclusion criteria and to carrying out the relevant clinical examinations, including neurological tests and manual examinations of the cervical spine.

- An important criterion for a possible follow-up study would be that the patients are referred by a medical institution or one medical practitioner. This would make the course of the therapy and communication much easier because it is very time-consuming to establish contacts with many individual doctors and to talk to them.

- It is also important to check the patients' consumption of analgesics during the study. One participant in the study declared at the beginning of the course of treatment to take analgesics because the pain had become so strong that painkillers were advised by the doctor. All other participants in the study did not take any painkillers thus a neutral course of therapy was guaranteed.

- I do not want to claim statistic significance of the results of the two groups in my study because due to the low number of participants (20) no real relevant conclusions can be drawn. I am convinced that a study design with 40 patients would have had more informative value and thus more statistical relevance. In a follow-up study I would recommend to have also a third group of patients, who receive both kinds of treatment, ultrasound therapy complemented by osteopathic treatment.

7.5.4.3 Discussion of the Results

The aim of my controlled application study was to find out whether the symptoms of pain of cervicobrachialgia can be influenced by osteopathic treatment. I was also interested in comparing the effectiveness of osteopathic treatment with that of conventional treatment methods, i.e. ultrasound therapy.

The results of group A (osteopathic group) showed that both an improvement of pain intensity (VAS) and an improvement of mobility of the cervical spine, shoulder and arm could be observed. The analysis of the *SF-36 Health Survey* shows that the items vitality and mental well-being, role-emotional, social functioning, physical functioning, role-physical, general health and bodily pain have improved during the course of treatment.
The results of group B (ultrasound group) also showed that the pain intensity improved (VAS), even though compared with the results of group A the pain was reduced to a lesser extent. It has to be pointed out that the patients of group B indicated a greater pain intensity at the beginning of the course of treatment than the patients of group A. The analysis of the items of the *SF-36 Health Survey* indicates both treatment methods could reduce the pain and thus helped the patients to better deal with their work and daily activities.

In general the results showed that both the osteopathic treatment and the ultrasound treatment contributed to improving the pain and thus a better handling of work and everyday life. From my point of view, supported by the results of my survey, the osteopathic treatment achieved in particular a more pronounced improvement of the item bodily pain and a more obvious increase in vitality and mental well-being.

The most significant result in the comparison of the two treatment methods was that the intensity of the bodily pain experienced by the patients in group A was clearly reduced which entailed an obvious improvement of the patients' well-being and vitality. This showed that the osteopathic treatment had a more thorough and intensive effect on the overall healing process.

- According to my subjective observations the patients of group B were psychologically more stressed and suffered from a higher pain intensity at the beginning of the course of treatment than the patients of group A due to events in their personal life and stress at work.

- But to my surprise I noticed in the analysis of the SF-36 Health Survey questionnaire that exactly these items (bodily pain, vitality and mental well-being) improved considerably during the course of treatment.

- Nevertheless it is important to point out that especially the pain symptoms of the patients of both groups, but in particular those of the osteopathic group A, had improved. This opens up new perspectives and encourages me to continue to discover and explore the possibilities of osteopathy.

8 Conclusion

Through the intensive study of the condition cervicobrachialgia and its symptoms of pain I recognized how fundamental and complex the work with the peripheral nervous system is.

In this context I would like to recount an event I experienced with a patient some years ago, which illustrates how important it is to understand that you have to be very careful and gentle in working with the peripheral nervous system. A 55-year-old female patient was referred to me with the diagnosis of cervicobrachialgia. Today I recognize that then I treated the brachial

plexus not gently enough because I did not know enough about its elasticity. The patient thus had to live with quite some pain over a longer period of time. After this accident I heard about the post-graduate courses of J.P.Barral. From him I learned that a manipulation of the brachial plexus has to be carried out with the utmost care. He pointed out that an incautious treatment of the plexus can itself cause a cervicobrachialgia. This represents a real danger and shows how strongly the brachial plexus can be influenced.

Once I realized that I started to study the condition of cervicobrachialgia more thoroughly and I began to research and read the available books and articles on the topic. It was very interesting to find out that a large number of patients came to my practice exactly with this problem. Thus I decided to realize the present study.
In the course of the project I realized that you have to be very skilful to work on the nervous system with your hands. I also recognized that it is extremely important to know the anatomy.

The nervous system is a very sensitive system, which cannot be contacted offhand. Your contact has to be very precise, exact and gentle in order to treat the nervous system. Only then the body can use its self-healing mechanism to restore health, which includes the peripheral nerves.
The work on this paper offered me the possibility to extensively study the topic and thoroughly research the nervous system. I am very grateful to be able to apply the knowledge I have gained in the course of this study in the work with my patients in the future.

