1. Introduction and Hypotheses

Ear infections are the most frequent reasons for children's medical consultations. According to investigations by Austrian, German and US unions of ENT specialists, one child out of three develops an accumulation of fluid in the middle ear, which predisposes the child to repeated ear infections. One complication of ear infections which ought not to be underestimated is a remaining hearing disorder, which may lead to loss of hearing. Delayed development of speech may also be expected.

In literature numerous causes for the frequency of ear infections with children are found. Mentioned is the immaturity of the immunologic system, which creates an ear infection as complication of a small child's cold, nutritional sensibilities, resp. incompatibility of certain substances as well as connections with tooth regulations. Injuries in the head- and face area either in the moment of birth or during early childhood are also considered as a frequent predisposing factor.

Fluid in the middle ear constitutes a good culture medium for germs which may provoke an acute infection.

The classical treatment of ear infections is a dose of antibiotics. If there is still fluid in the middle ear after infection signs have subsided, antibiotics are often preventively prescribed in low dose for a long period. Surgical treatments are the paracentese (tympanotomy), and in case of very viscous secretion the insertion of a tympanic cavity wash tube in order to enable drainage via the tympanic membrane.

An anatomic factor, too, is responsible for the frequency of ear infections with small children. The auditory tube has an almost horizontal course with a child below the age of four, while with elder children and adults the tube is descending to the pharynx. This may aggravate the drainage out of the tympanic cavity.

The auditory tube is also very essential for the reflections towards my thesis. For me, it represents a central part for the fluid accumulation in the middle ear. Accordingly, I have set up the following working hypothesis, stated theoretical reasons for them and verified them in the practical part.

Hypothesis 1:

Otitis media is the result of a reduced drainage out of the tympanic cavity via the auditory tube → Otitis media with effusion (seromukotympanum). This reduced drainage is reflected in changes of the tympanogram and the audiogram.

Hypothesis 2:

Individual osteopathic treatment results in improved drainage from the tympanic cavity. This improvement is shown in tympanogram and audiogram with a group of subjects with otitis media with effusion.

2. Theory

In this part of my thesis I have described anatomy, functions, pathophysiology of otitis media with effusion and osteopathic connections, particularly the auditory tube as central element.

2.1. Anatomy of the Middle Ear [1, 31, 33, 36, 41, 42, 48]

The middle ear, *auris media*, is a cavity system in the petrous portion of the temporal bone. It is separated from the external ear via the tympanic membrane, *membrana tympanica*. The middle ear has mucous lining and contains of the tympanic cavity, *cavum tympani (tympanum)*, the auditory ossicles, *ossicula auditus*, having the function to transmit the sound waves from the tympanic membrane to the labyrinth system in the inner ear; and the auditory tube, *Eustachian tube, tuba auditiva* – being the connection to the pharynx. The tympanic cavity has a further connection to a cavity system – towards dorsum to the mastoid cells, *cellulae mastoideae* in the mastoid process, *processus mastoideus*.

2.1.1. **Tympanic Cavitiy**, *Cavum Tympani*

The tympanic cavity has 15mm length, 15mm width, 3 – 6mm height and is shaped like a flat box. The thin, vascular mucous membrane consists of a simple cubical epithelium.

The tympanic cavity is divided into three layers. Above the tympanic membrane there is the *epitympanon*, the upper tympanum. *Mesotympanon*, the middle tympanum, is on the same level as the tympanic membrane. *Hypotympanon*, the lower tympanum, lies below the tympanic membrane.

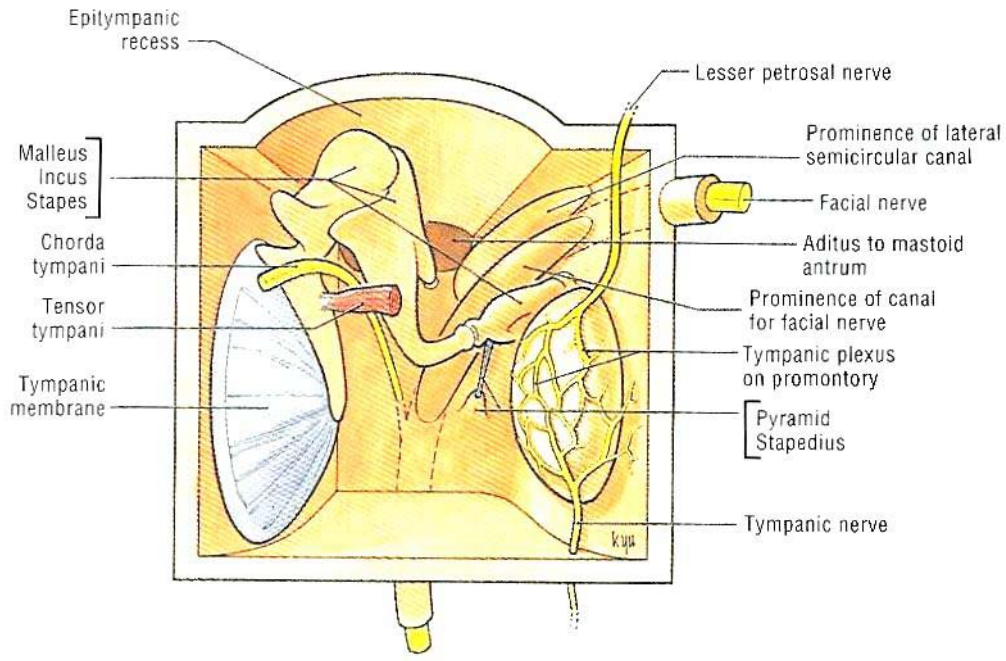


Illustration 1. Walls of the tympanic cavity (Agur 1991)

The tympanic cavity is limited by six walls:

The lateral wall, *paries membranaceus*, is formed by the tympanic membrane and the surrounding bone ring as demarcation from the external auditory canal. The tympanic membrane is framed cranially by *pars horizontalis* of *squama temporalis* and ventrally by *os tympanicum* and partly by the temporal bone. Between the upper border of os tympanicum and the roof of the tympanic cavity there is a cleft, which is filled with connective tissue, the petrotympanic fissure, *fissura Glaseri*. Here *ligamentum mallei anterior* and *chorda tympani* exit out of the tympanic cavity and *arteria tympanica anterior* enters the tympanic cavity.

The floor of the tympanic cavity, *paries iugularis,* is formed by *facies basalis pyramidalis* of the petrous portion of the temporale bone as demarcation of *fossa iugularis,* which contains the *bulbus superior of internal iugularis vein*. According to the size of the bulbus the wall can be thin like paper – big bulbus – or thick up to 1cm. In case of a very thin wall otitis media may easily spread to the iugularis vein. At the connection between *paries iugularis* to the dorsal wall, there is the *prominentia styloidea*, the upper end of *styloid process*. *Nervus tympanicus* und *arteria tympanica inferior* pass through the floor of the tympanic cavity.

The roof, *tegmen tympani*, *paries tegmentalis,* outlines the tympanic cavity from the middle cranial fossa. It is formed by *lamina tegmentalis* of the petrous portion. Between *tegmen*

tympani and *pars horizontalis* of the *temporale squama fissura petrosquamosa* is located – with a child the *petrosquamous suture*. Via this fissure infections can be transmitted out of the tympanic cavity on the meninx and the temporal lobe of the brain. Through *fissura petrosquamosa* there course the *arteria tympanica superior* into and some tympanic veins out of the tympanic cavity.

The dorsal wall, *paries mastoideus*, serves as demarcation to *cellulae mastoideae*. The upper part opens into the *antrum mastoideum*, a roundish space which the auriferous *mastoid cells* with muculous lining end into. *Musculus stapedius* arises in the dorsal wall.

The anterior wall, *paries caroticus*, forms the demarcation to *canalis caroticus*. Here *epi- and mesotympanum* change into *canalis musculotubarius*. *Septum canalis musculotubarius* divides the canal into two parts – the superior *semicanalis m. tensoris tympani*, containing *musculus tensor tympani*, and the below lying *semicanalis tubae auditivae*, representing the osseous part of the auditory tube. The opening of the auditory tube into the tympanic cavity is *ostium tympanicum tubae* and is situated in the geniculated area of *arteria carotis interna*.

The medial wall, *paries labyrinthicus*, separates the middle ear from the inner ear. In this wall there are the *promontorium*, a bulging by the inferior spiral canal of the cochlea, *fenestra vestibuli* which is closed by the base of *stapes*, *fenestra cochlea* – closed by *membrana tympanica secundaria* – and *processus cochleariformis*, a cochlear process representing the exit and turning point for *musculus tensor tympani*.

Almost all **arteries** of the tympanic cavity are branches of *arteria carotis externa*:

Arteria tympanica superior, out of *arteria meningea media* → epitympanon.

Arteria tympanica inferior, out of *arteria pharyngea ascendens* → floor of tympanic cavity

Arteria tympanica anterior, out of *arteria maxillaris* → area of tubal orifice

Arteria tympanica posterior, out of *arteria stylomastoidea* → dorsal section of tympanic cavity.

Arteriae caroticotympanicae reach out of *arteria carotis interna* to the mucous membrane of the tympanic cavity.

The **veins** of the tympanic cavity, *venae tympanicae*, flow into *vena retromandibularis* and further into *vena iugularis externa*.

Regional **lymphatic nodes** are *nodi lymphatici mastoidei, nodi lymphatici parotidei superficiales, nodi lymphatici parotidei profundi (nodi lympahtici pre-auriculares, nodi lymphatici infra-auriculares)* and *nodi lymphatici retropharyngeales*.

Innervation of the middle ear is effected via *nervus tympanicus* and *nervus facialis-intermedius:*

Nervus tympanicus is a parasympathetic branch of *nervus glossopharyngeus (IX.)* which carries also sensitive fibres for the mucous membrane supply of the tympanic cavity with it.

Nervus facialis (VII.) courses in the tympanic cavity's area in the medial wall above the oval window. There is only a thin bony layer. In the following part *nervus facialis* runs in solid bone, in mastoid. Here a branch of the facial nerve, *nervus stapedius*, gives off for motor innervations of *musculus stapedius* and *chorda tympani*. *Chorda tympani* consists of fibres of nervus intermedius – the non motor section of the facial nerve. It enters the tympanic cavity dorsally, courses towards the front between incudal limb and the handle of malleus. Chorda tympani leaves the tympanic cavity through Glaser's fissure into the lateral pharynx.

2.1.2. **Auditory Ossicles**, *Ossicula Auditus*

The auditory ossicles, *malleus*, *incus* and *stapes*, are tightly connected to each other having the task to transmit the sound waves from the tympanic membrane to the inner ear.

From an ontogenetic view malleus and incus develop from the first and stapes from the second pharyngeal arch. All three auditory ossicles are disposed cartilaginous.

