Danube University Krems

THE EFFECTS OF FUNCTIONAL APPLIANCE THERAPY IN THE STOMATOGNATHIC SYSTEM ON THE MUSCOSCELETAL SYSTEM OF CHILDREN WITH DYSGNATHIC DISORDERS

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1 ABSTRACT

There are varied interconnections within the body and there is a close fascial and neurophysiological interrelationship between the stomathognathic system and the musculoskeletal system. The purpose of my work was to show that dysfunctions in the stomatognathic system lead to changes outside of the stomatognathic system.

My thought was that the body posture, the mobility of the spine and the muscle length of kids who suffer from dysgnathic disorders should be influenced during the dental therapy with functional appliance therapy.

This study was carried out on ten patients, male and female, eight to fourteen years of age, presenting an Angle Class II division 1 malocclusion.

18 parameters were selected for the evaluation of the clinical functional status of the musculoskeletal system before the dental treatment began. The body posture, the mobility of the spine and the muscle length were examined.

Within a year after fitting a functional orthodontic appliance the clinical functional status of the musculoskeletal system was reevaluated using the same parameters and then compared to the former clinical functional status to see if there were any changes.

Correspondent to the representation of the stomatognathic system in the brain, my study confirms that malocclusion and its change can cause a multitude of dysfunctions in the body.

When comparing the two results it showed that through the effects on the stomathognathic system changes in body posture, spinal mobility and muscle length had occurred.

However, the examinations show that a correction of a dysfunction does not always lead to improvement of the evaluated parameters.

That means that corrections of a dysfunction in the stomatognatic system can lead to positive as well as negative changes.

These phenomena confirm the ascending and descending chains of dysfunctions as described in osteopathy.

According to this study, treatment of children with dysgnathic disorders with functional orthodontic appliances influences the function of the musculoskeletal system.

For achieving better results in the future it is necessary to consider the stomatognathic system as part of the entire organism and it is therefore essential that the therapy plan includes an osteopath in addition to an orthodontist.

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2 INTRODUCTION

Due to my practical experience as a physiotherapist and an osteopath I have had the chance to treat various children and adults in the last few years who were suffering from manifold acute and chronic spine problems.

The osteopathic education has changed the way that I am looking on my patients. I now consider my patients as one whole organism and that helps me to keep the anamnesis as complete as possible. I do not stay focused on the location where the symptoms occur; I also perform a thorough osteopathic examination.

It is remarkable for me that especially children with scoliosis and bad postures caused by problems in the stomatognathic system often receive dental treatment as well. I notice that in many cases the dysgnathy is diagnosed and treated long before the scoliosis is diagnosed. Since I observe the children with scoliosis over a long time frame, I notice from time to time that the intensity of the progredience only reduces after completion of the orthodontic therapy.

Based on that experience I want to deal within the framework of my master´s thesis with the following question:

Is there a verifiable interaction between the stomatognathic system and the musculoskeletal system?

The further I get into this topic I realize that colleagues in orthopedic, physiotherapeutic and dental practices also notice that patients with problems in the musculoskeletal system often show dysgnathic disorders as well. Bad posture or scoliosis of children is in most cases associated with dysgnathic disorders as well.

Especially in cases where local symptomatic treatment of patients with chronic symptoms proved unsuccessful, some dentists, physiotherapists and orthopedists got the idea not to look for the cause of the problem at the point where the symptoms occur but to consider the patient as a system that functions as a unit.

An approach to such thoughts is also found in literature.

G. Plato and S. Kopp[34], after 10 years of studies, have stated that „chronic pain syndromes, such as chronic headache, atypical facial pain, but also pain in the region of the pelvic diaphragm can be caused and maintained by dysfunctions of the craniomandibular system“. [Plato and Kopp, S. 150].

They have come to the conclusion that, vice versa, pain syndromes in the musculoskeletal system can cause dysfunctions of the temporomandibular joints, the entire craniomandibular system, or the occlusion.

The orthopedist P.H. Ridder[39] *(1998)* asked himself whether problems in the region of the temporomandibular joints or malalignment of a tooth could be responsible for disorders or pathologic changes in the periphery. His study has confirmed that disorders in the area of the temporomandibular joints or malalignment of a tooth can lead to various complaints in the body periphery.

According to some studies on musicians by *Dr. Götz Methfessel*[52], a high percentage of violinists and viola players complain about undifferentiated symptoms in the region of the „dental apparatus“, especially regarding the functioning of the temporomandibular joints and occlusion. Other causes mentioned are phenomena partly caused by posture, as for example non-compensated deformity of the teeth, primary lesions in the cervical spine, scoliothic pelvis, differences in leg length, etc.

Japanese scientists[39] used tests on animals to investigate the significance of changes in the stomatognathic system to the body periphery. The results have shown that a change in the position of the jaw leads to changes in the motor and autonomous nervous system.

Prof. J. Rohen[40] stated in his book “Funktionelle Anatomie des Nervensystems“ that there is a neurphysiological interrelationship between the stomatognathic system and the entire human body. The N. trigeminus is even the one nerv that has the most intense connections with other nerves.

Considering the varied interconnections within the body and the close fascial and neurophysiological interrelationship between the stomathognathic system and the musculoskeletal system we can hypothesize that the two systems influence each other.

According to this hypothesis I chose the following topic for my work:

The treatment of children with dysgnathic disorders with functional orthodontic appliances should influence verifiable the function of the musculoskeletal system concerning the body posture, the spinal mobility and the muscle length.

I am going to select 18 parameters regarding the body posture, the spinal mobility and the muscle length in order to evaluate the clinical functional status prior to the beginning of the dental treatment. The parameters are going to be re-evaluated within one year.

If there was an interaction between the stomatognathic system and the musculoskeletal system, the 18 parameters should perform an explicit alteration in between the two examinations.

This study is supposed to verify the interaction of the two systems.

3 BASIS

Cf. Milne, 1999.

3.1 General

From the functional point of view, the stomatognathic system not only consists of the temporomandibular joint and the muscles of mastication, but of those parts of the head, neck, and superior thorax, whose muscles, bones, ligaments, fasciae and nervous system control biting, chewing and swallowing.

The **stomatognathic system** mainly consists of the following:

Bone:	the Occipital bone (1 bone)
	the Temporal bones (2 bones)
	the Sphenoid bone (1 bone)
	the Maxillae (2 bones)
	the Mandible (1 bone)
	the Hyoid bone (1 bone)
	the Claviculae (2 bones)
	the Scapulae (2 bones)
	the Sternum (1 bone)
	the two uppermost ribs on each side (4 bones)
	the seven cervical vertebrae and the first three thoracic vertebrae (10 bones)
Joint:	the Temporomandibular joints
	the Atlantooccipital joint

	the Sternoclavicular joint
	the intervertebral articulations
	the sutural articulations
Muscle:	fusiform, flat, bipennate and multi-bellied forms
Fascia:	superficial; cervical; prevertebral; infrahyoid; pretracheal;
	the fasciae of Temporalis, Masseter, Sternocleidomastoid, Trapezius and Pectoralis major;
	Galea aponeurotica
Tooth:	consists of adamantine (dental enamel), cementum and dentin

With a view on the stomatognathic system‘s function and assessment each of the parts mentioned above must also be taken into consideration.

Of all the joints of the stomatognathic system the temporomandibular joints bear the most strain, followed by the atlantooccipital joint.

3.2 Temporomandibular Joint

Cf. Milne, 1999 and Platzer, 1991.

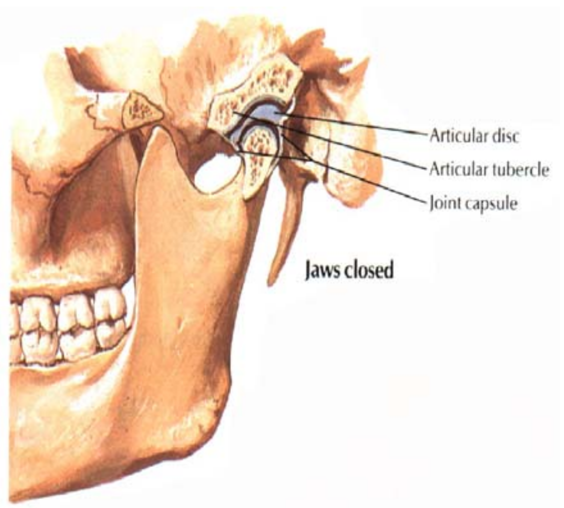


Fig. 1: Temporomandibular joint

The temporomandibular joint (Fig. 1) is a joint between the head of the mandible and the mandibular fossa with the adjacent articular tubercle. The nearly cylindrical head of the mandible is covered by fibrocartilage, and so is the mandibular fossa. Each temporomandibular joint is divided into a discotemporal and a discomandibular part by the articular disc.

This disc is biconcave and is located on the head of the mandible to compensate for the incongruity of the two opposing articular surfaces. The disc divides the temporomandibular joint into two compartments. The correct position of the disc in relation to the head of the mandible is an absolute prerequisite for perfect biomechanical functioning of movements of the mouth. Whenever the mouth is actively opened a hingelike motion of the inferior part and a forward gliding or protrusion of the superior part take place. Protrusion is mainly produced by the lateral pterygoid muscle. Besides opening movements, lateral motions and grinding motions are also possible.

3.3 Muscular System

Cf. Winkelmann et al., 1999.

Directly assigned to the muscles of mastication are those responsible for the elevation of the mandible (levators), the masseter, temporalis, and medial pterygoid muscles and the muscles responsible for the depression of the mandible (depressors), digastric, mylohyoid, stylohyoid and geniohyoid muscles. The lateral pterygoid muscle plays a special role, functioning as a levator as well as a depressor of the temporomandibular joint. Other muscles of functional significance to the temporomandibular joint are the infrahyoid muscles, the muscles of the tongue, the facial muscles, the muscles of the larynx and the pharynx, the scalenus group and the deep prevertebral muscles. The latter are also important for swallowing and speaking.

3.3.1 Functional Anatomy of the Most Important Muscles and their Clinical Relevance to the Temporomandibular Joint

The following muscles are assigned to the muscles of mastication in the narrow sense:

- M. masseter
- M. temporalis
- M. pterygoideus lateralis
- M. pterygoideus medialis

M. masseter (Fig. 2):

The muscle consists of superficial oblique and deep vertical fibres. The superficial part has its origin at the lower border of the zygomatic arch, passes backward and downward and is attached near the mandibular angle at the masseteric tuberosity. The deep part arises from the medial surface of the zygomatic arch, passes vertically downward and attaches from the ramus of the mandible up to the coronoid process of the mandible. The deep fibres of the Pars profunda are connected with the superficial muscle fibres of the temporalis muscle.

The main function of the masseter muscle is to elevate the mandible until the first dental contact, developing a very powerful but raw force of up to four tons of load.

M. temporalis (Fig. 2):

This fan-shaped muscle arises from the temporal plane and the temporal fascia and narrows to a powerful tendon which is attached to the coronoid process of the mandible. Due to its big surface at the cranium, we divide the muscle into Pars anterior, Pars medialis and Pars posterior. The fibres of Pars anterior run in cranio-caudal direction, those of Pars posterior more in dorso-ventral direction.

Among its main functions are the actions of elevating and retracting the mandible. In contrast to the masseter muscle, however, these actions are carried out with a high degree of fine-coordinative precision. The muscle should only be active at dorsal occlusal overlay, but not at dental contact in the front area. When opening the mouth or protracting the mandible the muscle acts eccentrically, thus serving different functions of the temporomandibular joint.

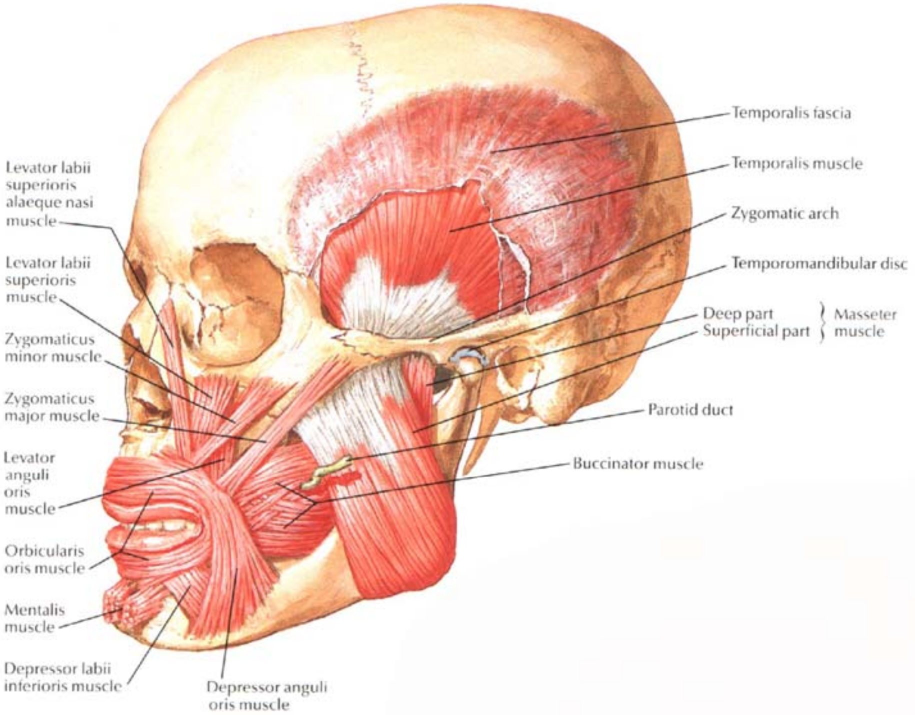


Fig. 1: Muscles Involved in Mastication

M. pterygoideus lateralis (Fig. 3):

The lateral pterygoid muscle arises by Caput infratemporale from the infratemporal crest and by Caput pterygoidale from the lateral surface of the pterygoid plate of the pterygoid process, passes almost horizontally backward to the pterygoid fovea of the neck of the mandible, to the articular disc and the joint capsule. Due to its attachment to the disc it pulls forward both the condyle and the disc. In addition, it acts eccentrically when closing the mouth and, when unilaterally contracted, synergetically with M. pterygoideus medialis, in the course of which it is involved in sideshift of the mandible.

M. pterygoideus medialis (Fig. 3):

The medial pterygoid muscle, whose origin is the pterygoid fossa of the pterygoid hamulus, passes backward and downward to the pterygoid tubercle, close to the medial surface of the angle of the mandible. Here it is connected with the masseter by a fibrous band, the two muscles forming a loop in which the mandible is suspended.

Among its functions are occlusion and sideshift of the mandible.

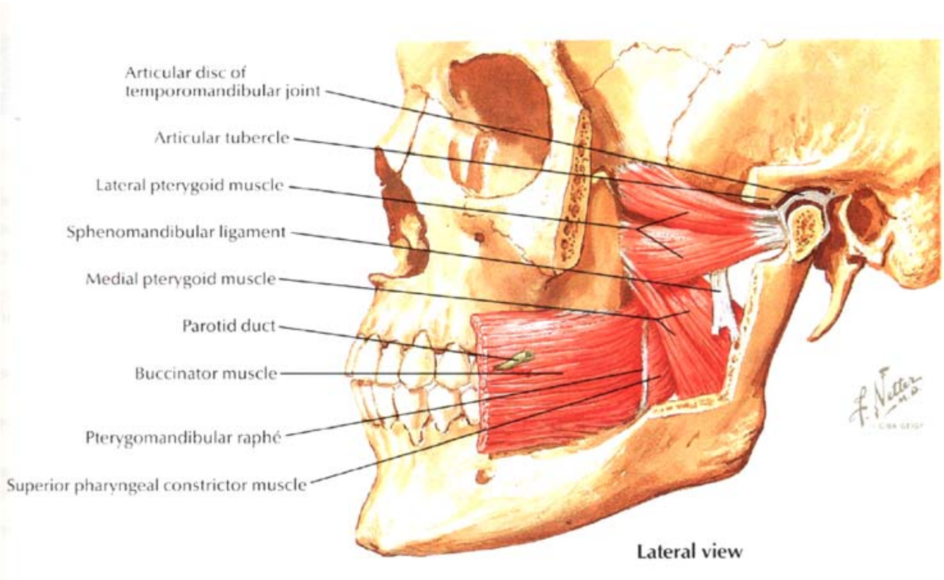


Fig. 2: Muscles Involved in Mastication

With regard to function there are some other muscles to be taken into consideration:

- Hyoid muscles: M. sternohyoideus
  M. omohyoideus
  M. sternothyroideus
  M. thyrohyoideus
  M. digastricus
- M. sternocleidomastoideus

- M. trapezius
- M. levator scapulae
- the flexor and extensor muscles of the neck
- M. pectoralis major
- M. latissimus dorsi

All muscles of mastication and all muscles attached to the cranial basis, the cervical spine, and the two uppermost ribs on each side are part of the stomatognathic system. As each of them may act incorrectly, all of them must be taken into account in a complete assessment of the stomatognatic system. In technical terms this means that they are all part of a closed kinematic chain. The state of the mandibular muscles may influence the body from the uppermost point of the greater wings of the sphenoid down to the tips of the toes. All muscles attached to the scapula also influence the stomatognathic system.

Not only contractile soft parts can have a significant influence on the articular functions of the temporomandibular joint. The anatomical attachment of the lateral pterygoid muscle to the articular disc, which causes functional biomechanical synergism and the resulting effects on the temporomandibular joint, may serve as an example here.

3.4 Body Posture and Position of the Mandible

Cf. Rossaint et al., 1996 and Ridder, 1998.

As the muscles of mastication are arranged in pairs, it is crucial for neuromuscular harmony of the cranium's muscular part that these muscles can exercise their forces in symmetrical**,** well-balanced conditions. Physiological occlusion plays an essential role in maintaining muscular equilibrium among the muscles of mastication.

From the biomechanical point of view, a change of the mandible's three-dimensional position relative to the maxilla leads to direct changes in dental bite, occlusion and functioning of the temporomandibular joints. Hence, a dysgnathic disorder forces the muscles into a dysharmonic state of tension.

Malposition of the occlusal plane in sagittal, transverse and vertical direction leads to a change of tonicity of the posterior muscle groups (Fig.5) while the spinal column takes up an adaptative position (Fig.4). In order to maintain orthostatic balance, neuromuscular hyperactivity in the general system is provoked.