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9 Annex

Original findings

Patient: female
Age: 28
Occupation: Secretary

Case history:

The 28-year-old secretary working in shifts complained about pain in the neck-shoulder-arm region. The pain on the left side, radiating into the arm, is stronger than on the right side. A disc prolapse and structural anomalies could be excluded through X-ray and MRT examinations. The patient also suffers from severe muscle tension and myogeloses in the area of the neck, expanding on both sides towards the shoulder joints and causing a pulling pain. The referring G.P. diagnosed the patient with cervicobrachialgia and thus prescribed an osteopathic therapy.

Medication:

- No medication

Other diseases/ complaints:

- No diseases
- Frequent problems of digestion with a tendency of constipation

Surgical interventions/ injuries:

- No surgery.
- Injury of the left knee as adolescent following a skiing accident

Family history:

- Nothing of importance

Lifestyle and dietary habits:

- Hobbies: swimming, hiking, biking, rollerblading, travelling
- Healthy diet: usually cooks herself, no smoking, rarely a glass of wine

Findings:

Observation: The patient has slightly protracted and raised shoulders on both sides. In addition she has an increased lordosis of the lower cervical spine, and a pronounced kyphosis in the upper thoracic region.

Thermodiagnosis: The mid-clavicular region feels warmer; more on the left than on the right side. In the Listening I was pulled more towards the left side.

Palpation: The neck muscles are hypertone. The lateral muscles of the neck and the muscles in the shoulder region are also tight. The first rib on the left side is blocked. The sternoclavicular joint and the acromioclavicular joint on the left side are restricted in their movement.

Axial system: The vertebrae of C4/5, C6/7 and Th1/2 on the left side cannot move freely. Active and passive movements of the cervical spine and head were tested in three planes. All movements – dorsal, ventral, side-bending and rotation – were restricted. The patient feels a painful pulling sensation especially in ventral flexion and rotation – more on the left than on the right side. The provocation test of the facet joints with extension and rotation of the cervical spine did not cause any pain. But the provocation test of hypermobility created a pulling pain which the patient felt in the lower cervical spine. The translatory gliding of the individual facet joints did not cause a stabbing pain between C4/5 and C6/7.

The muscle strength is not compromised and the tests do not provoke pain.

Neurological tests:

- No pathological finding.

Osteopathic diagnosis:

- Adson – Wright test does not give a pathological finding.

Hypothetic diagnosis: Due to the patient's occupation as secretary, which means a bad posture in front of her computer and a lot of time on the phone, a strong tension in the area of the cervical spine and shoulder region is caused. The continuously raised position of her shoulders pulls up the whole trunk. This ensues superficial breathing and problems of the stomach and intestines.

Osteopathic considerations: Stressful periods at work cause tensions in the regions of the neck and shoulders. This leads to restrictions of movement in the cervical spine and irritations of the brachial plexus, phrenic nerve and vagus nerve.

Treatment sessions:

1) **February 8, 2006**

In the first treatment session the pain extended from the cervical spine more to the left shoulder and radiated into the left arm. The movement of the cervical spine was restricted in all three planes. In the beginning the pain increased rather than decreased. Towards the end of the session the pain settled again and improved slightly according to the patient's own perception. The musculature became more relaxed. Thus the caudal movement of the shoulders improved. The overall respiration became deeper.

2) **February 15, 2006**

After one week the pain had slightly improved but is still present in a moderate intensity. The patient had effected changes at her workplace which support the therapy. She had organized a head-set for phone calls and had her desk and chair adjusted exactly to her height. These changes had the effect that the patient no longer had a very tight and awkward position of her shoulders and head. The axial system had improved in all three planes. Also the provocation tests of hypermobility could be carried out with less pain and tension. The facet joints are no longer painful.

After the second treatment session the patient felt easier and more relaxed in the cervical region and as regards the position of her head. A better more upright position of the shoulders and the trunk was achieved. Also the pain was reduced.

3) **March 1, 2006**

In the third week the feeling of the patient as regards pain and mobility in all three planes was similar to the feeling after the second treatment session. The muscles of specific regions felt tighter. The pain did not change much. Due to the fact that the patient changed her body position at her workplace and due to the numerous phone calls in stressful periods the patient perceived the pain situation more clearly.

After the third treatment session in the fourth week the patient felt that the pulling pain in the shoulder-arm region had improved. Also the radiation into the arm had improved as did the mobility in all three planes. The tension in the muscles was reduced as well.