The **malleus** is clavately, it consists of head, neck, handle and two processes. *Caput mallei* is almost globular and lies in the epitympanum. *Collum mallei* lies behind *pars flaccida* of the tympanic membrane. Head and neck are opposite to the *manubrium mallei* bent approximately 130° towards inside. The lower edge of the handle is spatulate, it forms the *umbo* in the tympanic membrane. The exterior edge of the handle, *processus lateralis*, is united with the tympanic membrane. *Processus anterior* is connected with the petrotympanic fissure by ligamentous fibres.

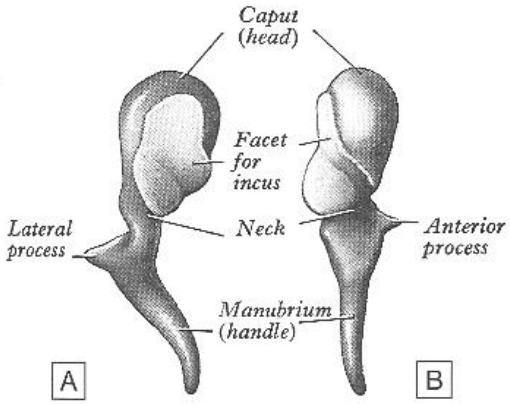


Illustration 2. Left malleus. A. dorsal aspect. B. medial aspect (Williams 1989)

The **incus** consists of *corpus incudis* – lying in the epitympanum and having at the anterior side a saddle-shaped articular surface for articulation with the head of the malleus – and two crura. The short *crus breve* is cone-shaped and horizontally directed dorsal. Its tip is covered with cartilage and fastened at *fossa incudis* by *ligamentum incudis posterius*. *Crus longum* has its course parallel with the manubrium mallei. At the lower side *crus longum* is bent rectangular into the labyrinth, forming here *processus lenticularis* with an umbonate bulb at the end for articulation with the stapes.

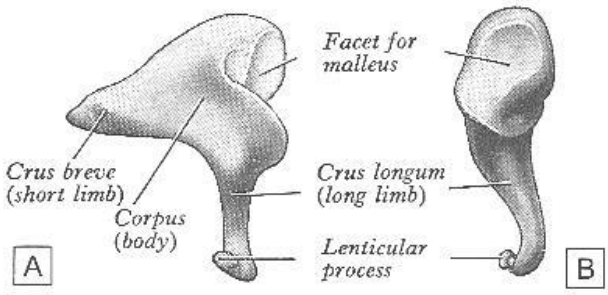


Illustration 3. Left incus. A. medial aspect. B. anterior aspect (Williams 1989)

Stapes is situated almost horizontally and consists of a base, two crura and a head. *Basis stapedis* is reniform, the upper edge is convex and the lower concave. *Crus anterior* is almost straight while *crus posterior* is longer and bent. *Caput stapedis* is square. On the exterior side there is the concave articular surface for the articulation with the incus.

Between the two crura and the base *arteria stapedia* courses during the early embryological development, later on the hole is covered by *membrana stapedia*.

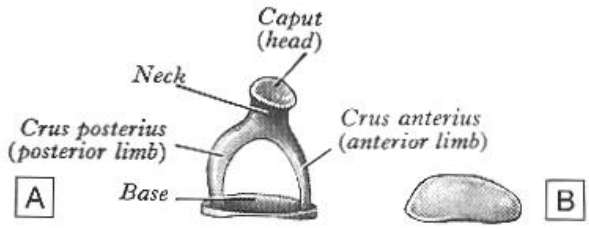
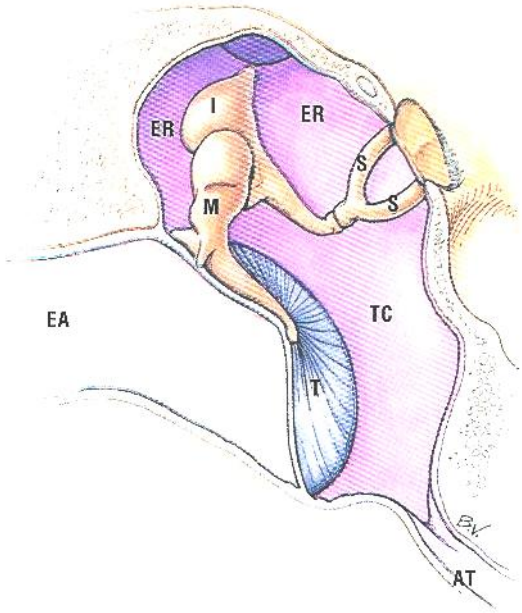


Illustration 4. Left stapes. A. superior aspect. B. basal aspect (Williams 1989)

Connections of the Auditory Ossicles:

The auditory ossicles are articulated with each other, with the wall of the tympanic cavity by ligaments. There is a fibrous joint between the base of the stapes and the connection to the inner ear.



M	Malleus
I	Incus
S	Stapes
EA	External acoustic meatus
T	Tympanic membrane
TC	Tympanic cavity
ER	Epitympanic recess
AT	Auditory tube

Illustration 5. Position of auditory ossicles, frontal section (Agur 1991)

The incudostapedial joint, *articulatio incudostapedia*, a spheroid joint, and the incudomalleolar joint, *articulatio incudomalleolaris*, a saddle joint with cartilaginous covering and thick and tight capsule, are reckoned among the joints.

The ligaments which are the connection to the tympanic cavity are *ligamentum mallei anterius*, connecting the malleus with the petrotympanic fissure, *ligamentum mallei laterale, ligamentum incudis posterius, ligamentum mallei superius and ligamentum incudis superius.*

Ligamentum anulare stapedis connects the cartilage coated basis of the stapes with the cartilage coated frame of *fenestra vestibuli*. The ligament consists mainly of elastic fibres and forms *syndesmosis tympanostapedia*.

There is a tight connection to the tympanic membrane via *manubrium mallei* and *processus lateralis mallei*.

Muscles of the ossicles chain are: *musculus tensor tympani* and *musculus stapedius*

MUSCULUS TENSOR TYMPANI arises from the cartilage of the pharyngotympanic tube, from the apex of the pyramid and from the superior wall of *semicanalis m. tensoris tympani*. The round tendon courses through the tympanic cavity and joins to the upper end of the handle of the malleus. Musculus tensor tympani uses *processus cochleaformis* of the tympanic cavity's wall as a hypomochlion and pulls the handle of the malleus inside, thus the tympanic membrane is stretched.

MUSCULUS STAPEDIUS, the smallest skeletal muscle of the body is 7mm long and double feathery. His origin is in the posterior wall of the tympanic cavity. The tendon has an anterior, lateral and cranial course towards the stapes and it inserts at *crus posterior stapedis*. The muscular tract is directed dorsal. Contraction of the muscle leads to a tilting movement of the basis of stapes, i.e. the posterior part is pressed into the *fenestra vestibule* and thus the *ligamentum anulare stapedis* is stretched, this means a reduction of the sound transmission to the inner ear.

Musculus tensor tympani is innervated by *nervus pterygoideus medialis*, a branch of *nervus mandibularis (cranial nerve V3)*, while *musculus stapedius* gets its innervation out of *ramus stapedius nervi facialis (cranial nerve VII).*

Both muscles fulfill two functions. On the one hand they keep the auditory ossicles in good tonicity, thus offering an optimum sound transmission. On the other hand they decrease the range of motion of the auditory ossicles and thereby protect the labyrinth from too strong load by a big sound.

2.1.3. **Tympanic Membrane**, *Membrana Tympanica*

The tympanic membrane forms the lateral wall of the tympanic cavity and separates it from the external auditory meatus. It is a thin, semitransparent, oval membrane which is adjusted to the floor of the tympanic cavity with an angle of 55°. The long anterior-inferior diameter measures 9-10 mm, the short one 8-9 mm.

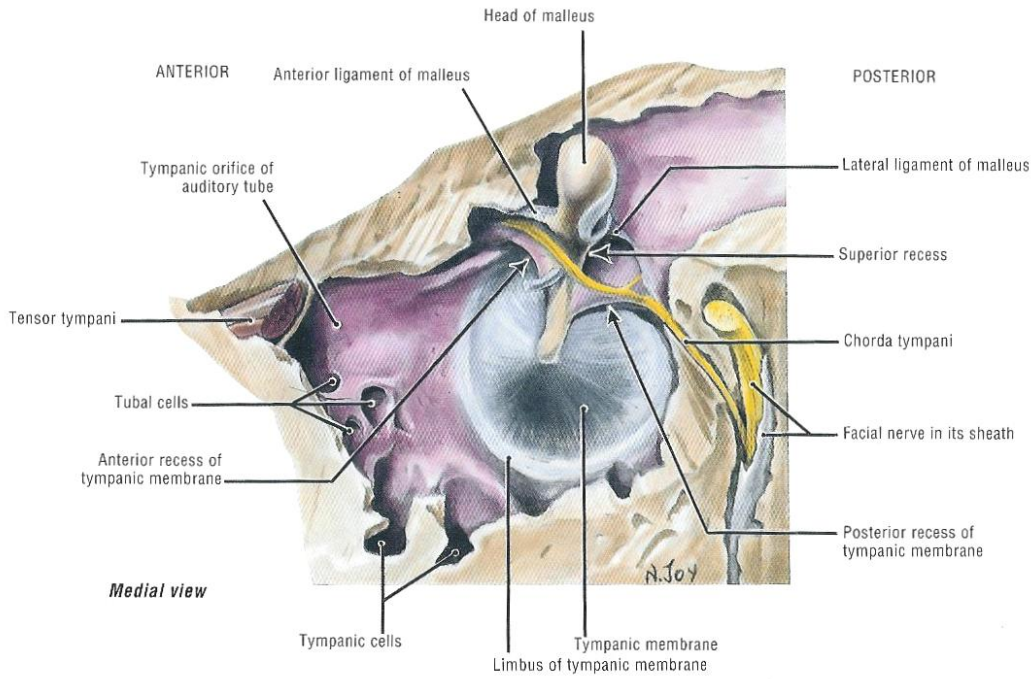


Illustration 6. Lateral wall of the tympanic cavity with the oval tympanic membrane (Agur 1991)

The tympanic membrane is surrounded by a thickened edge of fibrous cartilage, *anulus fibrosus*, which lies in the osseous *sulcus tympanicus*. In the superior part of the sulcus there is the small triangular *pars flaccida* – the thin and lax part of the tympanic membrane.

The far bigger part takes the *pars tensa* – the inferior and stretched part. Here the handle of the malleus is attached to the tympanic membrane.

The whole tympanic membrane is convex towards media, inserting fibres have a concave course upwards.

Pars tensa consists of three layers – an epithelial layer in the external auditory meatus, a fibrous layer, *lamina propria*, with radiate fibres directed towards the auditory meatus (*stratum radiatium*) and mucous layer directed towards the tympanic cavity, *lamina mucosa*, with circular fibres.

The **arterial supply** is affected via the branches of *arteria maxillaris*.

The superficial **veins** drain via *vena iugularis externa*, the low veins partly via *sinus transverses* and *meningeal veins* and partly via the *veins of the auditory tube*.