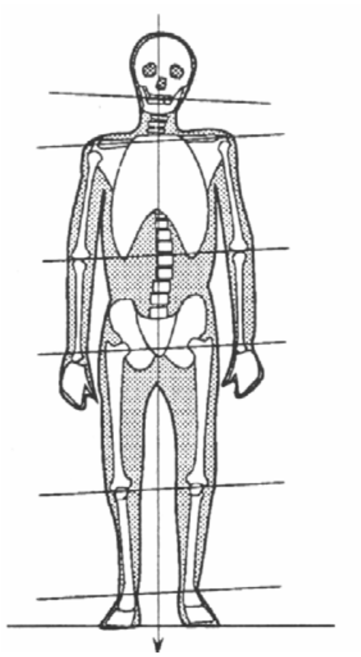


Fig. 3: Malposition of the occlusal plane leads to compensatory malpositions of the other horizontal planes of the body (shoulder, hip, knee) (according to J.E. Carlson)

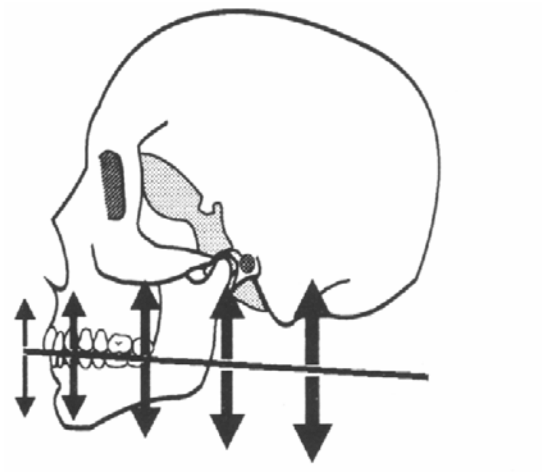


Fig. 5: Malposition of the occlusal plane with dysharmonic tension of the muscles of mastication in sagittal direction (according to J.E. Carlson)

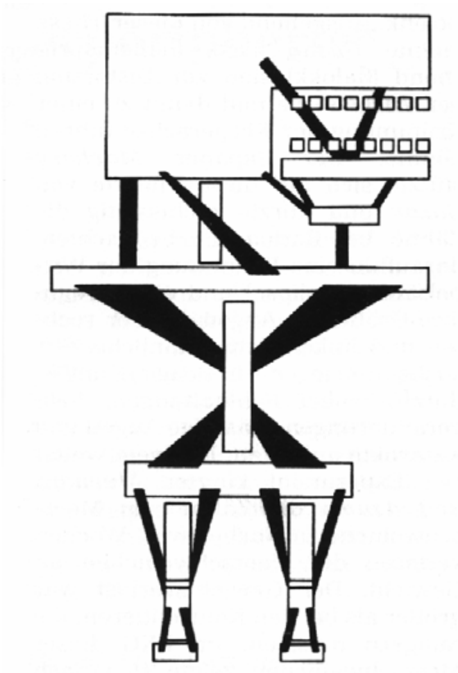


Fig. 6: The stomatognathic system and its functional-anatomical interrelation with the rest of the body

These phenomena also occur the other way round.

It has already been scientifically proved [16] that normal body-posture leads to changes of the mandibula's position. Dysfunctions in the musculofascial system of the anterior and posterior neck and also the position and functioning of the cervical spine lead to functional changes of the temporomandibular joints and occlusion.

3.5 <u>Fascial System</u>

Cf. Liem, 1998 and Pischinger, 1975.

3.5.1 General

The fascial connections between the cranium and the rest of the body are an important factor for the perfect functioning of the musculoskeletal system.

The Fascia is a fibrous structure which forms a continuous layer of connective tissue and sheath within the body. Embryologically it is mesodermal tissue, consisting of elastic and collagenous fibres, that encloses all muscles and organs. Excellent sliding and gliding capacity of the fascial layers, against each other as well as against muscles and organs, is important for mobility and tissue elasticity. The Fasciae facilitate fine physiological motions. *Prof. Dr. A. Pischinger*, who investigated into the function and anatomy of the connective tissue, underlined in his book *„Das System der Grundregulation“* [15] the importance of the connective tissue and the extracellular fluid for the functioning of the organ cells. Nerves, capillaries and cells directly influence this extracellular fluid. In the course of his studies Dr.Pischinger came to the conclusion that the extracellular space constitutes the primary control and that it is prerequisite for the function of organ cells. On these grounds he called this system " basic vegetative system".

He could never detect any direct contacts between vessels, capillaries, and nerves. They always had to overcome some distance, if only marginal, in extracellular space. It even proved that the closer examined area was to the periphery, the further apart the nerves and vessels were.

The connective tissue is composed of three components: cells, fibres (collagen, elastic, reticular), and the basic substance. Fibres and the basic substance are formed by the cells. The basic substance consists of mucopolysaccharides, particularly of the strongly water-binding hyaluronic acid. The composition of the individual components and the proportion of representation of the three components constitute the characteristics of each connective tissue.

3.5.2 Development of the Connective Tissue

During the transitional process from unicellular to multicellular organisms, in those first stages of cellular evolution, tissue between the cells developed. This intercellular tissue secured cohesion between the cells, facilitated contact and exchange of information between the cells and worked as protection against influences from outside. While the multicellular organisms developed further, the connective tissue specialized increasingly. The basic structure and the composition of the connective tissue surprisingly remained comparatively constant.

3.5.3 Function of the Fasciae

- **<u>Stabilisation and protection:</u>**

  Fasciae stabilize and protect, for example, articulations and organs by forming capsules, bands, and ligaments. They can lessen, absorb, or, if necessary, limit, encapsulate and store traumatic influences.

- **<u>Division:</u>**

  Fasciae divide certain areas of the body that are closely interconnected with regard to function. At the same time, they connect the individual subdivisions.

- **<u>Enclosure and connection:</u>**

  Fasciae enclose every muscle, every vein, all the nerves and all organs of the body. Running through the body they also function as connecting paths between the mentioned structures.

- **<u>Postural integrity:</u>**

  Owing to propriozeptors in the fasciae of the body they also take part in the dynamic organisation of body posture.

- **<u>Transmission of motor impulses:</u>**

  Heartbeat, breathing, movement of the primary respiratory mechanism, etc.

- **<u>Transmission, regulation and coordination of tensions:</u>**

  The fascial structures facilitate a reciprocal balance of tension between the locally involved structures and the body as a whole. This ensures that each tissue and the body as a whole has optimum flexibility and best possible functioning.

- **<u>Lymph transport environment:</u>**

  Dysfunctions of the fasciae (restricted movement) leads to:

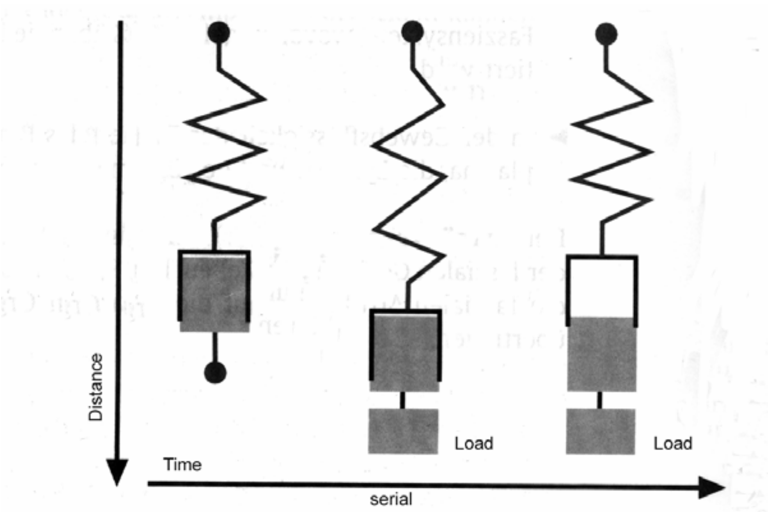
  * impairment of the cellular metabolism (cell respiration, nutrition, excretion)

- impairment of the free flow of the intercellular fluid and the lymph
- impairment of the immune system

This prepares the ground for the development of local and generalized dysfunctions and symptoms.

3.5.4 The Spring and Shock Absorber Model

In order to illustrate the organisation of dysfunctions of fibrous structures, I now mention the spring and shock absorber model developed by Little. It is a theoretic model which tries to clarify dysfunctional influences within the tissue. This model is based upon the elastic and collagen fibre structures which can be found anywhere within the tissue. The elastic fibres of the tissues react according to the spring model. The extent of distortion is in direct proportion to the extent of the applied force. The collagen fibres, on the other hand, act according to the shock absorber model. Here distortion is determined by the speed of the applied force. Fibrous structures act like an elastocollagenous complex, i.e. a combination of factors of the spring and shock absorber model. According to *Little*[11] fascial, ligamentous and muscular structures act according to the series model.



Series model (Fig. 7):

Fig. 7:
Spring and shock absorber model according to J.E. Upledger

After some time of applying a force or load the fascial tissue develops a lasting distortion. It remains like this, even after the force has vanished. Explanation: When a force or a load is applied, first of all, the elastic fibres (spring) will be stretched. After a certain period of time the viscous shock absorber function of the collagen fibres will compensate for the applied pulling forces, so that the elastic fibres (spring) will return to their initial position. Thus, a lasting change will have occured because the elastic pulling force of the spring, which could have brought back the fascial tissue to its initial position, is not available anymore.

3.5.5 Fascial Organisation

The fasciae of the human body are mainly organized in longitudinal direction. Horizontal fascial planes run at right angles within this longitudinally organizing fascial system. The transverse fascial planes function, on the one hand, as support of the longitudinal system. On the other hand, however, they are likely to impair the fine moveability of the longitudinal fasciae in case of dysfunctions like hypertension or conglutinations.

3.5.5.1 Cervicothoracal diaphragma (Fig. 8 and Fig. 12)

The cervicothoracal junction is another place where transverse bony, muscular and fibrous structures occur. They can impair the longitudinal fascial moveability and the fine moveability of the cranium. Furthermore, the venous drainage from the cranium along the internal jugular vein and the arterial flow along the internal carotid artery can be impaired. The anatomical structures in this region are extraordinarily complicated.

- bony: clavicle, acromion of the shoulder blade, manubrium and corpus of the sternum, the upper ribs, the lower cervical and the upper thoracic vertebrae (C 6 to Th 2), Art.°sternocostalis, Art.°sternoclavicularis, Art.°costovertebrales C7-Th2, Os.°hyoideum
- muscular: infrahyoid muscles, platysma, M.°sternocleidomastoideus, Mm.°scaleni, M.°trapezius, M. deltoideus, M. levator scapulae, splenius muscles, deep neck muscles, etc.
- visceral: esophagus, trachea, thyroid gland, heart, lung
- nerval: N. vagus, N. phrenicus, N. laryngeus recurrens, Truncus sympathicus (Ganglion stellatum)
- vascular: Truncus brachiocephalicus, A. carotis communis, A. subclavia, A. vertebralis, A. thoracica interna, Vena jugularis

Muscles of the cervicothoracal junction (Fig. 8):

We can systematically subdivide the muscles of the cervicothoracal junction into 4 sections:

1. Posterior section: The space between the back of the head, the Acromio-clavicular joint, and the upper thoracic vertebrae.
2. Anterior section: The space between the mandible, the hyoid bone, and the anterior tubercle of the transverse processes of the cervical vertebrae up to the first and second rib, the sternum and the clavicle.
3. Lateral sections: The respective spaces between the back of the head, the mastoid process, and the posterior tubercle of the transverse processes of the cervical vertebrae up to the shoulder blade and the ribs.

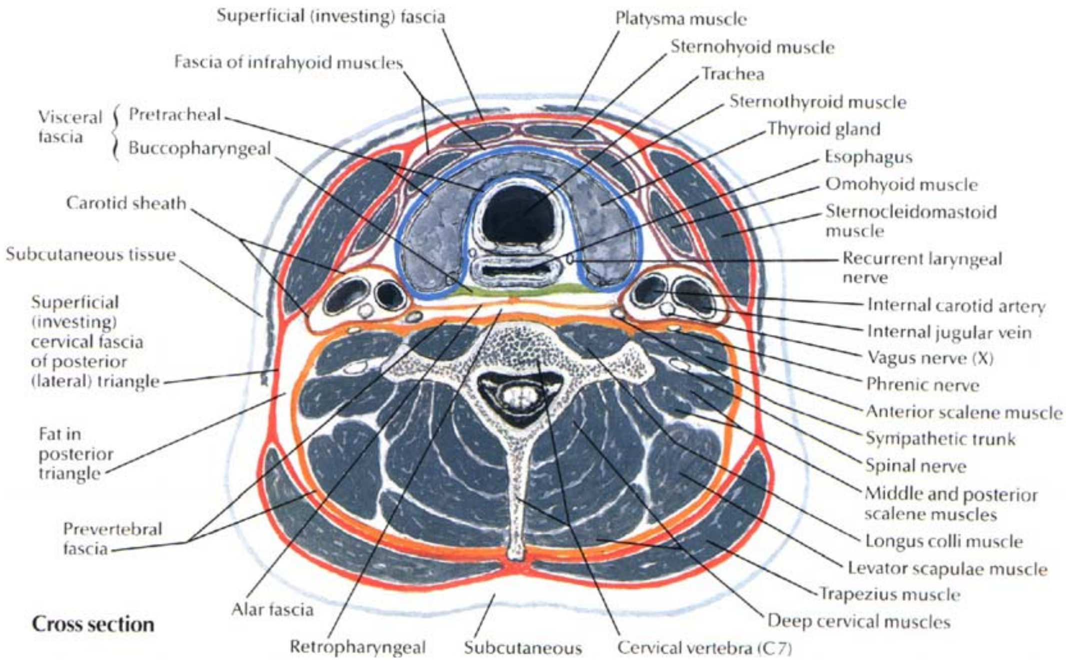


Fig. 8: Fasciae of the neck

Fascial path:

We can distinguish the following fascial layers at the cervicothoracal junction:

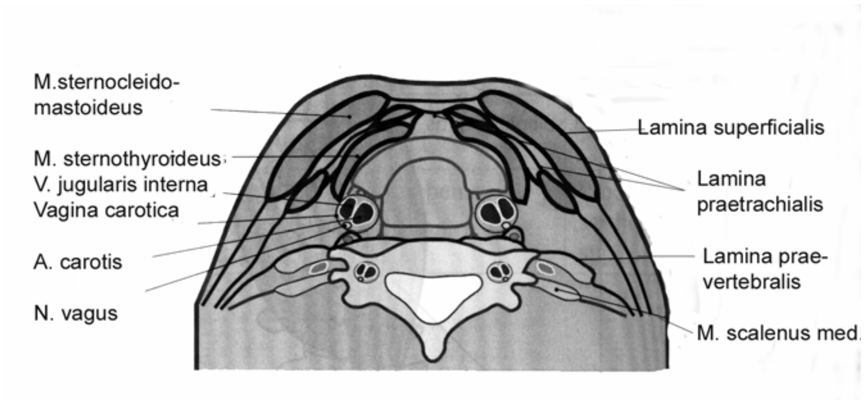


Fig. 9 : Fascia of the neck at C6 (View from above)

3.5.5.2 *Lamina superficialis fasciae cervicalis (Fig. 10):*

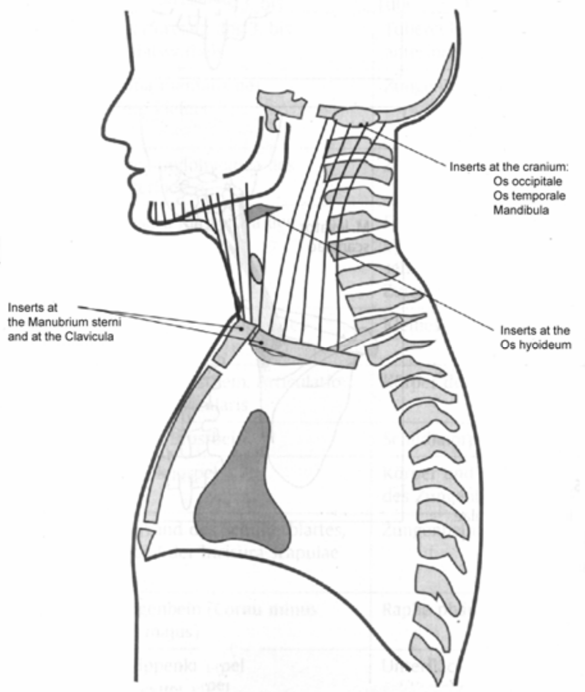


Fig. 10: Lamina cervicalis superficialis

- A superficial layer which encloses the sternocleido-mastoid muscle and the trapezius muscle
- The Lamina superficialis is located beneath the platysma
- It inserts at the anterior border of the manubrium, at the clavicle, at the hyoid bone, and at the mandible

- Downward it unites with the pectoral fascia
- Upward it splits up into Fascia masseterica, parotidea, temporalis and in Galea aponeurotica
- Backward it unites with the fascia of the neck (Fascia nuchae) and by a connective tissue suture of the nuchal ligament with the deep fascia of the neck and the tissue of the muscles of the neck
- In addition, Lamina superficialis encloses the muscular and ligamentary in-sertions at the styloid process

3.5.5.3 *Lamina praetrachealis fasciae cervicalis (Fig. 11)*

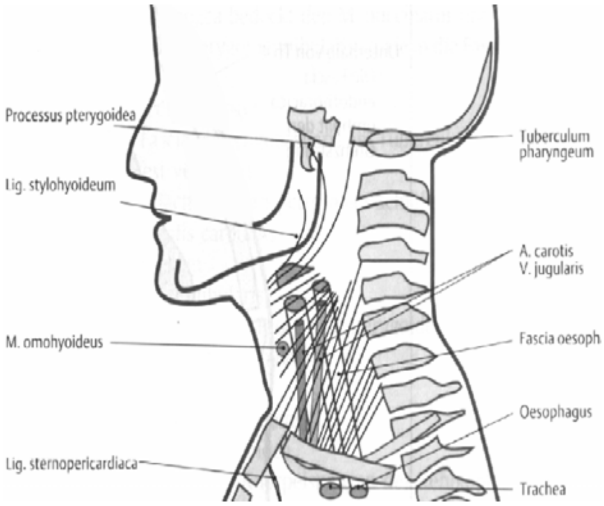


Fig. 11: Lamina cervicalis praetrachialis

- A medial layer which encloses the infrahyoid muscles
- Lamina praetrachealis extends between the two omohyoid muscles, is adherent to them and can be stretched by them. Contraction of the omohyoid muscle leads to dilation of the internal jugular vene.