4) March 13, 2006

No treatment session was scheduled in the fifth week. The pain improved considerably. The patient still feels tight and restricted at her workplace, e.g. when she has to spend a lot of time in front of her computer. The mobility in all three planes is good and painless, except for the end of the range of movement in the rotation to the left side. Also the provocation tests of hypermobility and the facet joints do not cause any pain.

After the fourth treatment session in the sixth week the pain improved considerably. The patient still feels some pain when she has to spend a prolonged period of time in the same position or when she is subjected to a lot of stress at work. All everyday movements can be executed well. The axial system has improved in all three planes, also the rotation to the left. The muscle tension has decreased and the position of the shoulders has improved. The overall position of the trunk in the standing position is more upright. Respiration is deeper and the diaphragm feels more relaxed.

Thus I finish the course of treatment for this patient and wish her good luck in dealing with the stress at her work and in everyday life.

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Translation of Figures and Tables

FIGURE 1

Strukturen und Vorgänge im nozizeptiven System
= Structures and processes in the nociceptive system

peripher = peripheral
zentral = central
Ursache = cause
Noxe = noxious stimuli
Schmerz = pain
anatomische Struktor = anatomical structure
Gewebe = tissue
Nozizeptor = nociceptor
afferente Nervenfasern Aδ, C = afferent nerve fibres Aδ, C
Rückenmark = spinal cord
supraspinales ZNS = supraspinal CNS
Physiologischer Vorgang = physiological process
Bildung und Freisetzung schmerzerzeugender Substanzen = Production and release of pain-generating substances
Transduktion (usw) = Transduction = change in the membrane potential
Transformation (usw.) = Transformation = conversion of sensor potentials in action potentials
Konduktion (usw.) = Conduction = transmission of nociceptive inputs
spinale Transmission = spinal transmission
kortikale Perzeption = cortical perception

pathophysiologische Mechanismen und Phänomene = pathophysiological mechanisms and phenomena

periphäre Sensibilisierung = peripheral sensitization → primary hyperalgesia
Sekretion von Neuropeptiden durch C-Fasern = Secretion of neuropeptides by C-fibres → neurogenic inflammation

spinale Sensibilisierung → vorwiegend….. = spinal sensitization → predominantly secondary hyperalgesia with allodynia

chronischer Schmerz = chronic pain

Schädigung neuronaler Strukturen… = damage of neuronal structures (central or peripheral) → neuropathic pain

TABLE 1

Faser = Fibre
Funktion = Function
Durchmesser = Diametre
myelinisiert = Myelinization
Leitungsgeschwindigkeit = Speed of conduction

Motorik, Reflexe, Propriozeption = Motor function, reflexes, proprioception
Berührung, Druck = Touch, pressure
Muskeltonus, Reflexerregbarkeit = Muscle tone, reflex irritability
Schmerz, Kaltempfinden = Pain, Feeling of cold
präganglionäre Sympatikusfasern = Preganglionary sympathetic fibres
Schmerz, Temperatur, postganglionäre Sympatikusfasern = Pain, temperature, postganglionary sympathetic fibres

FIGURE 2

Haut = skin
Viscera = viscera

FIGURE 3

aufsteigende nozizeptive Bahnen = ascending nociceptive pathways
absteigende nozizeptive Bahnen = descending nociceptive pathways (esp. inhibitory)

Kortex = cortex

medialer Thalamus = medial thalamus

lateraler Thalamus = lateral thalamus
Hypothalamus = hypothalamus
Gesichsthaut (und Kornea) = facial skin (and cornea)
Nozisensoren = nociceptors
C-Fasern = C-fibres
Aδ-Fasern = Aδ-fibres
N. trigeminus = trigeminal nerve
Motoraxon = motoaxon
Haut (Rumpf, Glieder) = skin (trunk, extremities)
sympatisches Axon = sympathetic axon
Tractus spinothalamicus = spinothalamic tract
Hirnstamm = brainstem
Rückenmark = spinal cord
zentrales Höhlengrau = central gray matter
segmentale Hemmung = segmental inhibition (Aβ-afferences)

TABLE 2

1. Tractus spinothalamicus lateralis (neospinothalamic system)

Verlauf = pathway
Funktion = function

Hinterhornneurone von Lamina I, II und V = posterior horn neurons of laminae I, II and V
→ ventro-posteriore (ventrobasale) Kerne des Thalamus, dort Umschaltung auf das 3. Neuron = → ventro-posterior (ventrobasal) nuclei of the thalamus, there relayed to the 3rd neuron