Innervation is given by *ramus auriculotemporalis of nervus mandibularis (cranial nerve V3)*, the *ramus auricularis of nervus vagus (cranial nerve X.)*, the *ramus tympanicus of nervus glossopharyngeus (cranial nerve IX.)* and probably also by *nervus facialis (cranial nerve VII.)*.

2.1.4. **Auditory Tube**, *Tuba Auditiva*

The auditory tube, *tuba pharyngotympanica Eustachii*, connects the tympanic cavity with the nasopharyngeal space. It has the function to care for pressure compensation between the tympanic cavity and the external auditory meatus. In addition, the auditory tube ensures the secretion drainage out of the tympanic cavity into the pharynx.

Tuba auditiva of an adult has a length of 4 cm and a course from dorsal-cranial-lateral to ventral-caudal-medial. The vertical interval between the two orifices measures 2 cm, the pharyngeal orifice lies lower than the tympanic.

In case of a new-born baby the auditory tube has a horizontal course due to which the secretion drainage out of the tympanic cavity is aggravated.

The auditory tube consists of five sections:

Ostium tympanicum, the lateral orifice towards the tympanic cavity lies in the anterior wall of the tympanic cavity.

The adjacent *pars ossea* forms the lateral third of the adult's auditory tube – in case of an infant the lateral two thirds. It courses in the petrous portion of the temporal bone.

- The lateral wall of the osseous part is formed by os tympanicum of the temporal bone. In this area there is the petrotympanic fissure.
- In the floor of *pars ossea* there are the mastoid cells. Also the drainage out of the pneumatic spaces of the pars mastoidea is affected via the auditory tube.

- The superior wall of *pars ossea* is formed by the *septum canalis musculotubarius*. It separates the auditory tube from *musculus tensor tympani*, the stretcher of the tympanic membrane.
- The medial wall of the osseous part constitutes the petrous portion of the temporal bone. It represents the demarcation from *canalis caroticus*.
- The osseous part of the auditory tube is well protected against compression.

The connection between the osseous and the cartilaginous part of the auditory tube is the *isthmus tubae auditivae*. In this area the petrous portion of the temporal bone and the sphenoid bone meet one another in the *petrosphenoid suture*.

Pars cartilaginea, the cartilaginous part of the auditory tube, forms the medial two thirds of the tube – with an infant the medial third. The wall is partly stiffened by the strap-shaped cartilage of the tube, *lamina membranacea*, a fibrous tissue lamina, which closes the inferior open groove; it is free of cartilage, whereby the lumen can be changed.

- The cartilaginous part is fastened at the surface of the greater wing of the sphenoid bone by tight connective tissue. Furthermore the superior edge of the auditory tube along *sutura sphenopetrosa* and the inferior lamella are fastened at *fossa scaphoidea* in the area of *processus pterygoideus* of the sphenoid.

Ostium pharyngeum, the medial orifice of the auditory tube, has an anterior, a posterior and inferior limiting torus. The inferior limiting torus is formed by *musculus levator veli palatini.*

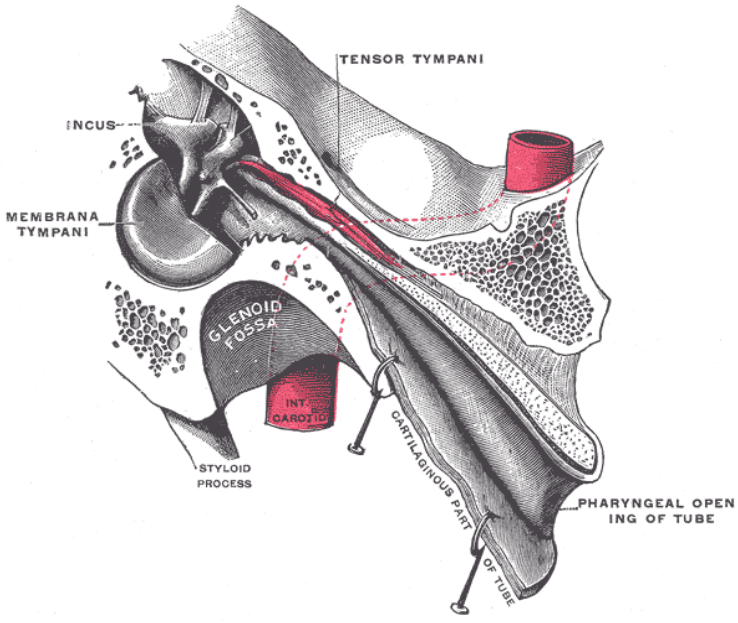


Illustration 7 Tuba auditiva im Längsschnitt (Williams 1989)

The **arterial supply** of the auditory tube is effected via *arteria maxillaris, arteria pharyngea ascendens und arteria palatine ascendens.*

The **veins** of the auditory tube drain into the venous *plexus pterygoideus*.

The **sensorial and motor innervation** is done via branches of *nervus sphenopalatinus* out of *ganglion oticum* and via *plexus pharyngeus* – mainly branches out *nervus glossopharyngeus (cranial nerve IX.).*

The **sympathetic innervation** is effected via fibres out of *ganglion sphenopalatinum, ganglion oticum, nervus glossopharyngeus, nervi petrosi and nervus caroticotympanicus*.

The **parasympathetic innervation** derives from the *tympanic branch of nervus glossopharyngeus.*

Four muscles have a tight connection to the auditory tube:

Musculus tensor veli palatini consists of two parts. A lateral bundle of muscle fibres arises from *fossa scaphoidea* in the area of *processus pterygoideus* and inserts at *os palatinum* and in the *palate aponeurosis*. The medial part arises from the lateral membraneous wall of the auditory tube and unites with the fibres of the lateral part. This medial part is also called *musculus dilator tubae auditivae* and is likely to be responsible for the active extension of the tube.

Musculus levator veli palatini arises from the inferior aspect of the apex of the petrous portion of temporal bone, coursing dorsally and medially, parallel to the cartilage of the tube and inserts at the soft palate. It shall support the active extension of the tube.

Musculus salpingopharyngeus arises from the medial and inferior part of the auditory tube. It courses downwards and backwards and unites with *musculus palatopharyngeus*. Its function is unknown.

Musculus tensor tympani was already described in connection with the description of muscles of auditory ossicles chain.

2.2. Functions

In this chapter I am going to desribe the functions of hearing, the ventilation and drainage and cleaning of the middle ear.

2.2.1. Hearing

A sound consists of a series of vibrations which pass as waves through air (aerial conduction), gas, fluids or solid substances (bone conduction). [11, 13, 16, 18, 24, 26, 41, 42, 48]

Men hear primarily via the **aerial conduction**, the auricles collect the sound waves which are conducted via the external auditory meatus to the tympanic membrane and set these vibrating. These vibrations are transmitted via the auditory ossicles chain to the middle ear. The power of vibration is concentrated by the small surface of the auditory ossicles in relation to the huge surface of the tympanic membrane. This concentration increases or decreases the sound.

Reaching the stapes, the sound vibration presses against the oval window – the transition to the inner ear – and sets the fluid of the vestibular and tympanic channel in action. In order to reduce the pressure of the moving fluid, the membrane of the oval window moves inwards. The receptors of the organ of Corti – part of the basilar membrane – pick up the impulse and transmit it to the tympanic nerve, from which the electric impulse reaches the cerebrum.

A sound vibration reaches from the huge surface of the tympanic membrane via the small surfaces of the auditory ossicles to the membrane of the oval window. This means a concentration of the acoustic energy. This concentration increases or decreases the sound prior to reaching the inner ear via the oval window. The two muscles of the middle ear – *musculus tensor tympani* und *musculus stapedius* – can limit the movement of the auditory ossicles by their contraction and thus protect the middle and inner ear, if a loud sound could cause damaging vibrations.

2.2.2. Ventilation of the Middle Ear

The tympanic membrane forms the border between the middle ear and the external ear, hence the environment [13]. In order that the tympanic membrane can fulfill its function which is to transmit the vibrations to the auditory ossicles, the atmospheric pressure must be the same in and outside of the tympanic membrane. This **pressure compression** is affected via the auditory tube which opens and closes periodically with swallowing and thus ventilating the middle ear, further opening is also done by yawning and sneezing.

The opening of the auditory tube brings also oxygen into the middle ear. This oxygen is necessary for the cell metabolism of the mucous membrane of the middle ear, the auditory tube and the Cellulae mastoideae.

2.2.3. Drainage of the Middle Ear

The air reaching the middle ear from the pharynx via the auditory tube is often polluted. Irritating substances like dust, allergens, cigarette smoke, but also bacteria and viruses can reach the middle ear this way. Subsequently the mucous membrane produces a protective layer against these substances. Drainage via the auditory tube must be possible, in order to get the middle ear clean again [13].

If the auditory tube is free – if the pressure in and outside of the tympanic membrane is compensated – the polluted secretion can be discharged. If the tube is blocked the middle ear cannot be ventilated anymore, the still remaining oxygen is consumed and a negative pressure in the tympanic cavity is created.

By coughing, sneezing, yawning and blowing one’s nose germs can additionally be sucked out of the nasopharynx. By the already existing secretors a good culture medium is generated for these germs [13].

2.3. Otitis Media with Effusion

Research in medical literature about otitis media showed different terms and definitions for that disease, like “tympanic effusion”, “otitis media with effusion”, “secretory otitis media”. In order to show the differences in the nomenclature and the difficulty of definition I have mentioned a few definitions by different authors in the first chapter. Some of the indicated articles speak about possible causes for the clinical picture; they are mentioned in chapter two. In the third chapter potential risk factors are listed, and in the fourth chapter I have described probable additional problems of otitis media with effusion.

2.3.1. Definitions and Descriptive Pathology

The AMERICAN ACADEMY OF OTOLARYNGOLOGY – HEAD AND NECK SURGERY, INC. defines otitis media as an inflammation of the middle ear which can occur in one or both ears[19]. An otitis media, impairing also the audition, can even have consequences for the child’s learning faculty and development of speech. A further complication can be a spread to the mastoid cells, which are separated from the middle cranial fossa only by a thin osseous lamella, whereby a spread to the cerebral membranes can occur.

An acute otitis media is caused by bacteria or viruses which climb up the auditory tube from the nose or the pharynx and thus reaching the middle ear. That happens if the auditory tube does not function properly – due to an infection of the tube in case of a cold, nasopharyngitis or an allergic reaction. The infection in the middle ear causes earache, a red tympanic membrane and effusion of secretion and pus behind the tympanic membrane. Sometimes the tympanic membrane tears and pus flows out of the ear. More often, however, fluid or pus remains in the middle ear, because the auditory tube cannot open in order to ensure a normal drainage. This is called **otitis media with effusion** or **serous otitis**. Even when the painful period is over this fluid may remain in the middle ear. On the one hand this may lead to decreased audition, on the other hand it is again a focus for new inflammation of the middle ear. While an acute otitis media takes its course with earache, feeling of pressure and frequently with fever, the serous otitis media occurs without pain and fever.