- It lies anteriorly of the cervical viscera
- It inserts at the back of the clavicles, the sternum and the hyoid bone
- The middle fascia of the neck is also involved in the formation of the vascular sheath for the jugular vene, the carotid artery and the vagus nerve. Thus, hypertonicity and increased fascial tension in this region may impair venous drainage from the cranium
- Lamina praetrachialis is adherent to Lamina superficialis in the midline between the hyoid bone and the thyroid isthmus
- Further downward the two fascial layers divide again and form the border of the suprasternal compartment (with the jugular venous arch)

3.5.5.4 *Lamina praevertebralis fasciae cervicalis*

- A deep layer which connects the head with the thorax
- It runs along the Sutura occipitomastoidea, behind the Fossa jugularis and parallel to Sutura petrobasilaris and petrojugularis
- Lamina praevertebralis is attached near the pharyngeal tubercle of the back of the head and runs to the third thoracic vertebra where it is adherent to the anterior longitudinal ligamentof the spinal column
- So it continues from the cranium along the anterior parts of the vertebral fasciae to the coccyx
- It covers the scalenus muscles
- Via the scalenus muscles it reaches the clavicle and the outward surface of the thorax. It is continuous with the sheath of the axilla
- In the axilla it encloses the A. subclavia and covers the Plexus brachialis, thus developing a fascial continuity to the upper arm
- The deep fascial layer is continuous with the fascia of the intrathoracic muscles and the endothoracic fascia (a layer that allows movement between the costal pleura and the thorax) and forms fibrous dome-shaped layers covering the apex of the lung
- The Lamina praevertebralis is connected with the superficial fascial layer of the muscles of the neck (Fascia nuchae) through the fascia of the scalenus muscles and the fascia of the levator scapulae muscle
- It also encloses the M. rectus capitis major and minor, the M. obliquus capitis superior, the M. semispinalis capitis and the M. splenius capitis
- Moreover, the deep fascial layer encloses the sympathetic trunk, the three ganglia of the neck and the phrenic nerve. The deep (Lamina praevertebralis) fascial layer lies behind the visceral compartment (esophagus, trachea, thyroid gland), which is attached to the diaphragm

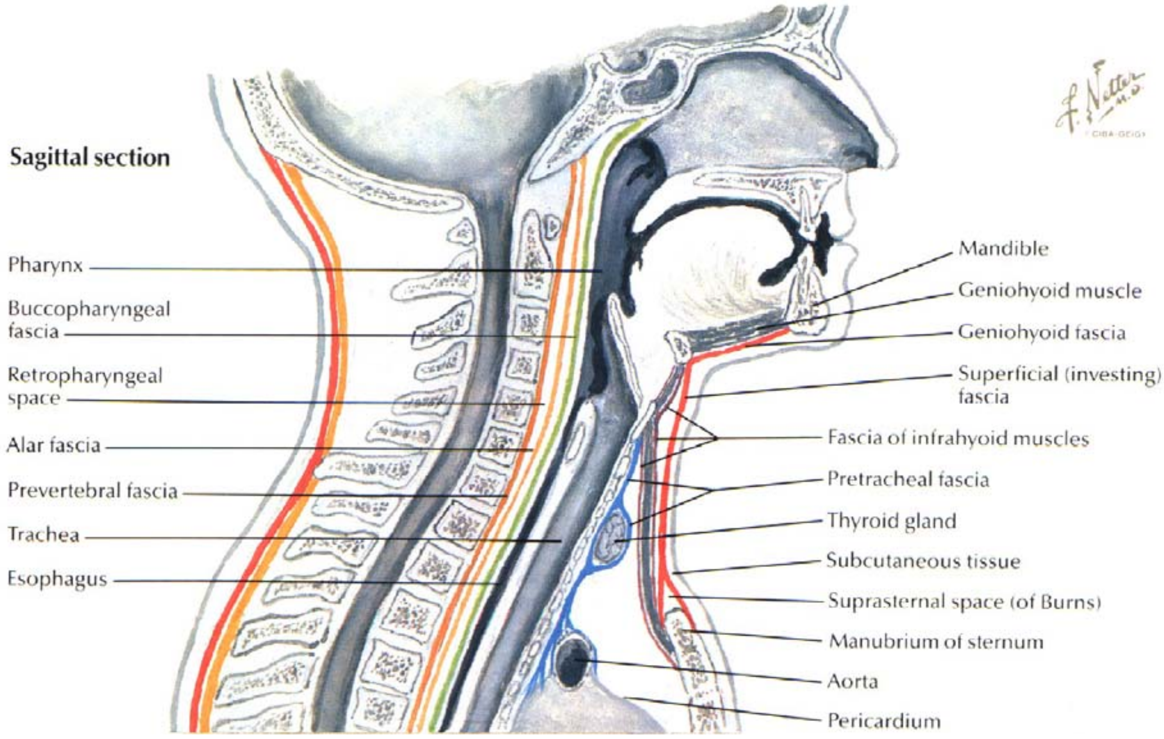


Fig. 12: Fasciae of the neck

3.5.5.5 <u>*Other fascial structures (Fig. 13 and Fig. 14)*</u>

<u>*„Rideau stylien“:*</u>

Attachment from posterior to anterior:

- Along the anterior border of the mastoid process
- At the anterior border of the sternocleidomastoid muscleAt the digastric muscle
- At the styloid process
- At the styloglossus muscle: from the styloid process to the lateral part of the tongue
- At the stylomandibular ligament

- At the stylohyoid ligament
- At the stylohyoid muscle
- Past the anterior border of the carotid canal
- Connection with the buccopharyngeal fascia

Fascia buccophyarngea and visceral compartment:

The buccopharyngeal fascia covers the buccinator muscle and extends backward where it merges into the pterygomandibular raphe and the fascia of the constrictor pharyngis muscle.

Attachment of the visceral compartment:

- Upward firmly anchored as pharyngobasilar fascia at the Tuberculum pharyngeum of the back of the head
- At the lower surface of the Pars petrosa of the temporal bone to the medial border of the carotid canal
- At the middle lacerate foramen
- At the pterygomandibular ligament
- At the lateral lamina of the pterygoid process
- At the posterior part of the mylohyoid line
- At the stylohyoid ligament
- At the cornua of the hyoid bone
- At the thyrohyoid membrane

Raphe pterygomandibularis:

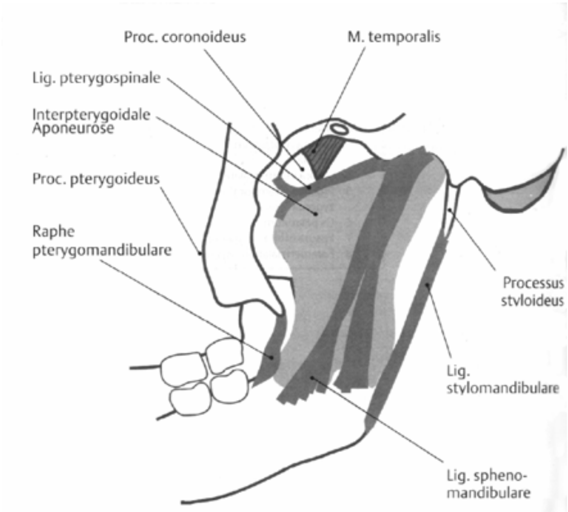


Fig. 13: Fascial connections (medial view)

- At the posterior side of the cartilaginous bridges of the larynx
- This fibrous band runs between the pterygoid hamulus of the sphenoid bone and the mandible. Furthermore, It passes over the inside of the temporomandibular joint. At its back, some parts of the constrictor pharyngis muscles arise, whereas the buccinator muscle arises at the front.

Interpterygoid aponeurosis:

Attachment as above:

- At the petrotympanic fissure, which is located dorsomedial of the fossa of the temporomandibular joints
- At the sphenoid spine
- At the medial borders of the spinous foramen and of the foramen ovale
- At the pterygospinous ligament (which runs from the Processus medialis of the pterygoid process to the sphenoid spine)
- Forward: At the posterior border of the pterygoidus process (Lamina lateralis) to the pterygomandibular raphe
- Downward: Attached at the anterior part of the ascending ramus of the mandible

- The loose border of the aponeurosis is located at the posterior part, uniting with the sphenomandibular ligament (the sphenomandibular ligament runs from the sphenoid spine to the interior surface of the mandible at the mandibular foramen

Aponeurosis pterygo-temporo-mandibulare:

Attachment:

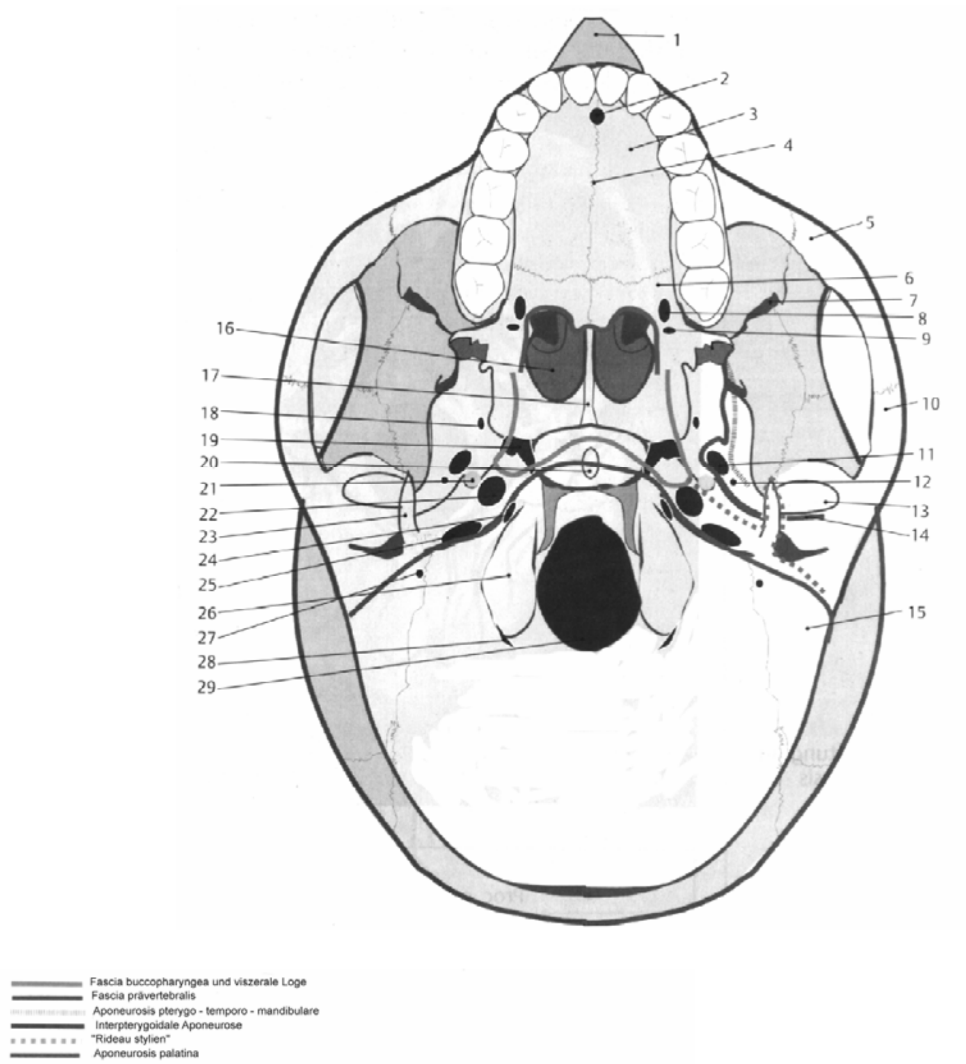
- Backward: At the anterior border of the Collum processus condylaris of the mandible
- Forward: At the lateral lamina of the pterygoid process
- The cranial border is reinforced by Hyrtl's ligament
- The caudal border is loose. It ends at the medial side of the lateral pterygoid muscle

Aponeurosis palatina:

This fibrous plate is the continuation of the muscles of the palate and the peristeum of the hard palate

Attachment:

- At the dorsal border of the horizontal lamina of the palatine bones
- At the medial lamina of the pterygoid process of the sphenoid bone



1 Os nasale
2 Foramen incisivum
3 Maxilla
4 Sutura intermaxillaris
5 Processus temporalis ossis zygomaticus
6 Os palatinum
7 Fissura orbitalis superior
8 Foramen palatinus majus
9 Foramen palatinus minus
10 Processus zygomaticus ossis temporalis
11 Foramen ovale
12 Foramen spinosum
13 Fossa mandibularis
14 Fissura petrotympanica
15 Processus mastoideus
16 Chonae
17 Vomer
18 Canalis pterygoideus
19 Foramen lacerum
20 Tuberculum pharyngeum
21 Tuba auditiva
22 Canalis caroticus
23 Processus styloideus
24 Canalis hypoglossi
25 Foramen jugulare
26 Condylus occipitalis
27 Foramen stylomastoideum

Fig. 14: Attachment of the fasciae at the cranial floor

3.6 Trigeminal Nerve

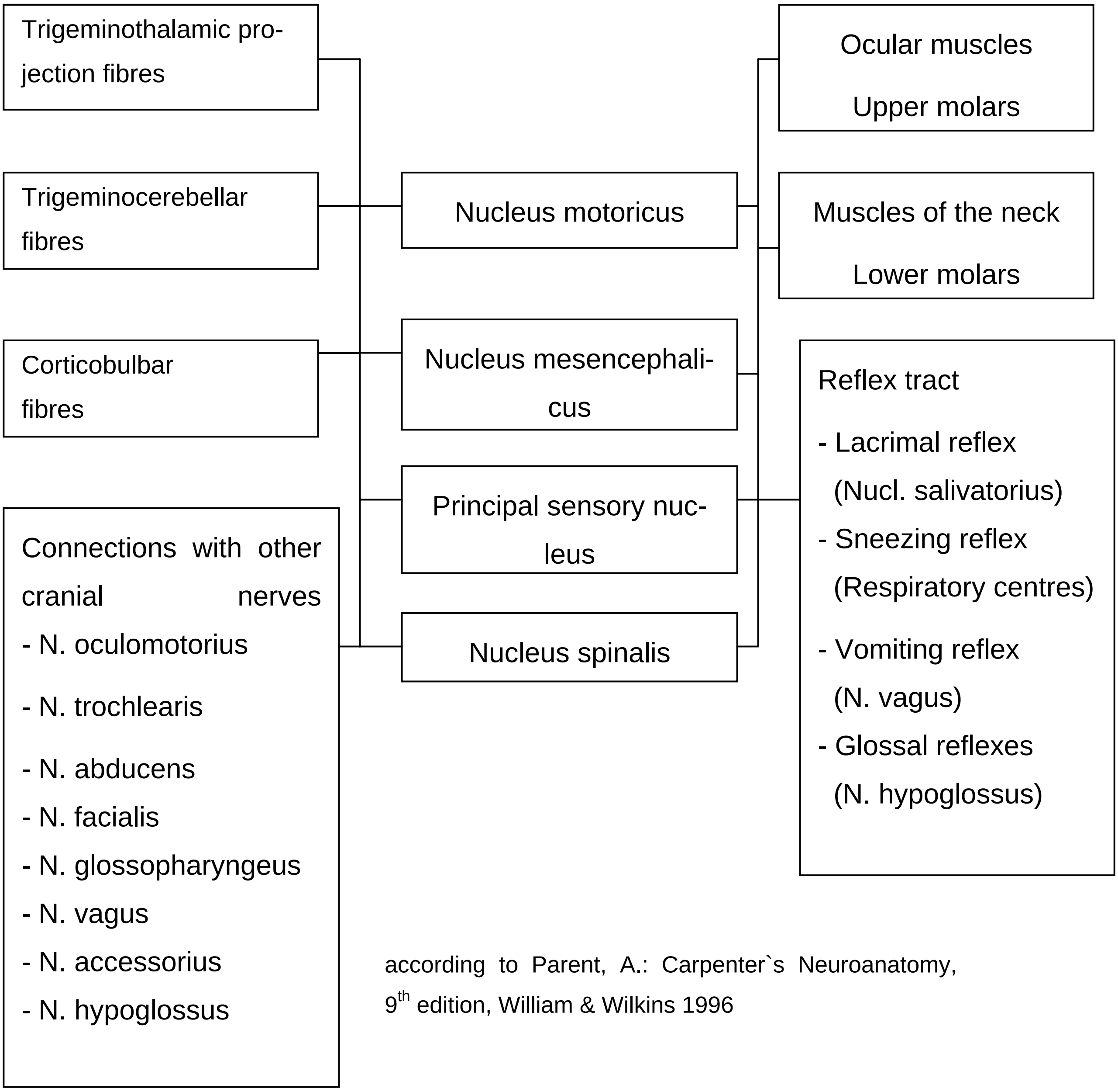
Cf. Netter, 1987

The trigeminal nerve is the largest cranial nerve.

It is attached ventrolaterally at the upper border of the bridge of Varolius and consists of a large sensory root (Portio major) and a much smaller medial motor root (Portio minor). The trigeminal nerve conducts sensory excitations from the face and the scalp, from parts of the external ear and the external ear canal, from the nasal and oral cavity, the teeth, the temporomandibular joint, the nasopharynx and the main part of the cerebral membrane in the anterior and middle cranial fossa. In addition, there are proprioceptive excitations from the muscles of mastication, possibly also from the lateral eye muscles and the mimetic muscles. The fibres of the motor root supply the muscles dividing from the mandibular arch, also the muscles of mastication, the mylohyoid muscle, the anterior belly of the digastric muscle, the M.°tensor veli palatini, and the M. tensor tympani. Numerous parasympathetic and sympathetic fibres join with the trigeminal nerve through connections with the oculomotor, trochlear, facial, and glossopharyngeal nerves and the sympathetic plexus around branches of the carotid arteries.