→ Projektionsfelder S1 und S2 des somatosensorischen Kortex; dort findet sich eine exakte somatotopische Gliederung in Form eines umgekehrten „Homunkulus“
= → projection fields of S1 and S2 of the somatosensory cortex; there an exact somatotopic mapping in the form of an “inverted” homunculus can be found

dient hauptsächlich der Lokalisierung und Differenzierung von Schmerzreizen = predominantly serves the localization and differentiation of pain stimuli

2. Tractus spinothalamicus medialis (paleospinothalamic system)

hauptsächlich Hinterhornneurone der Lamina I und II = mainly posterior horn neurons of laminae I and II

→ mediale Kerne des Thalamus und Formatio reticularis des Mittelhirns = medial nuclei of the thalamus and Formatio reticularis of the midbrain

→ Projektion ins Vorderhirn (Inselregion, frontaler Kortex) und in limbische, subkortikale (Amygdala) und kortikale (Gyrus cinguli anterior) Kerngebiete
= → projection into the forebrain (insular region, frontal cortex) and in limbic, subcortical (amygdala) and cortical (Gyrus cinguli anterior) nuclei

dient der Bewertung und emotionalen Verarbeitung von Schmerzreizen = serves the evaluation and emotional processing of pain stimuli

FIGURE 4:

Segmentinnervation der Armmuskeln = segmental innervation of the muscles in the arm

Zervikalsegmente = cervical segments

Thorakalsegmente = thoracic segments

Schulter = shoulder
Oberarm = upper arm
Vorderarm = forearm
Hand = hand

TABLE 3

Sensibilität = sensitivity
Kennmuskel = segment-indicating muscle
Muskeldehnungsreflexe = muscle stretch reflexes
Bemerkungen = remarks

Schmerz bzw. Hyperalgesie im Bereich der Schulter = pain or hyperalgesia in the shoulder region

partielle oder totale Zwerchfellparese = partial or total diaphragmatic paralysis

keine fassbaren Reflexstörungen = no perceivable reflex disturbances

partielle Zwerchfellparesen C3 liegen mehr ventral, C4 mehr dorsal = partial diaphragmatic paresis C3 is located more ventral, C$ mor dorsal

Schmerz bzw. Hyperalgesie lateral über der Schulter, etwa den M. deltoideus bedeckend = pain or hyperalgesia in the lateral shoulder region, approximately covering the deltoid muscle

Innervationsstörungen im M. deltoideus und M. bizeps brachii = disturbed innervation of the deltoid and biceps muscle

Abschwächung des Bizepsreflex = reduced biceps reflex

Dermatom an der Radialseite des Ober- und Vorderarmes, bis zum Daumen abwärts ziehend = dermatom along the radial side of the upper arm and forearm down to the thumb

Paresen des M. biceps und des M. brachioradialis = paresis of the biceps and brachioradial muscles

Abschwächung oder Ausfall des des Bizepsreflexes = reduced or absent biceps reflex

Dermatom lateral-dorsal vom C6 Dermatom zum 2. bis 4. Finger ziehend = dermatom located lateral-dorsal to that of C6 and extends down to the 2nd to 4th fingers

Parese des M. triceps, M. pronator teres und gelegentlich der Fingerbeuger, oft sichtbare Atrophie des Daumenballens = paresis of the triceps, pronator teres muscles and sometimes of the finger flexors; often visible athrophy of the thenar eminence

Abschwächung oder Ausfall des Trizepsreflex = reduced or absent triceps reflex

Differentioaldiagnose gegen das Karpaltunnelsyndrom: Beachtung des Trizepsreflex = differential diagnosis to the carpal tunnel syndrome: particular interest of the triceps reflex

Dermatom lehnt sich dorsal an C7 an, zieht zum Kleinfinger = dermatom borders dorsally on that of C/ and extends down to the little finger

kleine Handmuskeln, sichtbare Atrophie besonders im Kleinfingerballen = small hand muscles, visible artrophy especially of the hypothenar eminence

Abschwächung des Trizepsreflexes = reduced triceps reflex

Diffferentialdiagnose gegenüber der Ulnarislähmung: Beachtung des Trizepsreflexes = differential diagnosis to a paralysis of the ulnar nerve: particular interes of the triceps reflex

Dermatom vom Trochanter major über die Streckseite zur Innenseite des Oberschenkels über das Knie ziehend = dermatom from the greater trochanter via the anterior to the medial region of the thigh, extending over the knee

Parese des M. quadriceps femoris = paresis of the quadriceps femoris muscle

Ausfall des quadricepsreflex (patellarsehenreflex) = absent quadriceps reflex (patellar reflex)