The German Society for Ear, Nose and Throat Medical Science, Head and Throat Surgery (DEUTSCHE GESELLSCHAFT FÜR HALS-NASEN-OHREN-HEILKUNDE, KOPF- UND HALSCHIRURGIE) gives following description for **seromucoid tympanum**. Non-suppurating fluid of different viscosity is collected in the cavities of middle ear and the mastoid cells. This is caused by an impaired function of the auditory tube in case of allergy or obstruction of the nasopharynx (e.g. by adenoids). [21]

DR. BOENNINGHAUS describes the original cause of seromucoid tympanum as persisted tubal dysfunction and negative pressure in the tympanic cavity[11]. Thus the mucous membrane of the tympanic cavity becomes a secretory epithelium. The secretion being in the first instance serous, thickens more and more and becomes finally adhesive, ropy and viscous like glue – *"glue ear"*. This secretion cannot be discharged via the auditory tube anymore.

The authors SPREMO, MARKI'C and KURBALA, Department of Otorhinolaryngology, Clinical Centre of Banja Luka, define the seromucoid tympanum or **chronically secretory otitis media** as fluid in the middle ear without indication of an infection[44]. Above all, children in the age between three and 12 years are concerned. The functional and mechanical blocking of the auditory tube is mentioned as reason therefore. From what the authors say, the treatment must have the aim to remove the exudation out of the middle ear, to ventilate the middle ear for a longer period so that hearing can function again normally and prevent late effects – i.e. speech disorders – can be avoided.

For DR. JANE CARREIRO, DO at the New England University in Maine, too, the missing fluid drainage out of the middle ear via the auditory tube represents the biggest problem in otitis media[13]. The fluid may exist in the middle ear without any acute process, i.e. an acute inflammation of the middle ear. But remaining fluid in the middle ear is always a good culture medium for bacteria and there is always the risk of an acute infection.

While the acute otitis media represents an intensely painful infection of the mucous membranes in the middle ear, which is frequently accompanied by effusion development, the seromucoid tympanum is a tympanic effusion without any indication of an acute inflammation. The child does not complain about earache. The most common sign is reduced hearing ability.

The effusion development can be proved by a flat tympanometer curve and a changed curve of the audiogram [11, 21, 44].

2.3.2. Possible Causes for Collection of Fluid in the Tympanic Cavity

In a brochure of the Cranial Academy, Indianapolis, MARGARET SORREL, DO, describes three theories for the causes of fluid collection [43].

One of them is based on the fact, that the **negative pressure** developing upon the diffusion of gas into the blood vessels of the tympanic cavity enables a release of fluid from the blood vessels into the middle ear.

A second theory means that the secretion is a result of the **inflammatory process** of the mucous membrane.

The third theory says that increased fluid may collect in the child's pharynx upon teething, during an ordinary cold or when drinking a baby's bottle in lying position. This **fluid** lies very **near to the pharyngeal orifice of the auditory tube** and may easily be transported into the middle ear. An additional **swelling of the mucous membrane** makes the situation worse because the auditory tube is blocked and drainage out of the middle ear is stopped. The resultant negative pressure in the middle ear aggravates the situation even further.

Defects of the ciliary system of the auditory tube and the total middle ear are considered to be a further cause for the collection of secretion in the tympanic cavity due to a reduced discharge via the auditory tube. In an article DR. G. BORKOWSKY and his team of the ENT-University Hospital Bochum present the result of their study [12]:

Children who had a tendency to recurrent tympanic effusion – despite prior adenotomy – frequently showed anomalies of the ciliary systems of the mucous membrane. These ciliary defects would lead to **insufficient mucociliary clearance** of the tube and the anterior tympanic cavity sections. This results in congestion of fluid and persisting tympanic effusions. The reason for the ciliary defects might be **virus infections** [12].

In a study on patients who had surgery because of tumour invasion and the maxilla was removed there could be observed secretory otitis media at one third of the subjects. This study was carried out by TALMI ET AL. at Department of Otolaryngology – Head and Neck Surgery, Israel, and published under "incidence of secretory otitis media following maxillectomy" [47.] **Circulatory Problems** due to external reasons may also lead to congestion in the middle ear.

2.3.3. Risk Factors

Besides **increased occurrence** of otitis media **with boys** compared with girls DR. BRYAN MANN of the Fort Hays State University – College of Health and Life Science – indicates also **genetic** and **family predisposition**, **craniofacial abnormalities** and **frequent diseases of the upper respiratory tract**, **allergies** and **asthma**, **passive smoking** and the **colder season** to be risk factors [37]. Furthermore there is mentioned a connection with nursing. Children, who were **not breast-fed**, suffered more frequently from inflammation of the middle ear. **Drinking** a baby's bottle **in horizontal position** is also considered as risk factor for otitis media – see also 1.2.2.

The AMERICAN ACADEMY OF PEDIATRICS, too, speaks about the above-mentioned risk factors in the article "Managing Otitis Media with Effusion in Young Children – the Otitis Media Guideline Panel". Additionally, **child care in groups** – nursery school, day-nursery, day-home – is indicated to be a risk factor [3, 22].

Various literatures also mention a correlation between tendency for otitis media and **allergies** [18, 20, 25, 28, 29, 33]. In particular, there are indicated **incompatibilities** of cow's milk and dairy products, wheat, eggs, chocolate, citrus fruits, corn, soybeans, peanuts and sugar.

2.3.4. Additional problems and Complications

One of the statements of the different definitions in the chapters before was that sero(muco)tympanum represents a complication of an acute otitis media. The secretion existing in the tympanic cavity cannot be discharged via the auditory tube and is thus forming a very good culture medium for bacteria, which reach the middle ear mainly from the nasopharnyx via the tube. A **renewed infection** is programmed in advance.

The **auditory impairment** resulting from the fluid in the middle ear represents a further difficulty. The tympanic membrane is also limited in its flexibility by the fluid and transmits already reduced sound waves to the auditory ossicles. These, too, can only become active in a limited manner; the sound, which is transmitted to the inner ear, can only be perceived in a subdued way [8, 13].

In a study of the Department of Otolaryngology of the University of Manitoba, Winnipeg, the question of a sensor neural loss of hearing was investigated [9]. The audiograms of 123 patients with unilateral chronic otitis media were compared with the curves of the not involved contra lateral side and a clear correlation was found between loss of hearing and otitis media. Under the title "Does chronic otitis media cause **sensorineurale hearing loss**" the results of BLAKELEY and KIM were published in the Journal of Otolaryngology [9].

A longer lasting auditory impairment will have consequences for the child's **development of speech** and also the **faculty of learning- resp. concentration**. In "Otitis media and child development: speech, language and education" HANSON and ULVESTED confirm this statement as well as BLUESTONE, KLEIN, PARADISE show the negative effects of otitis media on the child's development in "Workshop on effects of otitis media in the child" [8, 10, 16].

In very serious cases the auditory ossicles and part of the temporal bone can be damaged, **sclerosing** and **cholesteatome** in the ear occur. In a study of the Department of Paediatrics Otolaryngology, Children's Hospital of Pittsburgh, a quarter of the subjects failed to respond to antibiotic treatment. The consequences were cholesteatome, facial palsy and sensor-neural loss of hearing. These examinations were preceded by GOLDSTEIN, CASSELBRANT, BLUESTONE and KURS-LASKY [15].

2.3.5. Classical Treatment

The standard treatment of otitis media is administration of **antibiotics**. If fluid remains in the ear after an acute inflammation, a low dosage of antibiotics is given for a longer period according to the literature.

In serious cases – if the auditory impairment persists – it is often required to do a **paracentesis** – section in the tympanic membrane – and to lay a tympanic cavity wash tube so that the fluid can drain via the tympanic membrane [18, 20, 21, 22, 23, 24, 26].

CAROL MEREDITH, DO, at the OCC – Osteopathic Centre for Children – in London mentions an interesting aspect in connection with the setting of tympanic cavity wash tubes. As per her experience the insertion of a tympanic cavity wash tube is accompanied by even more internal rotation of the temporal bones. The intensified internal rotation blocks even more the drainage out of the tympanic cavity via the auditory tube [40].

2.4. Osteopathic Possibilities

In the first part of this chapter I am going to quote a few famous statements of osteopathic literature; the articles are listed as per initials of the authors. The second part includes my personal reflection: Above all, I want to consider the auditory tube above all as central element in the treatment.

2.4.1. Osteopathic Literatur

DR. VIOLA FRYMANN, DO, the "Grande Dame" of osteopathy has great experience in the osteopathic work with children. She is director of California's Osteopathic Centre of Children in San Diego [2, 27]. At this clinic lots of children with recurrent ear infections are treated. Some of the infections started when the children were six months old and have gone on for years. Those children were treated with antibiotics over and over again. When in osteopathic treatment the structural problem – often originated at birth – was addressed ear infections became progressively less frequent.

For Viola Frymann it is important to cure the temporal bone from restriction in internal rotation. As per her opinion the fluid will remain in the middle ear as long as the temporal bone stays in internal rotation. The probability of a renewed infection increases.

DR. ROBERT C. FULFORD describes that the problem of possible ear infection begins already at a trauma of birth [2,5,14]. The *rectorespiratory reflex* impairs the outflow of lymph from the neck und upper shoulder region. Fulford's solution of this problem is to treat sacrum, pelvis and chest, in order to guarantee a good outflow of lymph through the whole system. He explained that a restriction of the sacrum impaired the whole primary respiration mechanism. With that there goes a pattern of restricted breathing what decreases the pumping of the lymphatic circulation. Inadequate lymphatic circulation causes poor fluid drainage form the head and the neck. Fluid builds up in the middle ear, producing an ideal breeding ground for bacteria. For Fulford it is necessary to correct the underlying problem of fluid stagnation instead of trying to wipe out the bacteria with antibiotics.

J. SCOTT HEATHERINGTON describes in "Manipulation of the Eustachian Tube" a manipulation of the auditory tube via the mouth and the region of nose and throat. This action is a short but unpleasant procedure for the patient [28]. In the *Fossa Rosenmuller* – directly at the entrance of the auditory tube into the pharynx – this pumping technique is applied. The aim is to loosen connective tissue adhesions in this area, to open the auditory tube and to compensate the atmospheric pressure on both sides of the tympanic membrane. Heatherington also describes additional lesions of the temporal bone and dysfunctions between C2/C3, C3/C4 of the affected side [2, 28].

For STUART KORTH, DO, founder and director of the Osteopathic Centre for Children London, the rotation of the temporal bone around one axis, which passes through the petrous portion, is of immense importance for good drainage via the auditory tube. Only with a corresponding rotation the cartilaginous part of the auditory tube is able to move properly. This part is decisively participating in the drainage [32].

At the pharyngeal end of the auditory tube there is a small tonsil. If the suspension of the pharynx at *tuberculum pharyngeum* of the occiput is disturbed, it may lead to a drainage problem out of the auditory tube.