The sensory and motor roots emerging at the bridge pass outward and forward over the upper border of the petrous part of the temporal bone at its apex. The sensory root widens to the crescent-shaped Gasserian ganglion, which contains pseudounipolar cells. The processes of these cells form a peripheral and a central part, the peripheral one comprising most of the sensory fibres of the ophthalmic, maxillary, and mandibular nerves and the central one converging to form the sensory trigeminal root, which enters the brain stem. It either ends in the sensory pontine nucleus or passes downward with the spinal tract to the spinal (inferior) nucleus. The peripheral processes of unipolar cells in the mesencephalic nucleus act as proprioceptive fibres. They are special insofar as they are the only primary sensory neurons, the cell bodies of which are located within the CNS.

Diagram of the Interconnections of the N. trigeminus



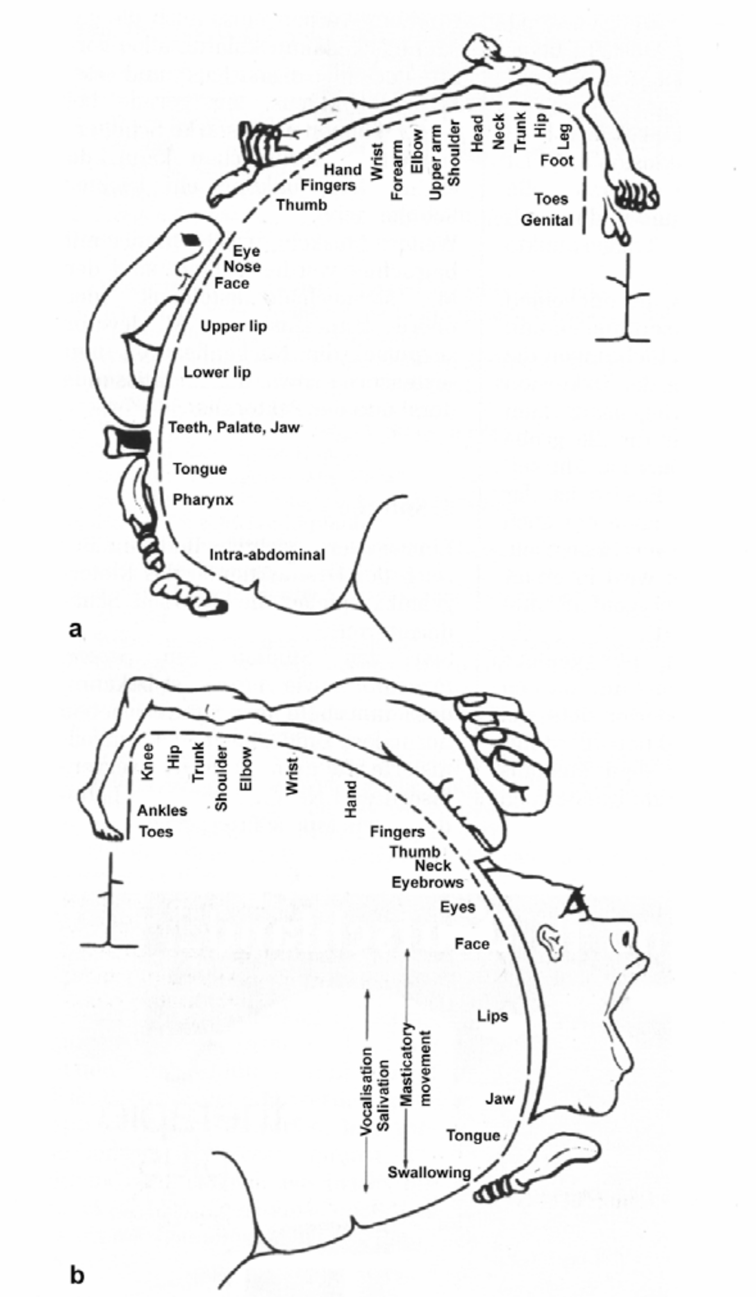
according to Parent, A.: Carpenter`s Neuroanatomy, 9th edition, William & Wilkins 1996

The motor fibres arise from the motor nucleus, which is situated in the upper part of the bridge at the medial side of the main sensory nucleus.

The ophthalmic, maxillary, and mandibular nerves emerge from the convex border of the trigeminal ganglion. The small motor root passes below the ganglion toward the mandibular nerve.

3.7 Precentral / Postcentral Gyrus

Cf. Ridder, 1999.



The importance of the stomatognathic system becomes immediately apparent, when we look at the representation of this system in the precentral and postcentral gyrus. From swallowing to chewing and to the lips, it comprises more than 30 per cent of the gyrus, much more than the hand. As for sensory representation, it still comprises 25 per cent. This means that 25 to 30 per cent of all afferences which are conducted to the motor cortex and further distributed there, accordingly causing effects at the periphery of the body, originate in the stomatognathic system.

Fig. 15 :

a) sensory homunculus according to Penfield and Rasmussen

b) motor homunculus according to Penfield and Rasmussen

3.8 Eugnathy and Dysgnathia

Cf. Spiro, 1984 and Schmuth et al., 1994.

3.8.1 Eugnathy

Orthodontic diagnosis is based on the criteria of eugnathy. Functionally, the soft parts orally (tongue) and vestibularly (cheeks and lips) adjacent to the rows of teeth are in dynamic balance in eugnathy. Not only their activity is important, but also their mass. Posture of the head (muscles of the neck) also contributes to the development and maintenance of a functional balance.

3.8.2 Dysgnathia – Angle Class II Malocclusion

We speak of an Angle Class II malocclusion, if the permanent lower first molar stands in distal position relative to its upper antagonist. This distal occlusion may be caused by a retrognathic mandible, a protracted maxilla, or a combination of both conditions.

4 METHODOLOGY

4.1 Working Materials

- *Measuring tape*
  I use a measuring tape to evaluate the parameters.
- *Question and examination form (see Appendix)*
  One sheet of paper is used to document the orthodontic status. To evaluate the osteopathic status I use a four-paged examination form.

4.2 The Elements of the Test Series

Selection of research patients:

Ten test persons are assigned by several dentists on the basis of the following criteria:

- Diagnosis: Angle Class II division 1 malocclusion
- The research patients are male and female, aged between eight and fourteen years.

4.3 The Test Procedure

4.3.1 Dental Examination

An orthodontic status (model analysis and cephalometric analysis) is established with all the children (see Appendix I).

4.3.2 Osteopathic Examination I

(See Appendix II)

The osteopathic examination is carried out in several steps as follows.

4.3.2.1 Patient documentation

Surname, first name, date of birth and number of brothers and sisters are documented.

4.3.2.2 Medical history

Medical history sheet see Appendix

4.3.2.3 Clinical functional status of the musculoskeletal system

The examination and evaluation of the body posture, the spinal mobility and the muscle length is done using the orthopaedic examination methodology and functional testing on the upright standing, the bending over and the lying child.

The child must take off all clothes except for the underpants in a pleasantly warm medical treatment room.

The following parameters are examined in order to evaluate the body posture.

Evaluation of the statics:

Evaluation of the statics is done in standing position. The research patient is asked to stand upright.

The parameters are evaluated as follows:

Lateral inspection:

Genu recurvatum

Anterior inspection:

Genu valgum / varum

Posterior inspection:

Evaluation of the position of the scapula in cranial direction
Evaluation of the waist triangles
Pes valgum/ varum

Inspection in supine position:

Evaluation of the leg length

Evaluation of the active excursive movements of individual spinal column segments:

Evaluation of the active excursive movements is also done in standing position. The patient is directed to carry out specific movements. The active excursive movements of the following articular structures are evaluated, if possible, comparing the two sides:

Temporomandibular joint:	Evaluation of the mandible's movement for asymmetry
Cervical spine:	Rotation right/ left Lateral flexion right/ left
Trunk:	Rotation right/ left Sidebending right/ left

Standing flexion test:

Procedure:

The Patient stands with his/her back to the examining person.

The thumb of the examining person palpates at the same time both Spinae iliacae posteriores superiores (posterosuperior spines of the ilium). The patient is told to keep both feet on the ground, straighten the legs at the knee-joint and then to slowly bend forward. Position and movement of both spines shall be observed and evaluated during the forward bending of the trunk.

Evaluation:

The sacrum rotates around a horizontal axis in relation to the ala of the ilium in the sacro-iliac articulations. This rotation of the sacrum is called nutation.

When the results are negative, which means free mobility in the sacro-iliac articulations, the spines of the ilium are at the same height at the end of the forward bending motion as they were at the beginning.

If there is no nutation and the standing flexion test proves positive, this indicates, first of all, a blockage of the sacro-iliac articulation at the respective side. If the ischio-crural muscles are shortened on both sides, this may be misinterpreted as a positive standing flexion test for both sides.

Note:

In the evaluation of a standing flexion test asymmetries of the pelvis and the hip joints should be taken into consideration or ruled out. The examining person should even out a scoliotic pelvis caused by a difference in leg length by putting a small board underneath the short leg before the test.

Ott-sign:

The Ott-sign is a measurement for the capability to fold and unfold the thoracic spine.

Procedure:

The patient is standing. The examining person marks the spinous process C7 and a point 30 cm downwards. The distance increases by 2 - 4 cm during bending forward and decreases at maximum reclination by 1 - 2 cm.

Schober-sign:

The Schober-sign is a measurement for the capability to fold and unfold the thoracic spine.

Procedure:

The Patient is standing. The examining person marks the skin above the spinous process S1 and 10 cm upward. These marks shift apart during bending forward up to a distance of approx. 15 cm. The distance decreases at maximum reclination to 8 - 9 cm.

Finger-floor distance:

The finger-floor distance is a measurement for the moveability of the whole spinal column during forward bending.

Procedure:

The Patient is standing. During bending forward, with the legs straightened at the knee-joints, both of the extended arms/hands should reach the feet to about the same extent. The distance between the fingertips and the floor is measured.

Muscle function test:

The examination of shortened muscles is done according to the muscle function test by Vladimir Janda.

We speak of muscular shortening when it has come to a shortening of muscles at rest. The muscle at rest in vivo is shorter than normal and it can not be passively stretched as much as the articulation‘s full range of movement would allow. An aggravated form of this kind of shortening is a form of muscle contraction as it develops due to a change in the balance of forces. The tendency towards muscular shortening not only occurs under pathological circumstances, but apparently is a characteristic adaptative reaction.

Examination of shortened muscle groups, in principal, means measuring of the passive range of movement in the joint, in that position and direction where it is possible to discern an isolated, exactly determined muscle group.

In order to achieve reliable results, the following factors were taken into account when examining shortened muscles:

The examining person must strictly adhere to starting position, fixation and direction of movement as determined.

The examining person executes a slow movement at a constant speed, which in the end shall softly come to a halt without bouncing back in any case. Thus the extension impulse and, therefore, the irritability of the muscles remains almost constant. Pressure and pull must always be directed towards the direction of the required movement.

The following muscles were examined for this test:

Upper part of the M. trapezius and M. levator scapulae:

Starting position:	The patient is in supine position.
Fixation:	The shoulder is fixed from above at the tested side.
Movement:	Passive lateral flexion of the cervical spine while omitting forward and backward bending or rotation.
Normal range of movement:	
	The examining person compares the range of movement on both sides and palpates the tension in the fibres of the upper part of the trapezius muscle.

M. iliopsoas:

Starting position: Supine position, with the coccyx over the edge at the far side of the bed. The leg that is not examined is bent until the pelvis retroverts and the lumbar lordosis is completely evened out. The leg is fixed in this position at the knee.

Fixation: By drawing up the leg that is not examined to the trunk. In addition, the examining person presses the patient's leg towards his/her trunk in order to prevent lordosis formation of the lumbar column in any phase of the examination.

Normal position: Thigh horizontally, the lower leg hanging vertically with relaxed muscles.

Pathological position: Flexion of the hip indicates a shortening of the M. iliopsoas.

Ischio-crural muscles:

Starting position: Supine position, legs straightened.

Fixation: At the lower third of the thigh of the leg that is not examined, without touching the patella.

Movement: The examining person holds the patient's lower leg that will be tested so that his hand keeps it in extension by pressing the knee from the front against the upper arm of the examining person in order to avoid external rotation of the leg. Then the examining person executes a flexion in the hip-joint.

Normal range of movement:

Inclination angle of 80 degrees.

M. rectus femoris:

Starting position:	Prone position, legs straightened.
Fixation:	The pelvis of the leg that will be examined is fixed by the cranial hand of the examining person.
Movement:	Passive flexion of the leg at the knee-joint.
Pathological position:	In case of a shortening a compensatory flexion in the hip or an evasive movement of the pelvis occurs.

4.3.3 Osteopathic Examination

(See Appendix III)

The clinical functional status of the musculoskeletal system is evaluated once again within a year after fitting of a functional orthodontic appliance.

4.4 Consideration of Methodology

The methodology of this study has to be critically scrutinized with regards to several criteria.

4.4.1 Checkup - Group

One criterion of my study is that the probands have to show the following dental diagnosis: Angle Class 2 division 1 malocclusion.

Due to this diagnosis it is in my opinion not ethical to forbid those children dental treatment for up to one year. That is why there is no checkup-group.

4.4.2 Parameters of Examination

The parameters of examination express the body posture, the spinal mobility and the length of the muscles.

Most of the parameters in the study are easy to collect, such as identifying an asymmetry, which keeps the error rate very low.

In spite of that, the reliability of the manual-diagnostical orthopaedic methodology is still a fundamental issue.

Especially the reliability of palpation results is judged in literature very differently from rather low [3, 23] to high [18].

Overall the argument for rather low reliability outweighs the other.

Whereas the reliability of metric examinations (Ott- and Schober-sign) concerning the limitation of mobility is higher rated [38, 53, 23].

It is necessary to bear that in mind in order to evaluate the results.

4.4.3 Timeframe of the Study

Due to the complex schedule of this study a one-year timeframe was chosen between the dental diagnosis, my first examination, the beginning of the orthodontic treatment and my second examination.

Since the pattern of posture constantly reacts compensatory to different influences, it is obvious that not only the dental intervention but also other factors (e.g.: adolescence, physical and psychological stress factors,...) may have influenced the pattern of posture between the first and the second examination.

5 RESULTS

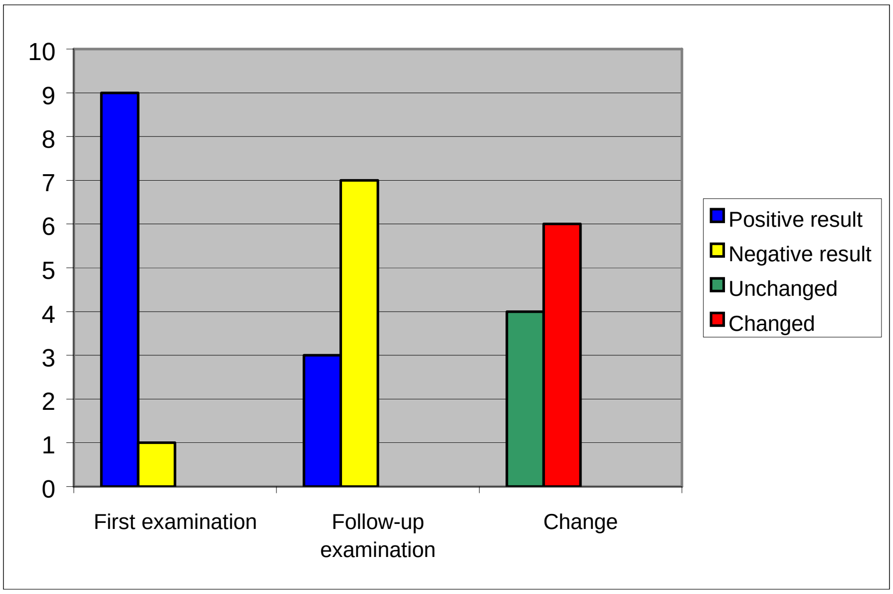
5.1 Evaluation of Each Examination Result

Ten children presenting an Anglo Class II division 1 malocclusion were selected for evaluation of a clinical functional status of the musculoskeletal system before and after fitting a functional orthodontic appliance.

The parameters for both examinations were compared with each other and analysed as follows.

Temporomandibular joint

Patient	First examination	Follow-up examination	Change
1	right	NAD	yes
2	right	NAD	yes
3	left	NAD	yes
4	right	NAD	yes
5	right	right	no
6	left	left	no
7	left	NAD	yes
8	right	right	no
9	NAD	NAD	yes
10	right	NAD	yes



On ten research patients opening and closing movements of the mandible were tested for asymmetric deviation.

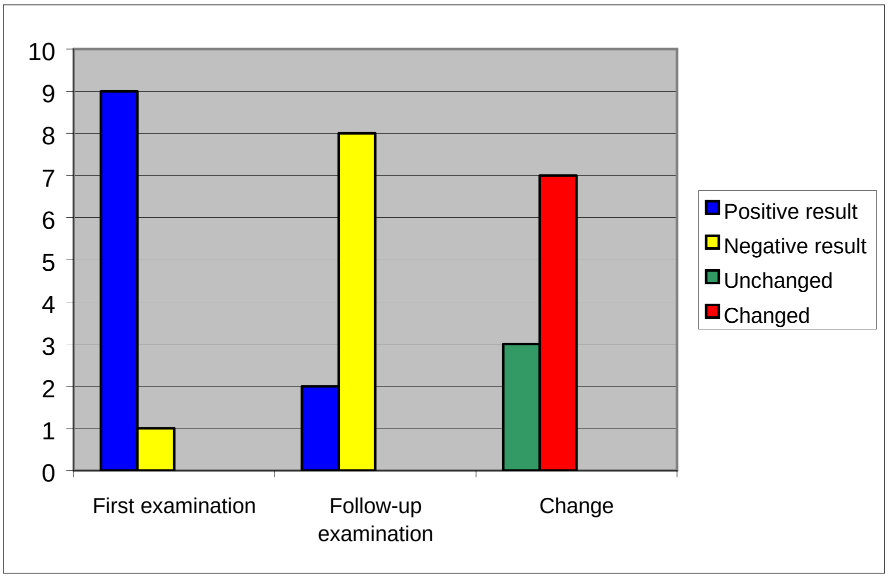
On the first examination one child showed no deviation. Out of the other nine children, a deviation to the right was detected in six and a deviation to the left in three.

On the follow-up examination the results of the child without deviation remained unchanged. Out of the six research patients showing a deviation to the right at baseline, two results remained unchanged and the other four results showed no asymmetry.