Differentialdiagnose gegen die Femoralislähmung: das innervationsareal des N. saphenus bleibt intakt = differential diagnosis to a paralysis of the femoral nerve: the innervation area of the saphenus nerve is intact

FIGURE 5:

Infraschall = infrasound
Hörschall = audible sound
Ultraschall = ultrasound

Schallfrequenz in Hz = sound frequency in Hz

FIGURE 7:

Duplikatur der Skalenmuskelfaszie mit Plexus Brachialis = duplicature of the scalene fascia with Plexus brachialis

Faszie des M. Scalenus medius = fascia of the M. Scalenus medius

neurovaskulärer Raum = neurovascular space

TABLE 4:
(die Nerven und Muskeln kann man lassen wie sie sind, außer bei C8 – siehe unten)

Segment = segment
Reflex = reflex
Kennmuskel = segment-indicating muscle
Auslösung = test
Reaktion = reaction
Peripherer Nerv = peripheral nerve

keine Reflexe = no reflex

Zwerchfell = diaphragm

Skapulohumeralreflex = scapulohumeral reflex

Schlag auf den medialen Rand der unteren Skapulahälfte = stroke with the reflex hammer on the medial border of the lower half of hte scapula

Adduktion und Außenrotation des hängenden Arms = adduction and external rotation of the patient's arm which hangs loosely at his/her side

Bizepsreflex (radioperiostal reflex) = biceps reflex

Schlag auf die Bizepssehne bei flextiertem Ellbogen = stroke on the biceps tendon with the elbow in flexion

Beugung im Ellbogen = flexion of the elbow

Schlag auf die Lateralseite des distalen Radiusendes = stroke on the lateral side of the distal end of the radius

Trizepsreflex = triceps reflex

Schlag auf die Trizepssehne bei flektiertem Ellbogen = stroke on the triceps tendon with the elbow in flexion

Streckung im ellbogen = extension of the elbow

kleine Handmuskeln = small hand muscles
Kleinfingerballenmuskeln = muscles of the hypothenar eminence

Daumenreflex = thumb reflex

Schlag auf die Sehne des Flexor pollicis longus = stroke on the Flexor pollicis longus tendon

Flexion im Daumenendglied = flexion of the terminal phalanx of the thumb

Fingerflexorenreflex = finger flexor reflex

Schlag auf die Beugesehnen am Unterarm = stroke on the flexor tendons in the forearm

Flexion der Finger bzw. des Handgelenks = flexion of the fingers and the wrist

FIGURE 14:
Englische Quelle: http://www.swin.edu.au/victims/resources/assessment/health/sf-36-questionnaire.html

Items:

3a Vigorous activities
3b Moderate activities
3c Lifting or carrying groceries
3d Climbing **several** flights of stairs
3e Climbing **one** flight of stairs
3f Bending, kneeling, or stoopingS
3g Walking more than a mile
3h Walking several blocks
3i Walking **one block**
3j Bathing or dressing yourself

4a Cut down on the **amount of time** you spent on work or other activities

4b Accomplished less than you would like

4c Were **limited** in the **kind** of work or other activities

4d Had **difficulty** performing the work or other activities (for example, it took extra effort)

7 Physical pain - intensity
8 Did pain interfere with normal work

3 Vigorous activities
1 General Health

11a I seem to get sick a little easier than other people

11b I am as healthy as anybody I know

11c I expect my health to get worse

11d My health is excellent

9a full of life
9e a lot of energy

9g worn out
9i tired
6 interference with normal social activities (to what extent)
10 interference with normal social activities (how much of the time)

5a Cut down on the **amount of time** you spent on work or other activities

5b Accomplished less than you would like

5c Didn't do work or other activities as **carefully** as usual

9b very nervous
9c felt so down in the dumps that nothing could cheer you up
9d calm and peaceful
9f downhearted and blue
9h happy

Subskalen = subscales
Summenskalen = summary scales

Körperliche Funktionsfähigkeit (Physical functioning)
Körperliche Rollenfunktion = Role-physical
Schmerz = Bodily pain
Allgemeine Gesundheitswahrnehmung = General health
Vitalität = vitality
Soziale Funktionsfähigkeit = Social functioning
Emotionale Rollenfunktion = Role-emotional
Psychisches Wohlbefinden = Mental health

Körperliche Summenskala = Physical summary scale

Psychische Summenskala = Mental summary scale

FIGURE 15:

kein Schmerz = no pain

max. vorstellbarer Schmerz = maximum pain imaginable

DECLARATION

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

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