With children with otitis media the mucous membranes of the upper respiratory tract are frequently changed. According to Stuart Korth, the causes lie in the face, cranial base and in the upper cervical spine; frequently, however, allergies are also responsible for the change of the mucous membranes. As per his experiences 50% of the children with chronic deafness have allergies. In this context the lymph vessels and the motion of the sacrum are to be considered [32].

For good ventilation and drainage of the middle ear a good nasal breathing is important, i.e. all impediments should be removed, whether by loosening the tensions of fascias and facial bones or as well surgically by removing too big adenoids which aggravate a free nasal breathing.

Subsequently to a surgical intervention it would be favourable to go on with osteopathic treatment, particularly because of the venous and arterial improvement of blood supply and an increased lymphatic drainage.

An important embryological correlation is noticed by Stuart Korth between the mandible and the auditory ossicles incus and stapes. Together with the sphenomandibular ligament – having insertions at the mandible and the sphenoid (here at *Spina sphenoidalis*) – they arise out of the Meckel's capsule. With the contact at the mandible there is indeed a direct connection to the

auditory ossicles and via the sphenomandibular ligament to the sphenoid and the temporal bone.

Sphenomandibular ligament and stylomandibular ligament – passing from the mandible to the styloid process of the temporal bone, have the important task to balance the mandible at the cranial base. Stuart Korth in this respect draws comparisons to the reins of a horse. With children with otitis media there could frequently be observed a strong compression between temporal bone, sphenoid, hyoid bone and mandible.

The hyoid bone is in tight junction to the pharynx via prevertebral fascia, the lowest lamina of the cervical fascia and hence also to the pharyngeal end of the auditory tube. For Stuart Korth it is important, too, to exactly examine the tensions of hyoid bone and cervical fascias.

DR. HAROLD MAGOUN, DO – one of the founders of the Sutherland Cranial Teaching Foundation and author of the book "Osteopathy in the Cranial Field" – adopts the view in "Practical Osteopathic Procedures" that a good precautionary medicine has to care for the mobility of the temporal bones resp. it has to correct the two cranial bones in an acute situation. Improved drainage of the ear will occur when there is good movement in internal and external rotation of the temporal bones[39].

Magoun also describes a technique for the auditory tube where the drainage is to be accelerated by.

Furthermore for Magoun the venous discharge out of the *pterygoid plexus* is important in order to prevent congestions.

Particular attention is also to be payed on the lesions in the acromioclavicular joint, the anterior cervical fascia, the thoracic inlet, the upper cervical spine, the immune system and the total lymph drainage [2, 28].

In "Teaching in the Science of Osteopathy" DR. WILLIAM GARNER SUTHERLAND, DO – founder and first president of the Sutherland Cranial Teaching Foundation – describes the importance of internal and external rotation movement of the petrous portion of the temporal bone for opening and closing of the auditory tube [46]. A fixation of the osseous connections of the auditory tube – *pars ossea tubae auditivae* – to the petrous portion of the temporal bone or of the cartilaginous fastenings – *pars cartilaginea tubae auditivae* – to the petrous portion of the temporal bone and the greater wing of the sphenoid causes a functional disturbance of the auditory tube, the orifices of the auditory tube stay either open or closed. The close anatomic correlation between the cartilaginous part of the auditory tube and the petrous portion of the

temporal bone and the greater wing of the sphenoid is of high importance for Dr. Sutherland. He describes the cooperation between external rotation of the petrous portion of the temporal bone and opening of the mouth of the auditory tube. It closes when the petrous portion rotates into internal rotation. When the petrous portion is kept in extreme internal rotation – that means when the orifice of the auditory tube is closed – the subject may complain about the feeling that their ears were blocked. Frequently swimmers and divers come with such symptoms.

Dr. Sutherland emphasizes as well the importance of the totality of the human body. That also includes insertions of muscles, soft tissues, fascias and not only the focus on the osseous structure [46].

2.4.2. Auditory Tube as „Central Element“

The auditory tube is tightly connected with the temporal bone by its osseous part. Any limitation of the tension resp. motion of the temporal bone can be transferred to the auditory tube. At the point of birth the temporal bone still has three parts – the two fibrously disposed *pars squamosa* and *pars tympanica*, and the *pars petrosa*, which has a cartilaginous development. At this time there are sutures between every single part. In the course of the development of the temporal bone the three parts unite, the sutures become zones of elasticity – **fissura petrotympanica, fissura petrosquamosa and fissura tympanicosquamosa** [1, 4, 41, 48]. Intraosseous lesions may easily appear at these zones of elasticity, the intraosseous motion of the bone is thus limited.

The connection between the auditory tube and the **sphenopetrous suture** between the greater wing of the sphenoid and the petrous portion of the temporal bone, also seems to be essential for me. The sphenopetrous suture is reinforced by the *sphenopetrous ligament (Lig. Gruber)*. This ligament arises at the dorsum sellae below the *posterior clinoid process* at the sphenoid and runs a course towards the *Apex partis petrosae* at the temporal bone.

The basic supposition for a free movement of the sphenopetrous suture is good motion in the *sphenobasilar synchondrosis* i.e. a free movement between the sphenoid and the occiput. Attention is also paid to the fact that the sacrum is a decisive factor in the movement of the sphenobasilar junction.

The second “joint partner” of the sphenopetrous suture is the temporal bone, in which the three parts of the ear – external, middle and inner ear – are situated. A good tuning of motion of the temporal bone in internal and external rotation – longitudinal axis through the petrous portion – with flexion and extension of the sphenobasilar synchondrosis is essential for good functioning of the suture and hence for a corresponding motion of the auditory tube.

Very near to the sphenopetrous suture in the area of the isthmus of the auditory tube there are the insertions of **m. tensor veli palatini** at the sphenoid and **m. levator veli palatini** at the temporal bone. Both muscles radiate into the aponeurosis of the palatine and serve also for the elevating of the palate during swallowing (for closing the nasal cavity), for yawning and speaking.

M. levator veli palatini runs parallel course to the auditory tube – see the illustration below – and may be considered as a pump for the cartilaginous part or the tube.

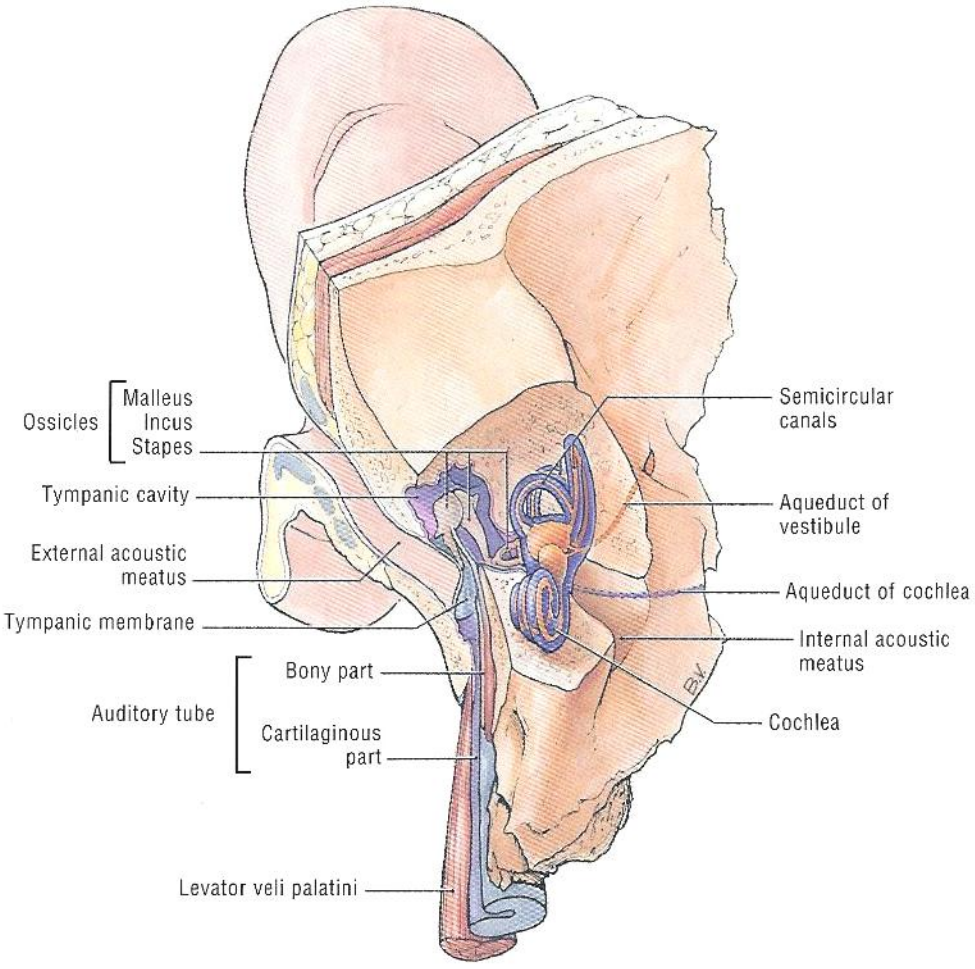


Illustration 8. External ear, middle ear, inner ear (Agur 1991)

In his article about the muscular compliance of the auditory tube DR. R. LEUWER describes his observations about the cooperation of **m. tensor veli palatini**, the most important opener of the auditory tube, and **m. mylohyoideus** as a representative of the muscular system of the deglutition. With his "ear healthy" subjects he was able to observe by aids of an electromyogram, that both muscles were innervated within the same period, actually during the oral and pharyngeal phase of swallowing.

At a great part of patients with chronic middle ear problems the innervation of m. tensor veli palatine began later, the auditory tube opened later.

Leuwer concluded the importance of the temporal coordination between the two muscles for good drainage of the auditory tube.

By means of MRI (magneto resonance tomographies) Leuwer showed the two parts of m. tensor veli palatini, *pars superficialis* with insertion at the sphenoid and *pars profunda* with insertion at the cartilage of the auditory tube. By contraction of the pars profunda the tube gets open in the cranial third, simultaneously the two lower thirds of the tube cross section are compressed by contraction of the pars superficialis. According to these examinations a contraction of the M. tensor veli palatini results in ventilation in the upper third and in an active drainage towards the pharynx in the lower thirds. This mechanism is additionally supported by mucosal folds inside of the auditory tube.

Another muscle with direct insertion at the auditory tube in the area of the pharyngeal orifice is **m. salpingopharyngeus**. It belongs to the pharyngeal elevators (*mm. levatores phayringis*). The fibres arise distally from the pharyngeal wall, which is formed by constrictor muscles of the pharynx (*mm. constrictors pharyngis*) and fixed to the pharyngeal tubercle of the pars basilaris of the occiput via raphe pharynges [1, 41, 48]. Again, the importance of free motion of the occipital bone becomes evident.