Out of the three children with a deviation to the left, one child showed unchanged results and two children showed no more asymmetry.

Varus/valgus malposition in the knee-joint

Patient	First examination	Follow-up examination	Change
1	right valgus	NAD	yes
2	right/left valgus	NAD	yes
3	right/Lvalgus	NAD	yes
4	NAD	NAD	no
5	right valgus	NAD	yes
6	right/left valgus	right/left valgus	no
7	right valgus	NAD	yes
8	left valgus	NAD	yes
9	right valgus	NAD	yes
10	right/left valgus	right/left valgus	no



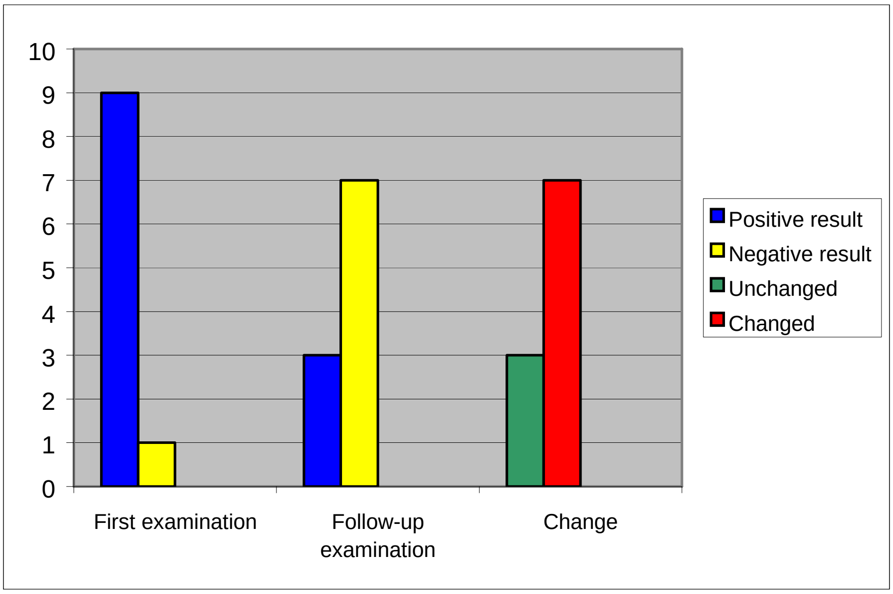
The position of the tibia relative to the femur was examined in ten research patients.

Out of those, four children had a valgus malposition on the right and on the left, four children only on the right, one child on the left, whereas in one child this parameter proved negative.

The follow-up examination revealed a considerable change of this parameter. Out of ten children, two children showed unchanged valgus malposition on both sides, on eight children this parameter proved negative.

Rotation of the head

Patient	First examination	Follow-up examination	Change
1	left	NAD	yes
2	left	NAD	yes
3	left	NAD	yes
4	NAD	NAD	no
5	left	NAD	yes
6	right	NAD	yes
7	right	left	yes
8	left	left	no
9	left	left	no
10	left	NAD	yes



On ten children the range of active movement for rotation of the head, comparing the two sides, was tested in standing position, starting out from a neutral position.

On the first examination a restriction of movement on the left was found on seven of these ten children, a restriction of movement on the right on two children and equal rotation on both sides (no abnormalities detected) on one child.

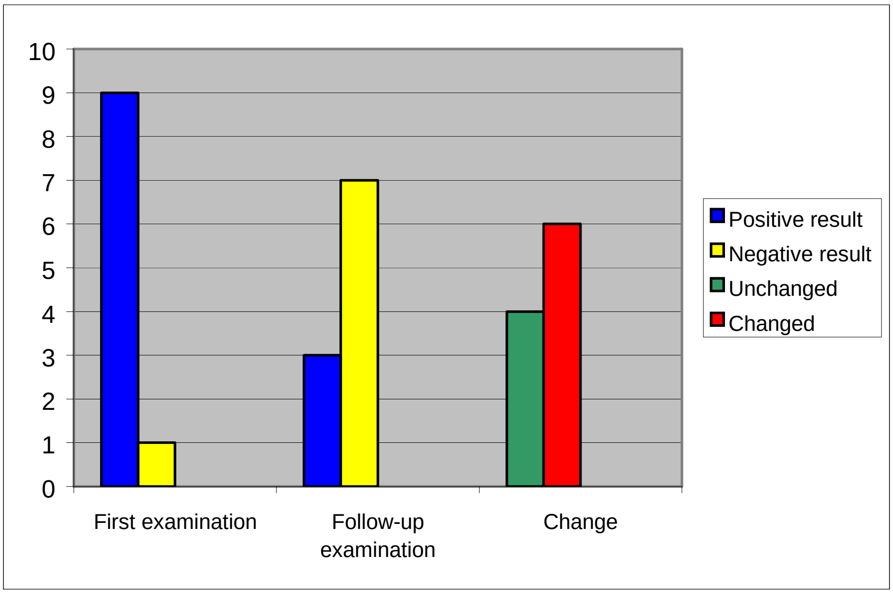
On the follow-up examination the range of movement of the seven children with restricted movement on the left changed insofar as in five children equal rotation on both sides (no abnormalities detected) was found and in two children the restriction remained unchanged.

One of the two children with a restriction on the right developed a restriction on the left, and one child developed an equal range of movement on both sides (no abnormalities detected). The parameter for the child that had shown no abnormalities, remained unchanged.

In seven research patients the parameters changed from one examination to the other whereas they remained unchanged in three research patients.

Lateral flexion of the head

Patient	First examination	Follow-up examination	Change
1	right	right	no
2	right	NAD	yes
3	right	right	no
4	NAD	NAD	no
5	left	NAD	yes
6	left	NAD	yes
7	right	NAD	yes
8	right	NAD	yes
9	left	NAD	yes
10	left	left	no



On ten research patients the range of active movement for lateral flexion of the head, comparing the two sides, was tested in standing position, starting out from a neutral position.

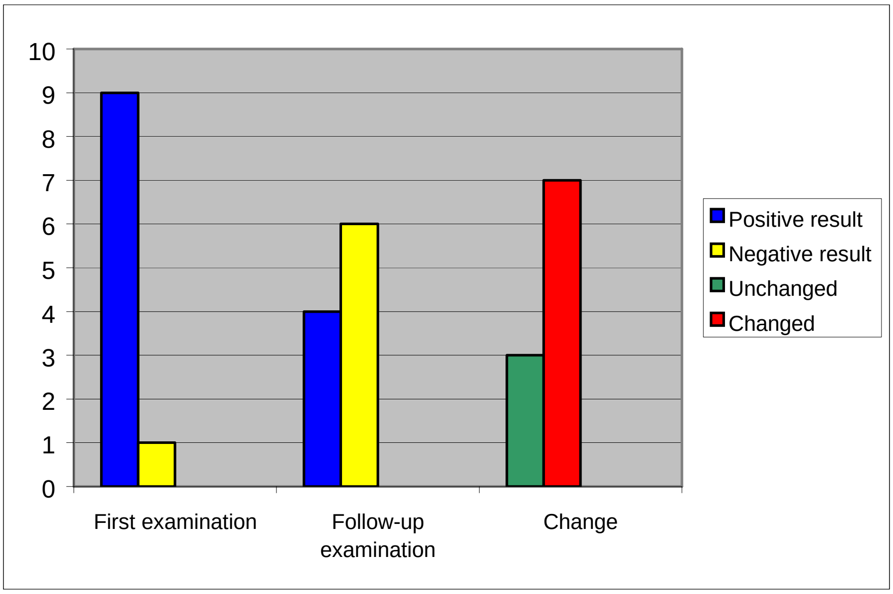
During the first examination restricted lateral flexion on the left was found in four of these ten children, restricted lateral flexion on the right in five children and equal lateral flexion (no abnormalities detected) in one child.

The follow-up examination revealed the following results for the four children with a restricted lateral flexion on the left: three children showed equal lateral flexion on both sides and in one child no abnormalities were detected.

On the follow-up examination, three of the five children with restricted lateral flexion on the right showed equal lateral flexion on both sides (no abnormalities detected) and in two children the results of the first examination remained unchanged. The results for the child that had shown no abnormalities on the first examination also remained unchanged (no abnormalities detected) on the follow-up examination.

Rotation of the trunk

Patient	First examination	Follow-up examination	Change
1	left	NAD	yes
2	left	NAD	yes
3	left	NAD	yes
4	left	NAD	yes
5	left	right	yes
6	left	left	no
7	right	left	yes
8	left	NAD	yes
9	NAD	NAD	no
10	left	left	no



On ten children the active rotation of the trunk, comparing the two sides, was tested in standing position.

Restricted rotation on the left was found in eight of these ten children, restricted rotation on the right in one child and equal rotation on both sides in one child.

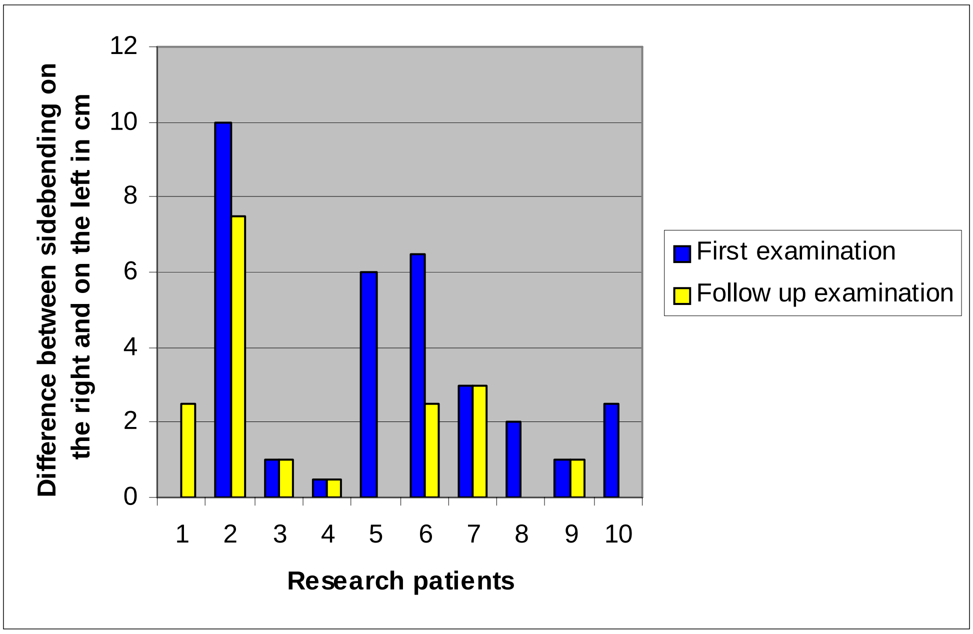
On the follow-up examination the eight children with restrictions on the left showed the following results: the results for two children remained unchanged, one child showed a restriction on the right on the follow-up examination and five children showed an equal range of movement (no abnormalities detected).

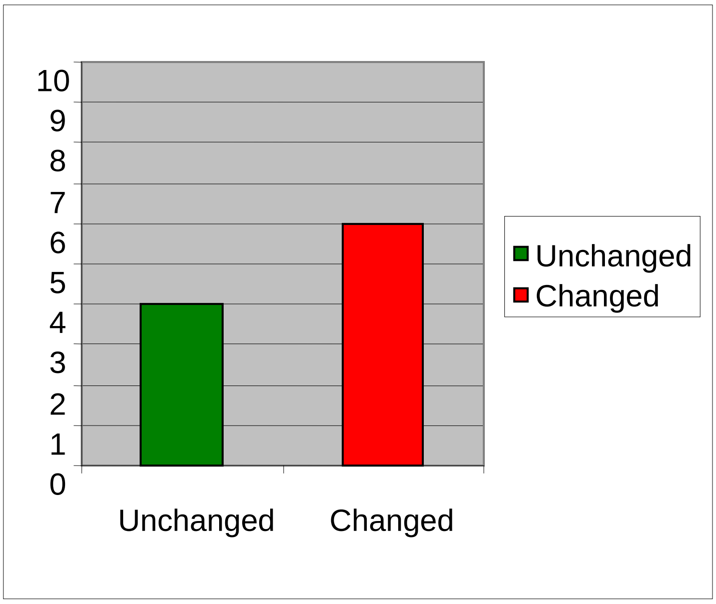
The child with restricted rotation on the right compensated to a restriction on the left and the results of the child with equal rotation on both sides remained un-changed.

Out of the 10 parameters of the first examination seven parameters changed on the follow-up examination.

Sidebending of the trunk

Patient	First examination right / left		Follow-up examination right / left		Change
1	31/31	0	37/34,5	2,5	yes
2	38/28	10	40/32,5	7,5	yes
3	36/35	1	30/31	1	no
4	31/30,5	0,5	33,5/33	0,5	no
5	42/36	6	39/39	0	yes
6	39,5/33	6,5	30/32,5	2,5	yes
7	40/37	3	43,5/40,5	3	no
8	32,5/30,5	2	32/32	0	yes
9	35/36	1	32,5/33,5	1	no
10	38/35,5	2,5	36/36	0	yes





In ten research patients sidebending of the trunk was measured, assessing side-bending on the right / left with regard to symmetry.

On the first examination one child showed symmetric sidebending, in the other nine children sidebending right and left differed from 0.5 cm to 10 cm.

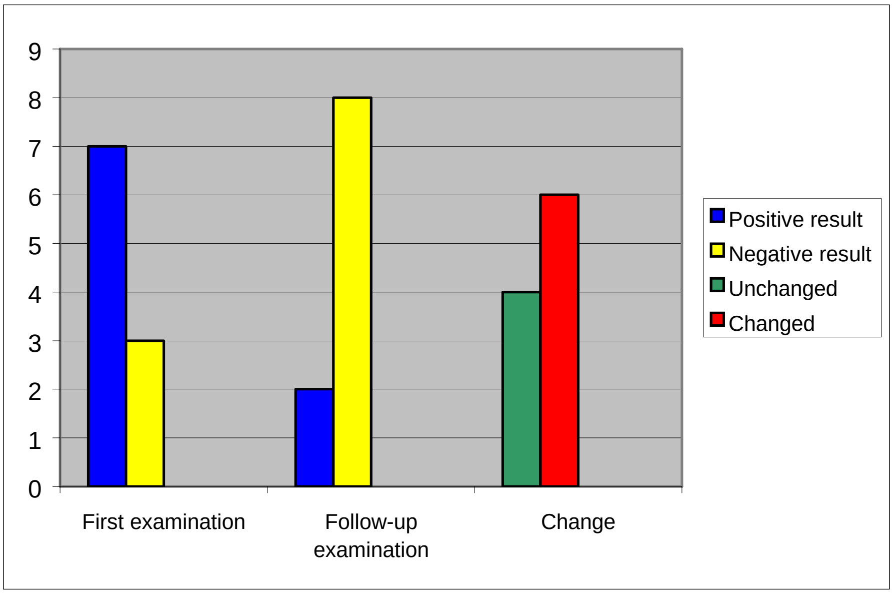
On the follow-up examination two children showed symmetric sidebending of the trunk and the other eight children showed a difference of 0.5 cm to 7.5 cm.

Looking at the figures one can see that the difference between sidebending on the right and on the left remained the same in four children. Six children showed a change in the difference between sidebending on the right and on the left.

In one child asymmetry got worse from one examination to the other and in five children significant approximation to symmetry was found. Six children showed a change in the difference between sidebending on the right and on the left.

Position of the scapula in cranial direction

Patient	First examination	Follow-up examination	Change
1	right	NAD	yes
2	right	NAD	yes
3	right	NAD	yes
4	NAD	NAD	no
5	NAD	NAD	no
6	NAD	NAD	no
7	right	NAD	yes
8	right	NAD	yes
9	left	left	no
10	right + left	right	yes



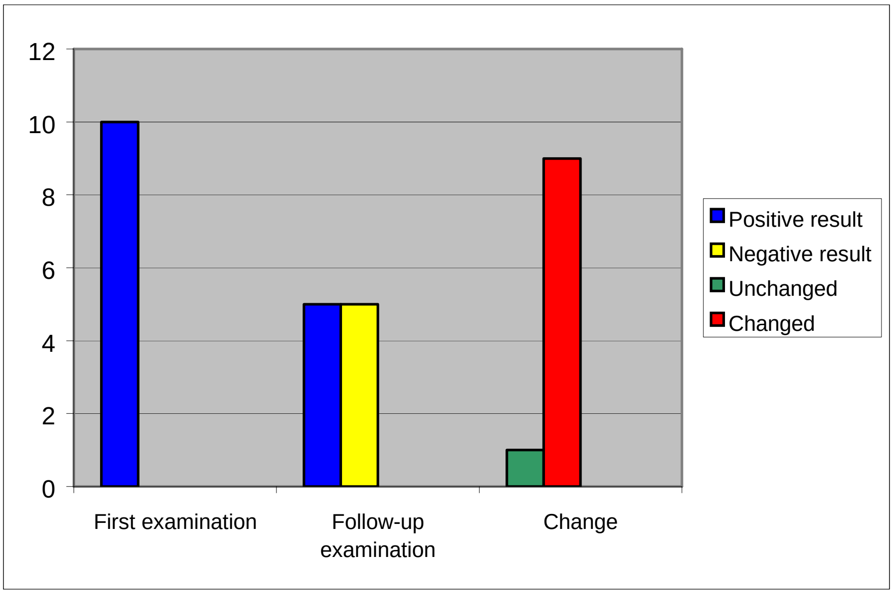
The position of the scapula was examined in ten children.

On the first examination elevation on the right was observed in five children, elevation on the left in one child, elevation on the right and left in one child and a physiologic position of the scapula in three children.

On the follow-up examination the five children with elevation on the right showed a physiological position of the scapula. The parameter for the child with elevation on the left remained unchanged. The child that had shown elevation on the right and left on the first examination only showed elevation on the right on the follow-up examination. The parameters for those three children where no abnormalities were detected on the first examination remained unchanged.

Asymmetry of the waist triangles

Patient	First examination	Follow-up examination	Change
1	pos.	improved	yes
2	pos.	improved	yes
3	pos.	NAD	yes
4	pos.	NAD	yes
5	pos.	improved	yes
6	pos.	pos.	no
7	pos.	improved	yes
8	pos.	NAD	yes
9	pos.	NAD	yes
10	pos.	NAD	yes



Analysis of symmetry of the waist triangles was conducted on ten children in standing position.