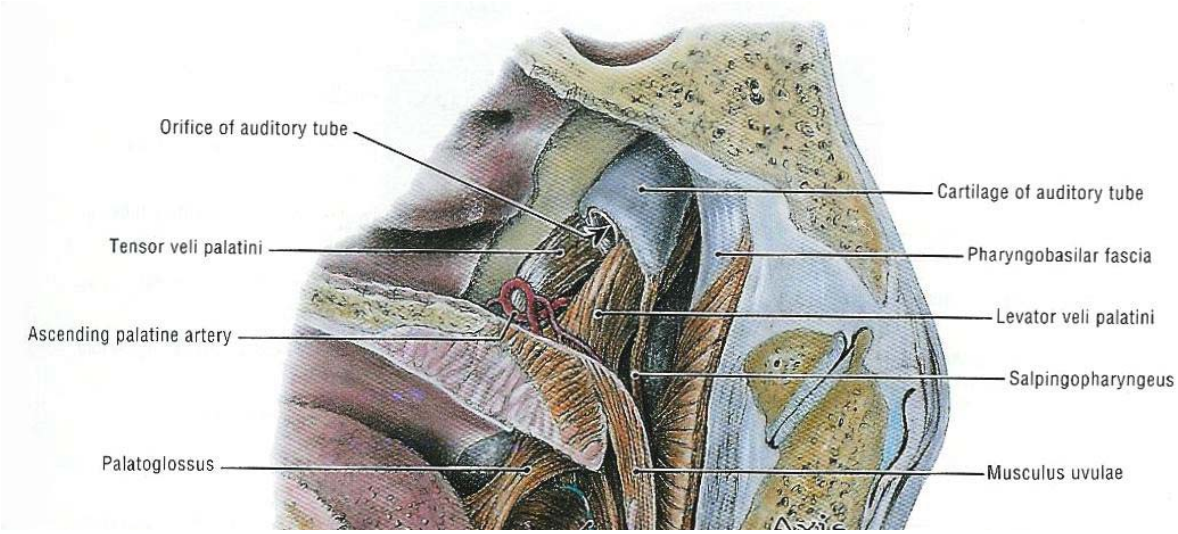


Illustration 9. Connection between M. salpingopharyngeus and the cartilaginous part of the auditory tube. Besides, the vicinity of M. tensor veli palatine to the auditory tube is to be considered! (Agur 1991)

2.4.3. Connections of the Auditory Tube to the Tympanic Cavity

The auditory tube represents the **way into the "dead end"** of the tympanic cavity [1].

From the tympanic cavity there is a direct connection via *additus at antrum* into the *cellulae mastiodeae* – the cavity system in the area of the temporal bone, which has a mucosal lining like the tympanic cavity and is filled with air. The *cellulae mastoideae* are close to venous *sinus sigmoideus* and hence with the venous system of the brain and the dura mater.

The way into the inner ear is separated from the basement membrane in the *fenestra ovale*. The way into the external auditory meatus is closed by the tympanic membrane.

Only a good motion of the auditory tube itself and the mucosal cilia enables a definite discharge out of the tympanic cavity into the pharynx.

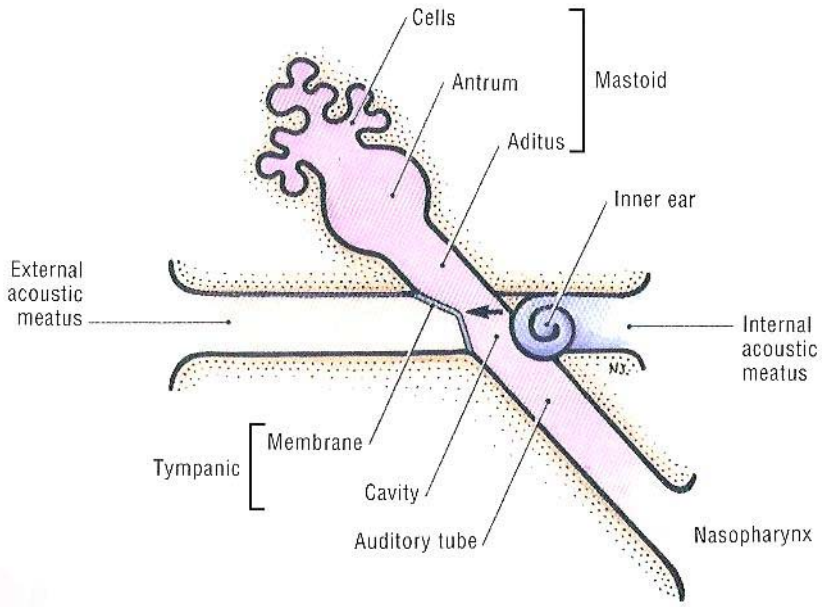


Illustration 10. Scheme of ear orifices and respiratory tract (Agur 1991)

One anatomic factor should be mentioned in relation with middle ear problems and **temporomandibular joint**. The floor of the tympanic cavity lies at the internal surface and the socket of the temporomandibular joint at the external surface of the temporal bone. These adjacent structures influence the motion of each other. Restricted movements in the capsule of the mandibular joint resp. in the system of the ligaments and fascia around it, may also impair mobility in the tympanic cavity. Stylomandibular and sphenomandibular ligaments – having a connection to the cranial base – are reckoned to the ligaments (see also chapter 2.4.1. – Stuart Korth). A fascial connection is given via *temporo-pterygo-mandibular fascia* [1, 32, 36, 41, 48].

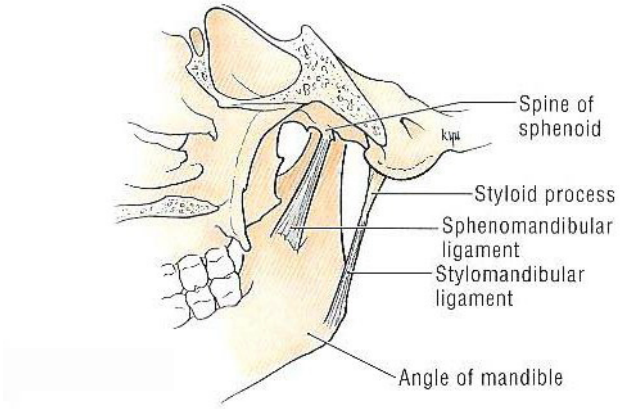


Illustration 11. Temporomandibular joint and stylomandibular and sphenomandibular ligaments (Agur 1991)

Arterial and venous circulation of the tympanic cavity and auditory tube is shown in the first chapters of my thesis.

A. T. Still has impressed the important principle of the osteopathy *"The rule of artery is supreme"* [45]. Referring to the area of the middle ear and the auditory tube there is to be considered the vicinity to *Arteria carotis interna* and to *Vena iugularis interna* resp. *Sinus sigmoideus* (with *Bulbus venae iugularis internae*).

The major part of the cerebral supply is affected via *Arteria carotis interna*. Via *Vena iugularis interna* 80% of the venous blood drains out of the brain.

2.4.4. Connections of the Auditory Tube towards cranial

The auditory tube is connected with the **occiput** and hence with the dorsal part of the cranial base via the pharynx, the sphenoid and the temporal bone. The pharynx is fastened at *Pars basilaris* of the occiput via *Raphe pharyngis.* The sphenoid has connections with the occiput via *Synchondrosis sphenobasilaris*, and the temporal bone via *Sutura petroiugularis, Sutura petrobasilaris* and *Sutura occipitomastoidea* [1, 41, 48].

The **tent of the cerebellum** is fastened at the petrous portion of the temporal bone. Any change of tension of the tentorium will have its effect on the petrous portion and consequently on the auditory tube, too.

The tent is together with *falx cerebri* and *falx cerebelli* also an important conducting structure for the **venous sinus**, the drainage system of venous blood out of the brain [4].

The venous sinus system is divided into two groups – the sinus of the vault with the *confluens sinuum posterior* (at *protuberantia occipitalis interna*) and the sinus of the cranial base with *sinus cavernosus ("confluens sinuum anterior").* From the sinus the total blood flows into the iugular vein.

From confluens sinuum posterior venous blood flows out of the *sinus sagittalis superior, sinus sagittalis inferior, sinus rectus* and *sinus occipitalis posterior* into the right and left *sinus transverses*. Sinus transversus picks up the *sinus petrosus superior* and *sinus petrosus inferior*. In the *sinus sigmoideus* venous blood leaves the skull into the *bulbus superior venae iugularis* and further on into *vena iugularis interna* [1, 48].

Chapter 2.1.1. describes the vicinity of the bulbus to the floor of the tympanic cavity.

Sinus cavernosus, being incompletely divided by connective tissue septa and tightly connected with the insertions of the tent of the cerebellum, lies at both sides of the sella turcica. Besides the arteria carotis interna, also important cranial nerves run their course through this sinus.

Vena ophthalmica, sinus sphenoparietalis, sinus coronaris and *plexus basilaris* run to the sinus cavernosus.

Efferent tracts are *sinus petrosus superior,* at the upper edge of the petrous portion of the temporal bone; *sinus petrosus inferior*, at the internal side of the petrobasilar suture; *sinus petrooccipitalis*, at the external side of the petrobasilar suture; and *sinus caroticus*. The efferent sinus end in the vena iugularis interna, like the sinus of the vault.

Tensions in the area of the insertions of the tent of the cerebellum as well as of the body of the sphenoid may have consequences for the drainage of venous blood.

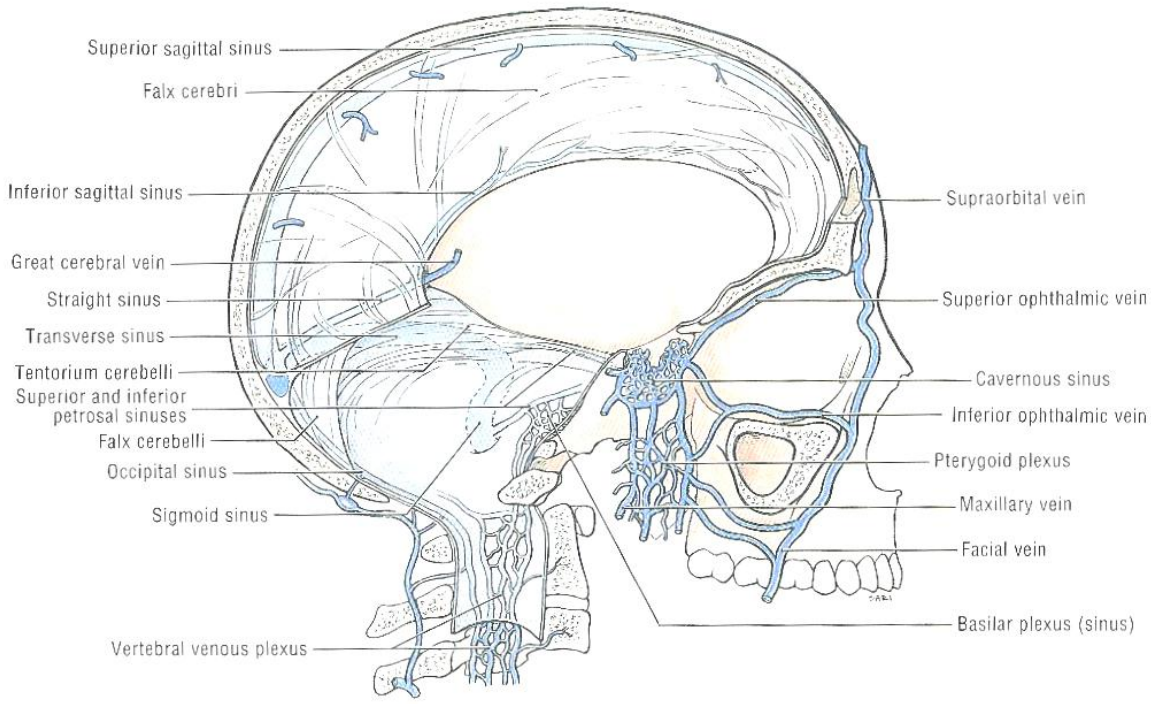


Illustration 12. Sinus venosi durae matris (Agur 1991)

2.4.5. Connections of the Auditory Tube towards caudal

The **cervical fascias** form an important connection from head to the thorax and hence to the caudal parts of the body [1, 5, 7, 41, 48].

The lowest layer, the *fascia praevertebralis*, represents the continuation of the *fascia endothoracalis*, the *fascia transversalis* and the *fascia pelvis*. The lowest layer of the cervical fascia arises from the occiput and extends to the third dorsal vertebra. It has also a connection to the pharynx and hence to the auditory tube, to the hyoid bone and to the clavicle. Increased tension within the fascia system will have its effects on the vascular structures running through the narrow pass neck. This applies to the arteries leading towards cranial, *arteriae carotis interna et externa* (*communis*) and *arteria vertebralis*, and the *vena iugularis*, deriving from the head and the lymph vessels, ending in the venous system on level of the *Fossa iugularis*. Any change of tension of the fascias will have its consequence on the drainage out of the head area. By the continuation of the low cervical fascia towards caudal there is also a connection to the remaining parts of the body. In this respect I should particularly mention the horizontally arranged diaphragms, *diaphragma thoracis, diaphragma urogenitale and pelvis*, and the “diaphragm” of the inlet of the thorax with cervical pleura and the ligaments of the apex of the lung.

These horizontal structures are leading structures for the vessels and some of them have points of passages for these vessels. In case of increased tension disordered drainage may occur [1, 5, 7, 31, 41, 48].

There is a quite essential, low lying connection to the sacrum via the occipital bone. The already described correlations of the auditory tube and the occipital bone are pursued via the **dura mater** towards caudal. A well tuned motion between these two bones enables a good flowing of the cerebrospinal fluid, with essential consequences for the immune situation, the feeding of the central and peripheral nervous system and supply of the vegetative nervous system.

The vegetative nervous system is among others responsible for the supply of the mucous membranes of the tympanic cavity, mastoid cells and the auditory tube. An improved mucosal function is for me also an important aim during treatment [1, 31, 41, 48].

2.4.6. Osteopathic Principles

The consideration of **"The unity of human being"** was an important fundamental principle for DR. ANDREW TAYLOR STILL, founder of the osteopathic concept. [35, 39, 45, 46]

All cells, tissues and organs of the body cooperate with each other – physiologically and pathologically, i.e. an abnormal change or dysfunction of one structure of the body will have its effect on the total body. With osteopathic treatment the total organism and circulation of the body fluids are influenced positively by the structure of the body.

Free motion of the body fluids is of immense importance for health. As per Dr. Still, diseases arise where there is locally or generally disturbed circulation. Hence it follows a further important principle of osteopathy: **"The rule of artery is supreme"**. A good feeding with oxygenated blood is necessary in order to maintain the cell metabolism. The lymph is also reckoned among body fluids having the task to clean and drain the connective tissue and cerebrospinal fluid, which is i.e. responsible for the metabolism of the brain and nervous system.

"The body has a self-regulating and self healing mechanism": the origin of diseases is strongly depending on the defensive and self healing power and on the strength of toxic influences. If the body's defence and compensation mechanism is insufficient, symptoms or disease will come up. With osteopathic treatment you try to resolve disease provoking influences, so that the self healing mechanism is reactivated.

A further principle in osteopathy says that **"structure and function are interdependent"**. This interdependence takes place on several planes – mechanical, membranous, circulatory, neurological, biochemical, endocrine and electrophysiological.

For optimum function of the body a normal structure and physiological tonicity of all body tissues is necessary. With osteopathic treatment the function is improved and this produces also an improvement of the structure of the body.

3. Methodical Procedure

3.1. Methodical Structure of the Practical Part of the Thesis

For the practical part of my thesis I have chosen a study with the type **within subject designs**. The test subjects acted as their own control group:

- An ENT specialist took the first measurement two to three months before the beginning of my osteopathic treatment.
- The second measurement was taken right before the first treatment. An inclusion criteria for my study was an abnormal curve in audiogram and tympanogram. Five boys at the age of 6 to 9 years remained for my study. There was an impaired hearing by secretion in the ear with all five of them, with two of them there was impairment on both ears.
- After the three osteopathic treatments another measurement was taken and compared to the preceding one.
- Since audiogram and tympanogram are reckoned among the standard examination ENT specialists take with otitis media, the same equipment was used for my tests, and the measurements are reproducible, reliability and validity of the measurement process can be evaluated as positive.

To the **inclusion criteria** were reckoned:

- Children at the age of 6 to 9 years
- The secretory otitis media lasts for at least three months, proved through audiogram and tympanogram that were created by an independent ENT specialist (orthodox medicine).
- Audiogram and/or tympanogram showed at that time values below the norm, i. e. a flat graph in the tympanogram and reduced faculty of hearing, proved through the auditory curve.

Exclusion criteria were:

- Acute otitis media
- During the period of osteopathic treatment no additional medication.

The subjects underwent an **osteopathic evaluation** by means of a uniform report and an **individual osteopathic treatment** based on determined findings.

The osteopathic treatments were preceded at following intervals:

- in the first session taking of osteopathic findings and treatment
- further treatment after two to three weeks
- osteopathic final findings after three further weeks

The parents were given an information sheet about the procedure of my study and subscribed a statement of agreement. Information sheet and statement of agreement are enclosed in the addendum.

During taking of findings the questions for the case history were put according to a precise scheme – structured interview.

In my study I have examined the effect of osteopathic treatment with chronic secretory otitis media by means of following variables: The independent variables were the treatment by means of measures of the ENT specialist before my osteopathic treatment and the osteopathic treatment itself. The dependent variables were the outcome measures from the audiogram (tone pitch in decibel) and from the tympanogram (pressure in decapascal, compliance in milliliter, scale for the evaluation for the curve shape).

Critical consideration of my thesis:

The life of the children in my subject group was already a life of suffering and their parents was recommended to undergo an operative procedure in form of a paracentesis mostly with setting of a tympanic cavity wash tube. Only those parents, who wanted to delay or denied the procedure, were sent to me. Five boys remained for my subject group; two of them had problems on both ears.

3.2. Audiogram

A complete audiogram consists of bone and aerial conduction. The bone conduction shows the ability to hear a sound transmitted via a bone, while the aerial conduction is the ability to hear a sound transmitted via air.

The complete audiogram is important for the distinction between middle ear deafness and labyrinthine deafness. In case of middle ear deafness the aerial conduction is reduced, whereas in case of labyrinthine deafness the bone conduction is reduced.

The result of the audiogram is presented in a graphic chart; the scope of audition is recorded in decibel in the different frequency ranges. A normal result shows a value around the zero line, a loss of hearing is indicated by a higher decibel number. [17, 19, 22, 30]

For my thesis the measuring of the aerial conduction is essential, because the sound conduction via the auditory ossicles is impaired by the secretion in the middle ear.

3.3. Tympanogram

The tympanogram is a test for measuring the motion of the tympanic membrane. [23, 24, 27, 30]

If the middle ear is filled with fluid, the tympanic membrane can only vibrate insufficiently; the tympanogram shows a flat graph.

A change of pressure in the middle ear is shown in the tympanogram by deviation of the graph, a negative pressure results to a deviation to the left.

The compliance indicates the flexibility of the tympanic membrane.

In the case of my subjects audiogram and tympanogram were taken prior to the first taking of osteopathic findings and after the final result.

3.4. Osteopathic Evaluation

In the beginning there was a detailed case history, in the subsequent manual taking of findings the following reflections were of great importance for my thesis.

- **Mechanical** problems of the **auditory tube** – anatomical connections
- Mucous membrane – **immune system**
- General **drainage** – circulation of lymph and cerebrospinal fluid
- What is the **osteopathic lesion**?

3.4.1. Case History

The case history was affected by means of a **structured interview** with the parents of the subjects:

- General data – name, date of birth, address, phone
- Problems – impairment, handicap
- Since when does otitis media exist? When did otitis media appear the first time? Since when has otitis media existed this time? Do the problems occur in combination with an infection (cold)?
- Which treatments were already affected? How did the child respond to earlier treatments?
- Are there further problems? Allergies? Learning disabilities? Abnormalities in behaviour? Retarded development of speech?
- Pregnancy: Course of pregnancy, medication, number of ultrasound examinations, infections during pregnancy?
- Birth: Duration of pregnancy, spontaneous birth, dry labour, induced labour, duration of labour, first stage of labour and expulsion period, analgesics during labour, epidural anaesthesia, vacuum extraction, forceps or Caesarean section, presentation?
- Birth weight, length, APGAR-Index, first breath

- Neonatal period: Breathing, screaming, sleeping, vigilance, eating, nursing, sucking, shape of the head, contusions
- Ideal motor development in the first year of life: 3 mo, 4 ½ mo, 6 mo, 9 mo, 12 mo – prone and supine
- Accidents, fractures, contusions, surgery
- Diseases
- Vaccination
- Digestion, vesical / renal activity
- Breathing
- Social situation: nutrition, passive smoking, housing conditions

3.4.2. Osteopathic Findings Report

In the following I would like to summarize the items which I considered to be significant for the report. The actual report is in the addendum.

- Posture in standing, general listening in standing and supine position
- Mobility of spine, pelvis and extremities
- Diaphragms
- Visceral items, Chapman reflexes
- Chapman Reflex for otitis media
- Cranial testing
- Vitality – quality of the tissues
- Manual thermal diagnostic of face and neck

The taking of findings was executed with my subjects prior the first osteopathic evaluation and after the final result.

At the beginning and in the end of each treatment session I preceded the tests being necessary for the actual state of tissue.

3.5. Procedure of Osteopathic Treatment

I preceded the osteopathic treatment according to the respective main problems, in other words **individually** for every single subject.

For the procedure of techniques, however, I tried to use the same type of technique as far as possible. Accordingly I chose the direct procedure for all structural techniques, the indirect procedure for the treatment of the fascia. For diaphragms and ligaments of viscera listening and recoil techniques were chosen.