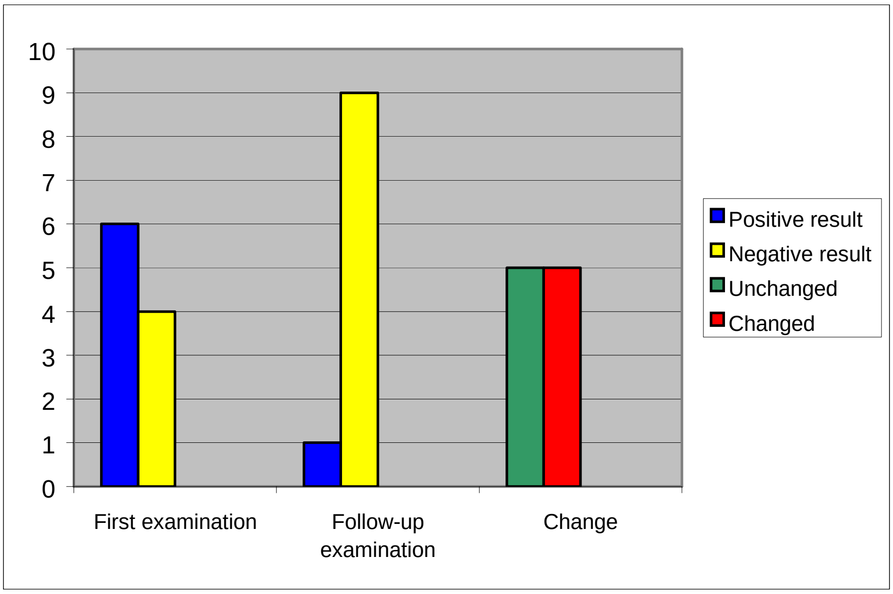
On the first examination all of the ten children showed significant asymmetry of the waist triangles.

The results of one child remained unchanged on the follow-up examination, in four children symmetry improved and in five children symmetry of the waist triangles was achieved (no abnormalities detected).

Nine out of ten results changed considerably.

Standing flexion test

Patient	First examination	Follow-up examination	Change
1	right	right	no
2	NAD	NAD	no
3	NAD	NAD	no
4	right	NAD	yes
5	NAD	NAD	no
6	NAD	NAD	no
7	right	NAD	yes
8	right	NAD	yes
9	right	NAD	yes
10	right	NAD	yes



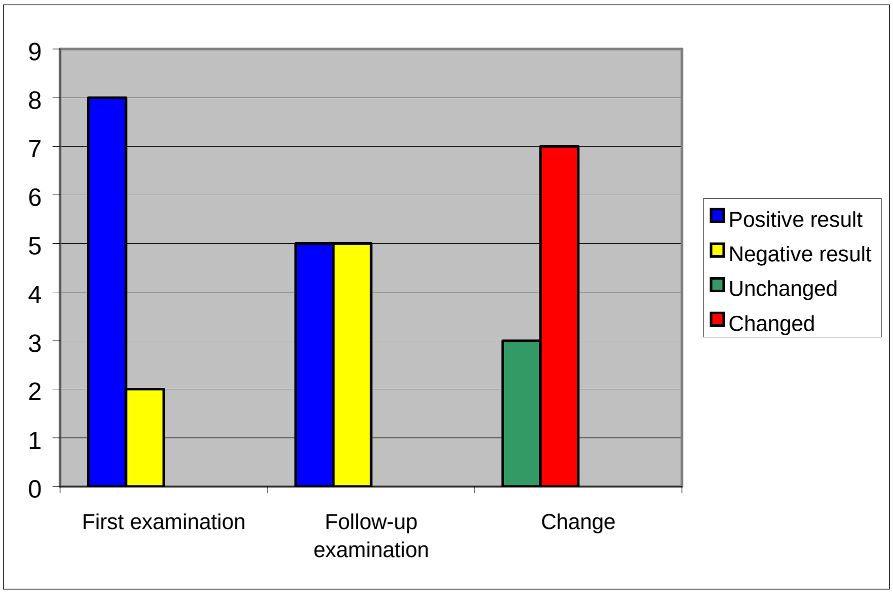
The standing flexion - test was conducted on ten children in standing position.

On the first examination six children showed a positive standing flexion test on the right and in four children no abnormalities were detected.

Of the six children with a positive standing flexion test on the right, in one of them the results remained unchanged on the follow-up examination, whereas no abnormalities were detected in the other five children. The parameter for those children where no abnormalities had been detected on the first examination remained unchanged.

Pes varus / valgus

Patient	First examination	Follow-up examination	Change
1	right	NAD	yes
2	NAD	NAD	no
3	right	NAD	yes
4	left	right	yes
5	NAD	right	yes
6	right	right	no
7	right + left	right + left	no
8	right	right + left	yes
9	right	NAD	yes
10	right + left	NAD	yes



The position of the calcaneal part of the foot was examined in ten research patients in standing position.

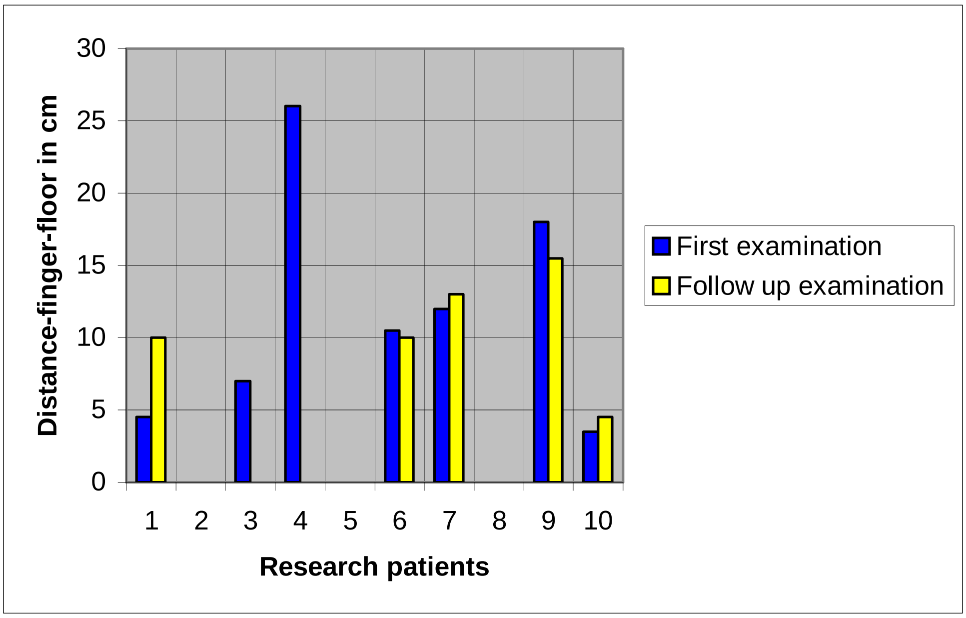
The first examination revealed the following results: Malposition of the left foot was detected in one child, in five children at the right foot, in two children of the right and the left foot, and in two children a normal position of the calcaneal part of both feet was found.

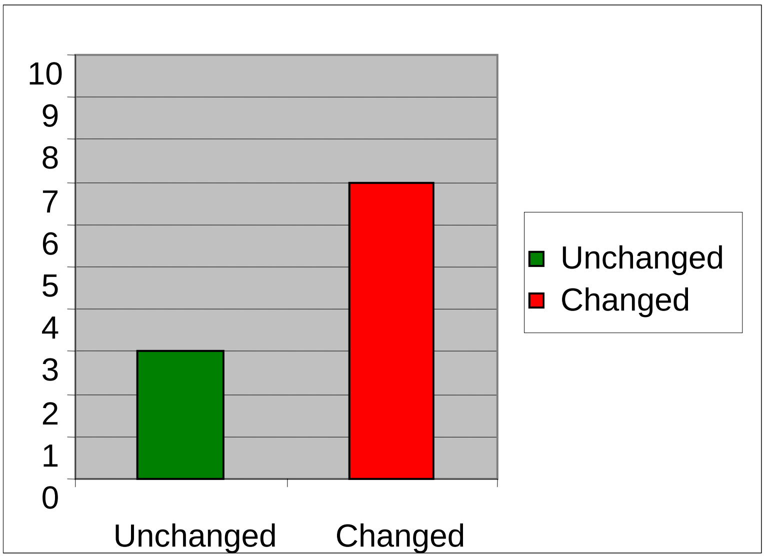
The child with a malposition of the left foot showed malposition of the right foot on the follow-up examination. In the five children with malposition on the right the follow-up examination revealed the following results: in one the results remained unchanged, one child developed malposition on the right and the left and three children showed a physiological position on both sides. The results of one of the two children with malposition on both sides remained unchanged whereas the results of the second child changed to negative results. The results of the two children with normal position at baseline changed as follows: the results of one child remained unchanged whereas the second child developed malposition on the right.

All in all a change of seven parameters in comparison to baseline was found.

Finger-floor distance

Patient	First examination	Follow-up examination	Change	
1	4.5 cm	10 cm	- 5.5 cm	yes
2	0	0	0 cm	no
3	7.0 cm	0	+ 7 cm	yes
4	26.0 cm	0	+26 cm	yes
5	0	0	0 cm	no
6	10.5 cm	10 cm	+ 0.5 cm	yes
7	12 cm	13	- 1 cm	yes
8	0	0	0 cm	no
9	18 cm	15.5 cm	+ 2.5 cm	yes
10	3.5 cm	4.5 cm	- 1 cm	yes


Distance-finger-floor in cm
30
25
20
15
10
5
0
1 2 3 4 5 6 7 8 9 10
Research patients
First examination
Follow up examination


10
9
8
7
6
5
4
3
2
1
0
Unchanged
Changed
Unchanged
Changed

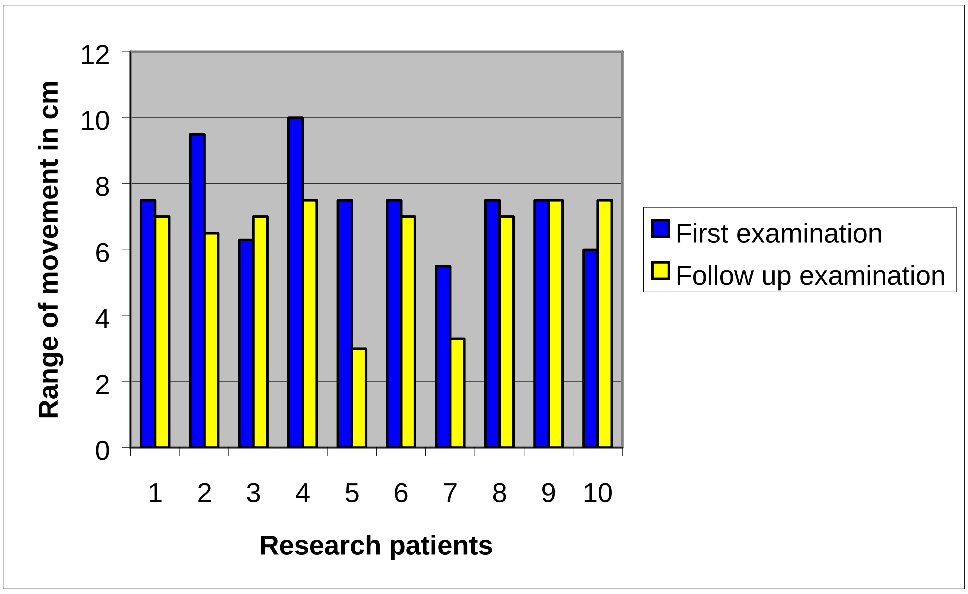
The finger-floor distance test was conducted on ten children. Three children showed a distance of 0 cm on the first examination and in seven children the distance varied from 3.5 cm to 26 cm.

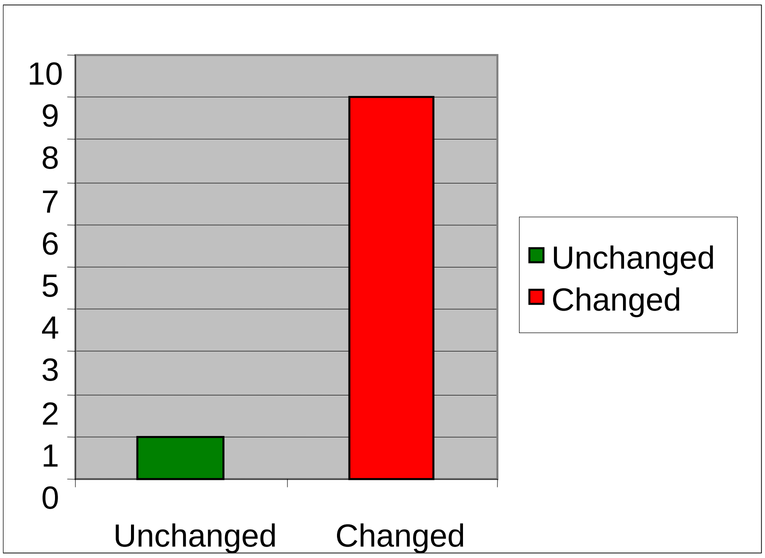
In five children a distance of 0 cm was found on the follow-up examination whereas the other five children showed a distance from 4.5 cm to 10 cm.

Three children showed a distance of 0 cm on the first examination as well as on the follow-up examination. In the other seven children the results changed from one examination to the other.

Ott - sign

Patient	First examination		Follow-up examination		Change	
1	36.5 / 29	7.5	35 / 28	7	-0.5	yes
2	35 / 25.5	9.5	33.5 / 27	6.5	-3	yes
3	35 / 28.7	6.3	34 / 27	7	0.7	yes
4	38.5 / 28.5	10	36 / 28.5	7.5	-2.5	yes
5	34.5 / 27	7.5	32 / 29	3	-4.5	yes
6	36.5 / 29	7.5	35 / 28	7	-0.5	yes
7	34 / 28.5	5.5	31.5 / 28.2	3.3	-2.2	yes
8	36 / 28.5	7.5	36 / 29	7	-0.5	yes
9	36.5 / 29	7.5	33.5 / 26	7.5	0	no
10	33 / 27	6	33 / 25.5	7.5	1.5	yes





The figures of total range of movement from maximum extension to maximum flexion on the two examinations were compared with each other, using the Ott sign.

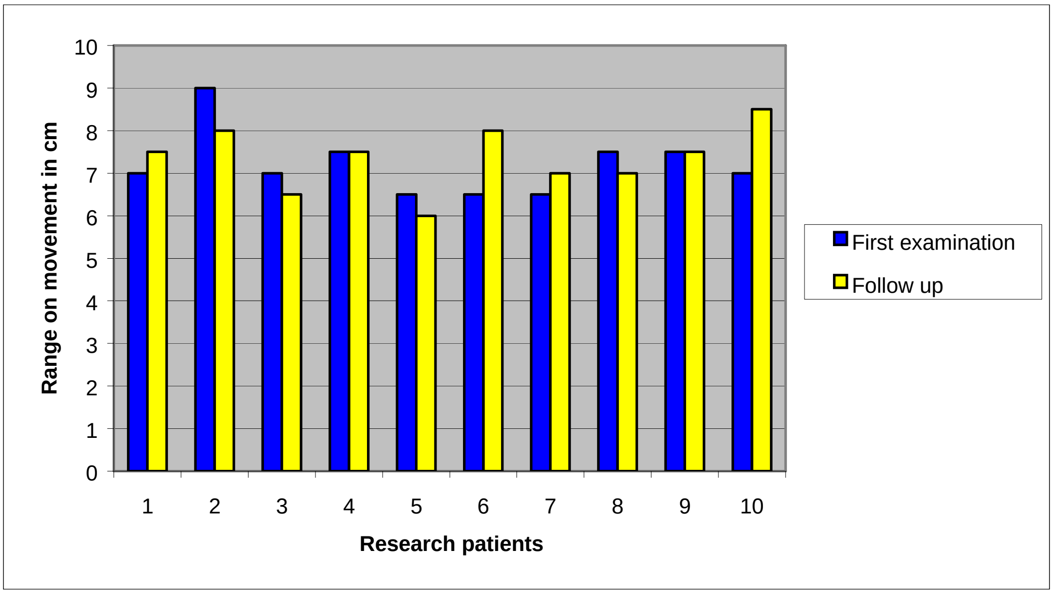
It showed that the range of movement of the children was within the normal scale.

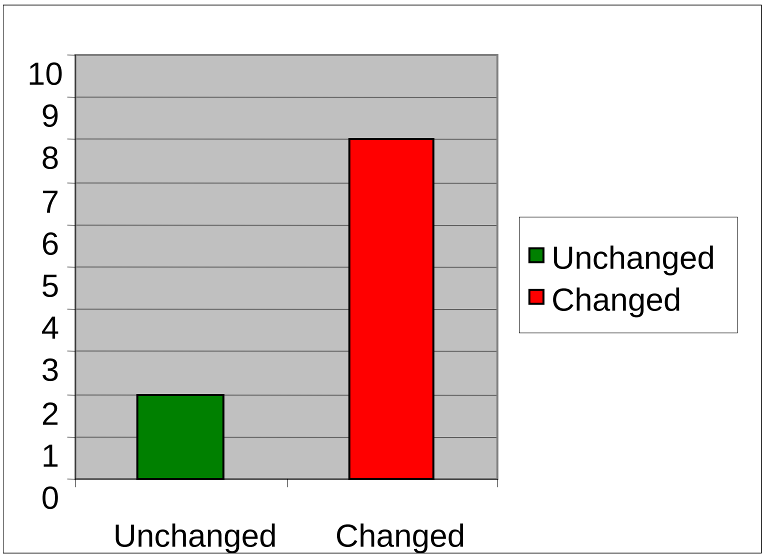
On closer examination of the figures, it was remarkable that only in one child a range of movement of 7,5 cm could be measured on both examinations. In the other nine research patients the range of movement changed from one examination to the other, the range of movement decreasing in seven children and increasing in two.

These measurements showed that a therapeutic orthodontic appliance changes tensions in the cervical and thoracic region in such a way that these changes influence the capability to fold and unfold the thoracic spine.

Schober - sign

Patient	First examination		Follow-up examination		Change	
1	15 / 8	7	15.5 / 8	7.5	0.5	yes
2	15.5 / 6.5	9	15.5 / 7.5	8	-1	yes
3	15 / 8	7	14 / 7.5	6.5	-0.5	yes
4	15.5 / 8	7.5	16 / 8.5	7.5	0	no
5	16 / 9.5	6.5	15.5 / 9.5	6	-0.5	yes
6	15 / 8.5	6.5	16 / 8	8	1.5	yes
7	16 / 9.5	6.5	16.5 / 9.5	7	0.5	yes
8	15.5 / 8	7.5	15 / 8	7	-0.5	yes
9	16 / 8.5	7.5	15.5 / 8	7.5	0	no
10	15 / 8	7	15.5 / 7	8.5	1.5	yes





The figures of total range of movement from maximum extension to maximum flexion on the two examinations were compared with each other, using the Schober sign.

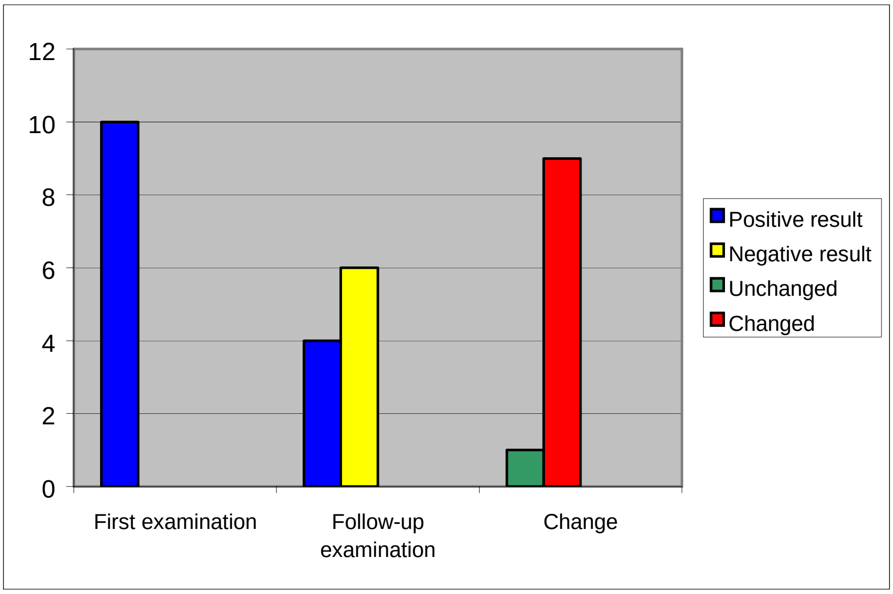
It showed that the range of movement of the children was within the normal scale.

Two out of ten research patients showed the same range of movement both on the first examination and the follow-up examination.

In the other eight children the range of movement changed, the results increased in four children and decreased in four children.

Leg length in supine position

Patient	First examination	Follow-up examination	Change
1	shorter right	NAD	yes
2	shorter left	NAD	yes
3	shorter right	NAD	yes
4	shorter right	shorter right	no
5	shorter right	shorter left	yes
6	shorter right	shorter left	yes
7	shorter right	shorter left	yes
8	shorter right	NAD	yes
9	shorter left	NAD	yes
10	shorter right	NAD	yes



Assessment of leg length was conducted on ten children in supine position with the medial maleoli as point of reference.

Eight of these ten children showed a shorter right leg and two children a shorter left leg.

The results of the eight children presenting a short right leg at baseline changed as follows: In three children a shorter left leg was found, the results of one child remained unchanged and no more difference in leg length could be detected in three children. No difference in leg length could be detected in the two children with the short left leg on the follow-up examination.

Nine parameters changed in comparison to the first examination.

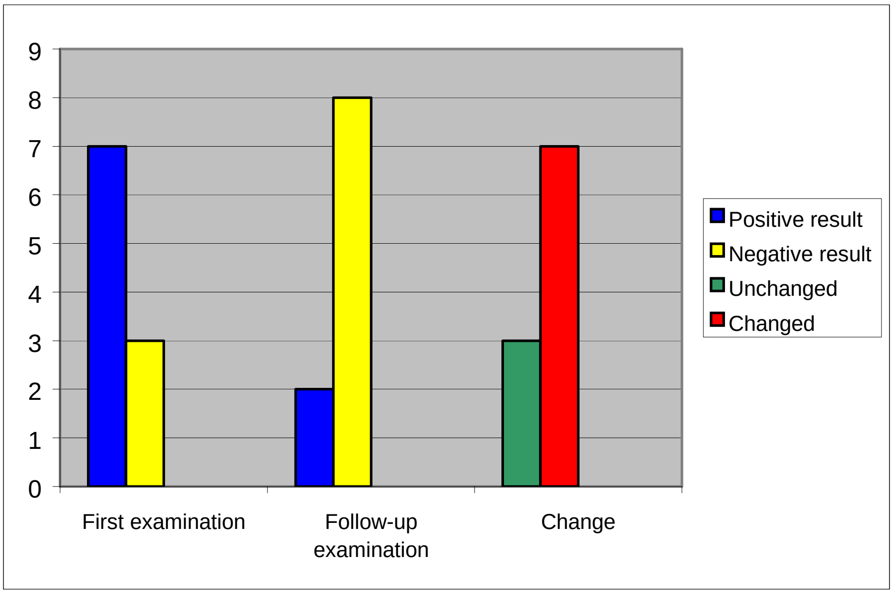
M. trapezius

Patient	First examination	Follow-up examination	Change
1	0 right/ 4 left	NAD	yes
2	4 right/ 0 left	NAD	yes
3	4 right/ 0 left	NAD	yes
4	NAD	NAD	no
5	NAD	0 right/ 4 left	yes
6	NAD	NAD	no
7	0 right/ 4 left	0 right/ 4 left	no
8	4 right/ 3 left	NAD	yes
9	0 right/ 4 left	NAD	yes
10	0 right/ 4 left	NAD	yes

0 = NAD

4 = moderately shortened

3 = significantly shortened



The length of the Mm. trapezii, comparing the two sides, was tested in ten research patients.

On the first examination the muscle on the left was moderately shortened in four research patients.

On the follow-up examination the results of one child remained unchanged, in the other three children no abnormal muscle length could be detected any more.

On the first examination moderate shortening of the M. trapezius on the right was found in two research patients, whereas on the follow-up examination negative results were found for both of them.

At first, one child showed moderate shortening of the muscle on the right and significant shortening of the muscle on the left, but on the follow-up examination no more deviation from standard length could be detected.

In three children no deviation from normal muscle length on the right as well as on the left could be detected, but moderate shortening on the left could be found in one of them on the follow-up examination.

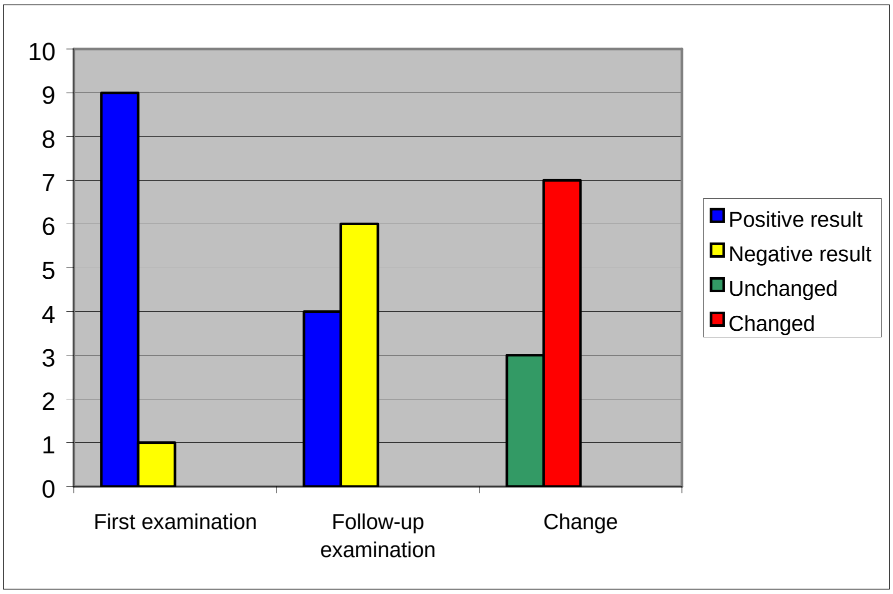
M. iliopsoas

Patient	First examination	Follow-up examination	Change
1	0 right/ 4 left	0 right/ 4 left	no
2	4 right/ 4 left	4 right/ 4 left	no
3	NAD	NAD	no
4	0 right/ 4 left	4 right/ 3 left	yes
5	4 right/ 0 left	NAD	yes
6	4 right/ 3 left	NAD	yes
7	4 right/ 4 left	4 right/ 3 left	yes
8	4 right/ 3 left	NAD	yes
9	4 right/ 4 left	NAD	yes
10	0 right/ 4 left	NAD	yes

0 = NAD

4 = moderately shortened

3 = significantly shortened



On the first examination the muscle on the left was moderately shortened in three children. The results for one of them remained unchanged on the follow-up examination, in one child the results worsened, turning to moderate shortening on the right and significant shortening on the left, whereas the results for the third child showed no more abnormal muscle length.

On the first examination three children showed moderate shortening on the right as well as on the left. The results for one of them remained unchanged on the follow-up examination. One child still showed moderate shortening on the right, but significant shortening on the left, and in one child no more deviation from normal muscle length could be detected.

In two children the first results showed moderate shortening on the right and significant shortening on the left, whereas no abnormalities were detected in both of them on the follow-up examination

On the first examination one child showed moderate shortening on the right, which could not be detected any more on the follow-up examination.

In one child no abnormalities were neither on the first examination nor on the follow-up examination detected.

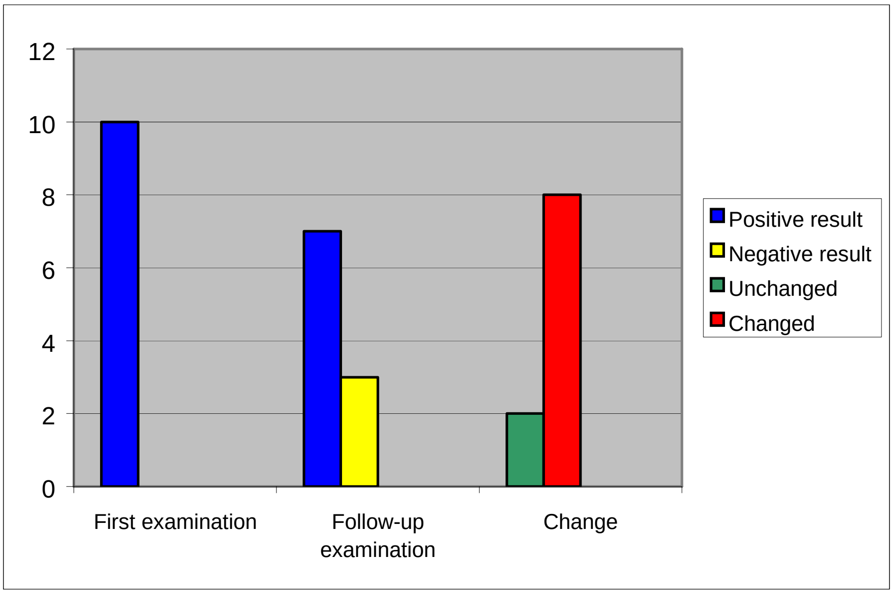
M. ischiocrurales

Patient	First examination	Follow-up examination	Change
1	4 right/ 0 left	4 right/ 4 left	yes
2	4 right/ 0 left	4 right/ 4 left	yes
3	4 right/ 0 left	NAD	yes
4	4 right/ 4 left	3 right/ 3 left	yes
5	4 right/ 0 left	4 right/ 0 left	no
6	3 right/ 4 left	3 right/ 4 left	no
7	3 right/ 4 left	4 right/ 3 left	yes
8	3 right/ 3 left	NAD	yes
9	3 right/ 3 left	3 right/ 4 left	yes
10	4 right/ 0 left	NAD	yes

0 = NAD

4 = moderately shortened

3 = significantly shortened



On the first examination five out of ten research patients showed moderate shortening on the right. The results for one of these remained unchanged on the follow-up examination. In two research patients moderate shortening on the right as well as on the left could be detected on the second examination. In two children no abnormalities were detected on the follow-up examination.

In one child moderate shortening on the right and the left was found on the first examination, which worsened on the follow-up examination, turning to significant shortening on the right and the left.

On the first examination two children showed significant shortening on the right and moderate shortening on the left. The results for one of them remained unchanged on the second examination, whereas in the second child moderate shortening on the right and significant shortening on the left was found.

At first, significant shortening on the right and the left was detected in two research patients. Both results improved on the follow-up examination. One child still showed unchanged results on the right, but only moderate shortening on the left. In the other child deviation from normal muscle length could not be detected anymore.

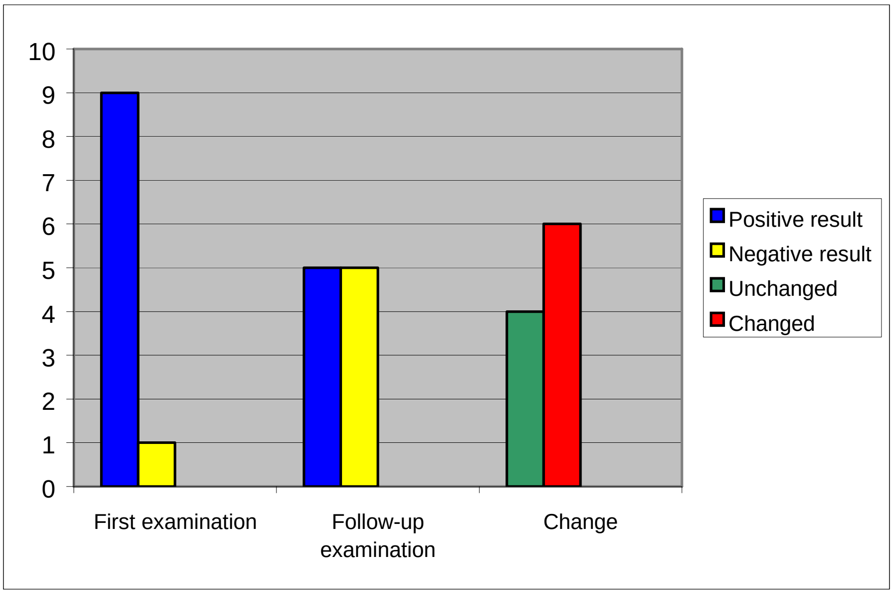
M. rectus femoris

Patient	First examination	Follow-up examination	Change
1	NAD	NAD	no
2	0 right/ 4 left	NAD	yes
3	0 right/ 4 left	NAD	yes
4	0 right/ 4 left	0 right/ 4 left	no
5	4 right/ 0 left	4 right/ 4 left	yes
6	0 right/ 4 left	NAD	yes
7	0 right/ 4 left	4 right/ 3 left	yes
8	4 right/ 4 left	4 right/ 4 left	no
9	4 right/ 4 left	NAD	yes
10	0 right/ 4 left	0 right/ 4 left	no

0 = NAD

4 = moderately shortened

3 = significantly shortened



On the first examination moderate shortening of the muscle on the left was found in six children. The results for two of these six children remained unchanged on the follow-up examination. The results for one worsened, turning to moderate shortening on the right and significant shortening on the left. In three children no abnormalities were detected.

One child showed moderate shortening on the right on the first examination, whereas on the follow-up examination moderate shortening on the right as well as on the left could be detected.

Two children showed moderate shortening on the right and the left on the first examination, the results for one of them remained unchanged on the follow-up examination. In the other child no deviation from normal muscle length could be found.

In one child no abnormalities were detected on the two examinations.

5.2 Summary of the Results

Change	No	Yes	Improved	Worse
Temporomandibular Joint	4	6	6	0
Genu varus/valgus	3	7	7	0
Rotation of the Head	3	7	6	1
Later Flexion of the Head	4	6	6	0
Rotation of the Trunk	3	7	5	2
Sidebending of the Trunk	4	6	5	1
Position of the Scapula	4	6	5	1
Asymmetry of the Waist Triangles	1	9	9	0
Standing Flexion Test	5	5	5	0
Pes varus/valgus	3	7	4	3
Finger-Floor Distance	3	7	4	3
Ott-sign	1	9	2	7
Schober-sign	2	8	4	4
Leg Length in supine Position	1	9	6	3
M. trapezius	3	7	6	1
M. iliopsoas	3	7	5	2
M. ischiocrurales	2	8	3	5
M. rectus femoris	4	6	4	2
Examinated Parameters 180	53	127	92	35

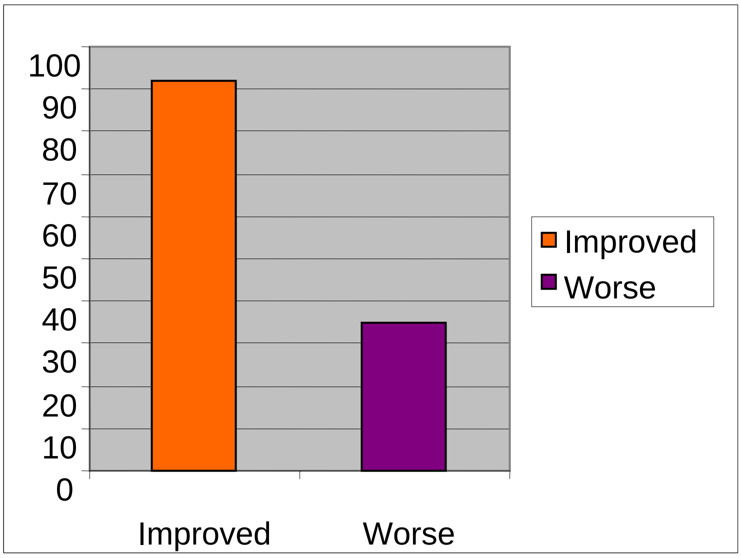
18 Parameters were examined on each of the ten children, which means that we have a total of 180 examined parameters.

On the follow-up examination 14 out of 18 parameters were different in six children when compared to the results of the first examination.

13 changed parameters were detected in one child and 11 changed parameters out of 18 were determined in another child.

Nine of these 18 parameters have changed in two children.

All in all, 127 out the 180 parameters have changed in between the first and the second examination, whereas 53 parameters remained the same.



92 out of these 127 changed parameters have improved whereas 35 of these parameters have gotten worse.

5.3 Interpretation of the Results

Due to the little number of research patients and the absence of a check-up group it was not useful to evaluate the results statistically.

There are several ways to consider these results.

5.3.1 The Individual Parameters of Examination

A tendency of change becomes obvious when you compare the results of each of the 18 parameters of the first examination to the results of the follow-up examination concerning body posture, spine mobility and muscle length.

The parameters concerning asymmetry of the waist triangles, Ott-sign and functional leg length in supine position have changed in nine out of ten research patients.

The Schober-sign and the length of the M. Ischiocrurales have changed in eight research patients.

A change concerning the parameters genu varus/valgus in the knee joint, rotation of the head, rotation of the trunk, pes varus/valgus, finger-floor distance, length of the M. Trapezius and the M. Iliopsoas between the first and the second examination occured in seven research patients.

The mobility of the temporomandibular joint, the later flexion of the head, the side-bending of the trunk, the postion of the scapula in cranial direction and the length of the M. rectus femoris has changed in six research patients.

Only the results of the standing flexion test have changed in five out of ten research patients.

5.3.2 Individual Results of Each Research Patient

It is also interesting to regard each child individually and the change of the 18 parameters between the first examination and the follow-up examination. These parameters influence the spinal mobility, the muscle length and especially the body posture of each individual.

14 out of 18 parameters changed in six children.

13 parameters changed in one child.

11 parameters changed in another child.

Nine parameters changed in 2 children.

These results show that at least half of the parameters have changed in every single child between the first and the follow-up examination. It is obvious that the muscoloskeletal system was considerably influenced by the functional appliance therapy and that the dental treatment has caused a clear change of the indivual body posture of each child.

5.3.3 Summary of All Parameters

When you sum up all 180 parameters and regard the results of the evaluation concerning the change of parameters, you come to the conclusion that 127 parameters have changed between the first and the follow-up examination and 53 remained the same.

The summary of all parameters does also confirm the results of the individual parameters of examination and of the individual research patients. It also becomes obvious that functional appliance therapy influences the musculoskeletal system concerning body posture, spinal mobility and muscle length.

After evaluating the results, it was clear to me that there is an obvious tendency that functional appliance therapy influences the body posture.

Therefore I asked myself another interesting question:

Does functional appliance therapy affect the body posture in a positive way (that means the body posture becomes more symmetric) or in a negative way (that means that the asymmetry becomes more intense)?

To answer that question it was necessary to find out whether the parameters have improved or if they got worse.

The evaluation of the 127 changed parameters showed that 92 parameters improved and 53 of these parameters got worse.

These results show that the majority (72,44%) of the changed parameters have improved whereas ca. 27,56% of the parameters got worse.

Due to the dental diagnosis and the same criteria at the first and the follow-up osteopathic examination it is not understandable why the parameters have improved as well as gotten worse.

These different results would confirm the hypothesis of the ascending and descending chains of dysfunctions as described in osteopathy.

If dysgnathy causes a descending chain of dysfunctions in the musculoskeletal system, then treatment with a functional appliance therapy will influence the examined parameters and therefore the body posture in a positive way.

But if the dysfunction is located in the musculoskeletal system, then it could cause a reflectory change in the three-dimensional position of the mandible.

During an orthodontic treatment it is only the compensation of the body that is treated, not the primary lesion (ascending chain of dysfunctions). Therefore it is possible that the examined parameters and the body posture change in a negative way during orthodontic therapy.

6 OUTLOOK

An analysis of this study shows considerable improvement of the evaluated parameters. There is a clear tendency that treatment with functional appliance therapy influences the body posture, the spinal mobility and the muscle length. The range of only 10 research patients is too small, however, to establish general validity. It would therefore be interesting to test this approach in a large-scale study. More research patients and a larger timeframe would be necessary. This could lead to better co-ordination between orthodontists and osteopaths. When the body is considered an organism that functions as a unit, the indication of treatments can be more exactly specified. This way the beneficial effects of treatment on the patient could be improved considerably. It would also be interesting to regard the ascending and descending chains of dysfunctions in a study. In order to figure out the most appropriate treatment it is suggestive to look for the primary dysfunction. Is the problem an ascending chain of dysfunctions (primary dysfunction is located in the musculoskeletal system) then it is necessary that the patient receives at first osteopathic treatment, in spite of the orthodontic diagnosis. Dealing with a descending chain of dysfunctions (primary lesion is located in the stomatognathic system) it is necessary to begin with the orthodontic therapy and to consider the osteopathy as an additional therapy. This approach would lead to a notable improvement of the patient’s results. In the future it will be necessary to consider the human body as one unit and to perform an interdisciplinary approach to the problem but unattached to the symptom.

7 DISCUSSION

Discussions started in the mid-20th century whether there is an interaction between the two disciplines of orthodontics and orthopaedics.

Due to the experiences in my practice I questioned myself too if there is an interaction between the stomatognathic system and spine. If there was, then osteopathic results must be influenced by an orthodontic therapy.

The results of my study have shown clearly that dysfunctions in the stomatognathic system influence the musculoskeletal system. The study showed that fitting a functional orthodontic appliance influenced the postural pattern, the mobility of the spinal column and muscle length.

In spite of the lack of reliability of the manual-diagnostic orthopaedic methodology, a clear tendency becomes obvious.

I did not just question myself whether there is a change or not, but also if the change affects the musculoskeletal system in a positive or in a negative way.

I noticed that the correction of a dysgnathic disorder did mainly lead to an improvement of the parameters, but to a slight extent it also led to a decline of the parameters of examination.

One reason could be that not only the pain is lying, as *Wühr*[52] writes in his book, but that the symptom is lying too and that due to the intense interconnections within the body dysfunctions in any system of the body can affect other systems too.

These results would confirm the hypothesis of the ascending and descending dysfunctions that are described in osteopathy. This means that dysfunctions in the musculofascial system can also lead to functional disorders of the stomatognathic system. The results of this study showed that influencing occlusion led to a worsening of the evaluated parameters.

The results of this study demonstrate that we can not look at the stomathognathic system in isolation without considering the rest of the organism. Any malocclusion can cause a multitude of dysfunctions in the body, correspondent to the stomatognathic system‘s representation in the brain. These phenomena have also been noticed, however, the other way round. The stomatognathic system and the musculoskeletal system mutually influence each other through the varied interconnections of our body. The statement by *Prof. J. Rohen*[40], that the stomatognathic system is interconnected with the entire body with the nervous system, and that the N. trigeminus is the one nerve that even has the most intense connections with the other nerves, supports this theory.

Schöttl[47] tries to explain these interactions very understandable: “This interaction is described in the American patient journal Myodata, which was mentioned above, not scientifically exact but in a very demonstrative way:

“We can compare our body posture with a very sensitive, balanced mobile. The change of one part of the mobile influences the other parts. To maintain an equation of the whole unit it is necessary that all individual parts reorganize. When your teeth do not fit together in an exact way then usually an equalization effect occurs that implies the entire body posture.” [Schöttl, p. 99].

Therefore the stomatognathic system can be regarded as one part of the musculoskeletal system and thus also as one part of the entire body posture.

Furthermore, the stomatognathic system is interconnected through the nervous system with the rest of the body as the trigeminal nerve is the cranial nerve with the most intense interrelations with the other nerves of the body.

Dr. P.-H. Ridder[39] has stated in his study that malocclusion can lead to abnormal signals, conducted by the trigeminal nerve. As the nerve fibres have no synapse in the trigeminal ganglion, the signals directly reach the Nucleus mesenzephalicus, which forms a huge network.

Considering these varied interconnections, we must necessarily adhere to holistic thinking and treatment. It is not possible to look at the stomatognathic system without regarding the rest of the body.

Other authors have dealt with this subject, too, and all of them have come to similar results.

G. Plato and S. Kopp[34], after 10 years of studies, have stated that „chronic pain syndromes, such as chronic headache, atypical facial pain, but also pain in the area of the pelvic diaphragm can be caused and maintained by dysfunctions of the craniomandibular system". [Plato and Kopp, p. 150].

They have come to the conclusion that, vice versa, pain syndromes in the musculoskeletal system can cause dysfunctions of the temporomandibular joints, the entire craniomandibular system, or occlusion.

The orthopedist *P.H. Ridder*[39] asked himself whether problems in the area of the temporomandibular joints or malalignment of a tooth could be responsible for disorders or pathologic changes in the periphery. His study has confirmed that disorders in the area of the temporomandibular joints or malalignment of a tooth can lead to various complaints in the body periphery.

According to some studies on musicians by *Dr. Götz Methfessel*[52], a high percentage of violinists and viola players complain about undifferentiated symptoms in the area of the „dental apparatus", especially regarding the functioning of the temporomandibular joints and occlusion. Other causes mentioned are phenomena partly caused by posture, as for example non-compensated deformity of the teeth, primary lesions in the area of the cervical spine, scoliothic pelvis, differences in leg length, etc.

Japanese scientists[39] used tests on animals to investigate the significance of changes in the stomatognathic system to the body periphery.

Maehara[39] shortened the dextral teeth of rats. He detected a compensatory curvature of the spinal column (skoliosis) and different sizes of the right and the left eye.

Then he shortened the teeth of beagles. The results were bad posture, changes of the fur, watery eyes and cataracts.

Then *Maehara and Hashimoto*[39] shortened some teeth of monkeys. They observed that the monkeys lost hair, were showing abnormal behaviour and their tongues turned bow-shaped. Later the scientists fitted a stencil-like splint to restore the former length of the teeth. This led to growing hair, a normal behaviour of the monkeys and straightening of their tongues.

We can conclude from these results that a change in the jaw's position leads to changes in the motor and autonomic nervous system.

By using three-dimensional measurements, a team around *Kopp*[34] could prove that immediately after manipulating the cranial articulations the position of the condyles shifted within a range of a few millimetres. In further examinations using the same measuring method it could be proved that after relaxing the sacroiliac joints and the pelvic floor, the suspended resting position of the mandible and, consequently, occlusion changed.

Frymann[11] also wrote that dysfunctions of the temporomandibular joints can cause several local symptoms such as, for example, malocclusion, abnormal movement in the temporomandibular joint, etc. She also detected, however, that in a great number of patients the symptoms can occur anywhere in the body.

Even though the connection between function and statics of the stomatognathic system and the body posture has been a favoured topic of discussion since the fifties due to the anatomical closeness of the cervical spine to the muscular interrelationship between the neck muscles and the stomatognathic system, it was in 2003 when it was proven that the functional state of the stomatognathic system influences the functionality of the cervical spine, as it is described in *Kopp et al.*[24].

Korbmacher et al.[25] concentrated in a literature survey on the issue of interactions between non-compensated deformity of the teeth and dysfunctions of the musculoskeletal system and have come to the conclusion that there is an obvious prevalence of pathologic orthopaedic results concerning patients with orthodontic disorders described in literature.

74 percent of the patients who were examined by *Dußler et al.*[8] showed pathologic orthopaedic results.

91,5 percent of the patients who were examined by *Hirschfeld & Hirschfelder*[15] had orthodontic disorders.

Prager[36] noticed an eugnathic jaw in only 13 percent of his orthopaedic patients.

Despite of the various descriptions by several authors and several publications in literature concerning the interrelation between functional disorders of the stomatognathic system and the other systems, especially the musculoskeletal system, this knowledge has still not become common use in practice.

Due to this cognition the dental medicine must give up the concept according to which the relative position of the jaws merely influences the immediately adjoining structures, such as the maxilla, the mandible, and the teeth.

In order to gain therapeutical success in the future, it is indispensible to look at the stomatognathic system as part of the whole organism and, apart from orthodontists, include osteopaths in the plan of therapy, too.

I would like to conclude my observations with a sentence by *Wühr*[54] which describes future dental medicine: " If we stop looking at and treating the stomathognathic system as isolated from the rest of the organism, and every indvidual as isolated from his/her environment, we will be able to satisfy our patients' needs in an even better way." [Wühr, p.49].

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10 APPENDIX

10.1 Appendix I

ORTHODONTIC STATUS

Name: Date of birth:

Day of DIAGNOSIS: Alter:

Medical history

☐ Family history ☐ Allergies ☐ Menarche

State of health:

Medications: Others:

Diagnosis

Skeletal: Maxilla: Mandible: Growth Tendency:

Dental: Angle Class II PMB 1 Angle Class II PMB 1 Angle Class II PMB Angle Class II PMB

Wide standing teeth, maxilla: mm with mm to frontal plane Overbite: mm

Narrow standing teeth, mandible: mm with mm to frontal plane Overjet: mm

Photo:

Transversal Cranial Radiography:

WS: **SNA:** **SNB:** **Upper Inc.:** **Lower Inc.:** **Wits:**

Myofunction: impaired nasal breathing:	☐	Tongue:	
infantile swallowing pattern:	☐	oversized:	☐
closure of the lips:	☐	caudal position:	☐

Therapy:

Objective of therapy:

1.

2.

3.

Plan of therapy:

☐ Extraction

Therapy:

Period of application (day/night):

Logopaedia:

Oral hygiene:

10.2 Appendix II

OSTEOPATHIC EXAMINATION FORM I

SURNAME FIRST NAME ☐M ☐F

ADDRESS Phone.:

Date of birth: Age:

Brothers or sisters:

DIAGNOSIS:

Other current symptoms:

Did any problems occur during pregnancy or birth?

Has any special disease been diagnosed in your child?

Was your child breastfed? How long?
☐ YES ☐ NO

First loss of a tooth:

Medical history:

Accidents:

Diseases:

Operations:

Current medications and therapies:

Family history:

Anterior inspection in standing position

Temporomandibular joint:	Deviation:	☐ right ☐ left
Leg axis:	Genu varum:	☐ right ☐ left ☐ NAD
	Genu valgus:	☐ right ☐ left ☐ NAD

Posterior inspection in standing position

Cervical spine:	Restricted rotation of the head:	☐ right ☐ left ☐ NAD
	Restricted lateral flexion of the head:	☐ right ☐ left ☐ NAD
Thoracic spine:	Restricted rotation of the trunk:	☐ right ☐ left ☐ NAD
	Sidebending of the trunk:	right: cm distance to the floor
		left: cm distance to the floor
Scapulae:	Evaluation of the scapula's position in cranial direction:	☐ right ☐ left ☐ NAD
	Asymmetry of the waist triangles:	☐ pos. ☐ NAD
Sacro-iliac articulation:	Forward bending:	☐ right ☐ left ☐ NAD
Foot	Pes varum:	☐ right ☐ left ☐ NAD
	Pes valgum:	☐ right ☐ left ☐ NAD

Flexion:	Restricted / Distance finger – floor (cm)	Palm on the floor: ☐ YES ☐ NO
Ott sign (30 cm downward of C7):	Flex.: cm	
	Ext.: cm	
Schober sign (10 cm upward of S1):	Flex.: cm	
	Ext.: cm	

Supine position

Leg length:	right leg: ☐ longer ☐ shorter ☐ NAD

Muscle tests

Shortening:	M. trapezius	right:	left:
	M. illiopsoas	right:	left:
	M. ischiocrurales	right:	left:
	M. rectus femoris	right:	left:
	0 NAD 3 significantly shortened 4 moderately shortened		

10.3 Appendix III

OSTEOPATHIC EXAMINATION FORM II

SURNAME FIRST NAME ☐M
☐F

DIAGNOSIS:

Angle class II division 1 malocclusion

FUNCTIONAL ORTHODONTIC APPLIANCE SINCE:

Other current symptoms:

CLINICAL FUNCTIONAL STATUS OF THE MUSCULOSKELETAL SYSTEM

Anterior inspection in standing position

Temporomandibular joint:	Deviation:	☐NAD ☐ right: ☐ worse ☐ unchanged ☐ improved ☐ left: ☐worse ☐unchanged ☐ improved
Leg axis:	Genu varum:	☐NAD ☐ right: ☐ worse ☐ unchanged ☐ improved ☐ left: ☐ worse ☐ unchanged ☐ improved
	Genu valgus:	☐ NAD ☐ right: ☐ worse ☐ unchanged ☐ improved ☐ left: ☐ worse ☐ unchanged ☐ improved

Posterior inspection in standing position

Cervical spine:	Restricted rotation of the head: ☐ NAD ☐ right: ☐ worse ☐ unchanged ☐ improved ☐ left: ☐ worse ☐ unchanged ☐ improved	Restricted lateral flexion of the head: ☐ NAD ☐ right: ☐ worse ☐ unchanged ☐ improved ☐ left: ☐ worse ☐ unchanged ☐ improved

Thoracic spine:	Restricted rotation of the trunk: ☐ NAD ☐ right: ☐ worse ☐ unchanged ☐ improved ☐ left: ☐ worse ☐ unchanged ☐ improved
	Sidebending of the trunk: right: cm distance to the floor left: cm distance to the floor

Scapulae:	Evaluation of the scapula's position in cranial direction: ☐ NAD ☐ right: ☐ worse ☐ unchanged ☐ improved ☐ left: ☐ worse ☐ unchanged ☐ improved
	Asymmetry of the waist triangles: ☐ NAD ☐ worse ☐ unchanged ☐ improved
Sacro-iliac articulation:	Forward bending: ☐ right ☐ left ☐ NAD
Foot:	Pes varus: ☐ NAD ☐ right: ☐ worse ☐ unchanged ☐ improved ☐ left: ☐ worse ☐ nchanged ☐ improved

	Pes valgus: ☐ NAD ☐ right: ☐ worse ☐ unchanged ☐ improved ☐ left: ☐ worse ☐ unchanged ☐ improved	
Flexion:	Restricted / Distance finger - floor (cm)	Palm on the floor: ☐ YES ☐ NO
Ott-sign (30 cm downward of C7):	Flex.: cm Ext.: cm	
Schober-sign (10 cm upward of S1):	Flex.: cm Ext.: cm	

Supine position

Leg length:	right leg: ☐ longer ☐ shorter ☐ NAD

Muscle tests

Shortening:	M. trapezius	right:	left:
	M. illiopsoas	right:	left:
	M. ischiocrurales	right:	left:
	M. rectus femoris	right:	left:
	0 NAD 3 significantly shortened 4 moderately shortened		