In craniosacral osteopathy I used as per demand indirect and direct techniques as well as liquor techniques and membrane techniques, especially techniques for the venous sinuses and the ventricles.

4. Results

4.1. Case History

The test group included five **boys** at the age of **six to nine** years. With two children there was secretory otitis on **both ears**.

The **first ear infection** occurred when the children were between **two and five and a half years**, in all cases in combination with a **cold**. Also at present, a cold is always a provoking factor for their middle ear infections and aggravation of hearing.

With regard to **earlier treatments** there was mentioned a wide range of nasal sprays, antibiotics, homoeopathy, Bach-flowers, laser acupuncture up to surgical interventions – removal of the adenoids, paracentesis, laying of a tympanic cave wash tube.

The **pregnancies** of four mothers had a normal course; the mother of one child had to take drugs for inhibiting labours from the 30th week of pregnancy on. The **duration of pregnancy** came up to 39 to 42 weeks.

Concerning the question about complicated delivery, it was stated that two children were delivered by vacuum extraction – both showed light deformations of the skull at birth.

All of the children were **breastfed**. The two boys with vacuum extraction delivery sucked very well; with the other three children, a bad **sucking action** was indicated.

All children were very **restless** during the **first months of life** and their well being was impaired by flatulencies and disturbed digestion.

Two children were far ahead in their **motor development** of the first year; they started walking already at ten months, the other three boys started walking at 12 months. Before walking, all of them did creeping and crawling cross-coordinated. Coordination and vestibular testing was fine.

For all of the children **accidents** in the head regions prior to the first occurrence of middle ear infection were mentioned.

Four children already had **surgery on adenoids** – one of them twice.

Three children were supplied with **tympanic cavity wash tubes** – the child with two adenotomies even twice.

With one child a **tympanotomy** was executed and fluid sucked off.

The question for **allergies** was answered with regard to milk in case of two boys. It was quite interesting that those two boys showed vesical problems in kind of recurrent infections and enuresis nocturna.

One child received **dental regulation**. After a four years interval without middle ear infection a secretory otitis media occurred three months after starting with the regulation of the teeth.

As **additional diseases** there were mentioned mild croup, tonsillitis, bronchitis and neurodermitis.

4.2. Osteopathic Findings

The basis for my osteopathic treatment was a well founded taking of findings. After a global examination in standing, sitting and supine position I tested particularly the vertebral column and the limb joints (structural osteopathy), the mobility and fixations of the organs (visceral osteopathy), and the mobility in and between the bones of the skull as well as in the sacrum (cranial osteopathy). The purpose of these detailed examinations was to find the basic problem of each respective child. In the osteopathic treatment I could then individually go into the discovered difficulty.

The **Ecoute test** – global examination in standing, sitting and supine – showed fascial tension towards the right abdomen – liver, right kidney –with four of five children, with one boy a clear tension towards the bladder.

The tests for the **mobility of the spine** showed restrictions in the cervical area on the side of the otitis media, significant impairments were found with four children on level C1, with three children additionally between C2/C3 and C3/4.

There were restrictions in the cervicodorsal transition with four children, with all five subjects in the dorsolumbal transition. The motion in the lumbosacral transition was limited with two boys. The sacrum showed intraosseous tensions with four children.

The tension of the **diaphragms** was increased with all children. I examined the tension of thoracic diaphragm, pelvic diaphragm, inlet of the thorax and the diaphragm (floor) of the mouth with its connections to the hyoid bone. Also the tent of the cerebellum being the most superior diaphragm, showed increased tension in most of the cases on the side of otitis media.

Testing the organs I found restrictions in the area of the liver with four children, in the area of the kidneys with three and in the area of the bladder with two children.

The anterior and posterior **Chapman reflexes** were also positive with respect to these organs.

Anterior and posterior Chapman reflexes for the middle ear were positive with all five subjects.

Manual thermodiagnosis as per Barral showed clear heat with three children in the area of the maxillary sinus, in case of the boys with restrictions and positive Chapman reflexes of organs, heat was also traced in these areas.

Vitality of the tissues was reduced with all children.

By means of **cranial testings,** I was able to find a compression of the sphenobasilar synchondrosis with two children and a vertical strain upwards and adaptation lesions in form of sidebending rotation with two children. The motion of the sphenobasilar junction with these children was more evidently directed towards extension. The temporal bones moved into internal rotation on the affected side.

Global testing of the **face** showed motion impairments on the non affected side, too.

Testing the **sutures** proved restrictions of the sphenopetrous suture, petrobasilar and petroiugular suture with four of five children. The motion of zygoma was limited with all five subjects. Temporozygomatic suture was blocked with three children, maxillozygomatic suture with four children.

I was able to observe an increased tension in the region of the **temporomandibular joint**, the capsule and the ligaments with all subjects.

Summarizing there was a general **poor drainage** of body fluids in the cervical area because of increased tension of the cervical fascias, the floor of the mouth with the connections to the hyoid bone, the inlet of the thorax and restrictions in the cervical spine on the side of otitis media. The cervical area is crossed by important structures like arteria carotis communis (aa crotis interna and externa), vena iugularis and nervus vagus (X.). Besides, the lymph vessels

run into the venous system in the cervical region. Tensions within the cervical area lead to blockage of lymph and venous blood.

Increased tension of the diaphragms and limited mobility of the sacrum, too, result in flow impairments of lymph and venous blood out of the inferior body regions. Good motion of the sacrum is essential for circulation of the total body because it represents the connection to the cranial system. Good motion also supports good circulation of the cerebrospinal fluid. The influence of the cerebrospinal fluid on nutrition of the central and peripheral nervous system was explained already.

Cranial restrictions, with the group of subjects especially in the region of sphenobasilar synchondrosis, sphenopetrous suture and the connections of petrous portion of the temporal bone to the occiput, lead to immobility of the auditory tube and decreased drainage out of the tympanic cavity. Intraosseous lesions of the temporal bone reduce the mobility of the osseus part of the auditory tube and decrease ventilation of the tympanic cavity and the mastoid cells. Restrictions between the occiput and C1 have a significant influence on drainage of the iugular vein.

An extension pattern, showed at the base of the skull, causes the internal rotation of the temporal bone – particularly on the affected side. This is a pattern that does not open the lumen of the auditory tube.

With regard to restrictions in the region of the temporomandibular joint, I should like to mention an article by MEW and MEREDITH [38]. They describe in "Middle Ear infection: an orthodontic perspective" how the development of the oropharynx is influenced by posture and function of tongue, lips and mandibula. Being necessary for ventilation of the auditory tube, the pumping activity of the palatine aponeurosis is important, too. With narrow faced children – that means an extension pattern of the sphenobasilar junction – this pumping activity seems to be reduced.

Visceral parameters were found in restricted motions of liver, kidney and bladder. Detoxification and hence metabolic function is connected with the liver. Good functioning is necessary for the immune system, especially in case of allergies. The kidneys, too, have a function of detoxification and discharge and perform an important contribution in blood circulation. The bladder has an essential function of discharge.

Restrictions of the spine were mainly found in the cervicodorsal and dorsolumbar transition and in the cervical spine. These sections are in close connections with the diaphragms. Good motion supports the pumping activity of the diaphragms.

The first impression of tissue quality means to me a global and very important testing. The children being treated by me all showed poor **vitality** and **motion of the connective tissue** at the first treatment. In general they were tired and fatigue. The boys also had pale complexion and partly dark rings under the eyes. Already the second treatment showed an improvement of the vitality of the tissues, after the third treatment at the latest, the metabolic situation was stabilized with all children and the vitality of the tissues normalized.

According to the basic problem of the subject, I have preceded an **individual osteopathic treatment**. The used techniques were adapted, too.

4.3. Audiogram

The results out of seven audiograms and tympanograms are included in the interpretation. They are basis for the approval of my hypothesis. With two children there was a secretory otitis media at both ears.

The results of the audiograms are shown in the below mentioned illustrations. Table 1 shows a survey of the measured values of the respective hearing losses in decibel. “Measurement 1” was preceded prior to the start of the treatment, “Measurement 2” after the end of the treatment (after 8 – 10 weeks). In the line “Improvement” the difference between the values out of the second and the first treatment were calculated.

Table 1. Survey of measured values out of the audiogram of the test group

Subject 1	125 Hz	250 Hz	500 Hz	750 Hz	1000 Hz	1500 Hz	2000 Hz	3000 Hz	4000 Hz	6000 Hz	8000 Hz
Measurement 1	30 dB	25 dB	20 dB	20 dB	15 dB	25 dB	20 dB	20 dB	20 dB	15 dB	30 dB
Measurement 2	5 dB	5 dB	0 dB	0 dB	5 dB	0 dB	0 dB	5 dB	10 dB	5 dB	0 dB
Improvement	25 dB	20 dB	20 dB	20 dB	10 dB	25 dB	20 dB	15 dB	10 dB	10 dB	30 dB

Subject 2	125 Hz	250 Hz	500 Hz	750 Hz	1000 Hz	1500 Hz	2000 Hz	3000 Hz	4000 Hz	6000 Hz	8000 Hz
Measurement 1	20 dB	25 dB	20 dB	20 dB	15 dB	15 dB	15 dB	10 dB	15 dB	40 dB	25 dB
Measurement 2	20 dB	15 dB	15 dB	15 dB	10 dB	10 dB	5 dB	10 dB	20 dB	30 dB	25 dB
Improvement	0 dB	10 dB	5 dB	5 dB	5 dB	5 dB	10 dB	0 dB	-5 dB	10 dB	0 dB

Subject 3	125 Hz	250 Hz	500 Hz	750 Hz	1000 Hz	1500 Hz	2000 Hz	3000 Hz	4000 Hz	6000 Hz	8000 Hz
Measurement 1	20 dB	25 dB	20 dB	20 dB	20 dB	15 dB	15 dB	15 dB	20 dB	25 dB	25 dB
Measurement 2	15 dB	15 dB	15 dB	15 dB	10 dB	5 dB	5 dB	10 dB	10 dB	15 dB	15 dB
Improvement	5 dB	10 dB	5 dB	5 dB	10 dB	10 dB	10 dB	5 dB	10 dB	10 dB	10 dB

Subject 4	125 Hz	250 Hz	500 Hz	750 Hz	1000 Hz	1500 Hz	2000 Hz	3000 Hz	4000 Hz	6000 Hz	8000 Hz
Measurement 1	30 dB	35 dB	35 dB	35 dB	30 dB	30 dB	30 dB	35 dB	40 dB	40 dB	40 dB
Measurement 2	25 dB	25 dB	30 dB	20 dB	20 dB	15 dB	15 dB	25 dB	25 dB	35 dB	25 dB
Improvement	5 dB	10 dB	5 dB	15 dB	10 dB	15 dB	15 dB	10 dB	15 dB	5 dB	15 dB

Subject 5	125 Hz	250 Hz	500 Hz	750 Hz	1000 Hz	1500 Hz	2000 Hz	3000 Hz	4000 Hz	6000 Hz	8000 Hz
Measurement 1	30 dB	25 dB	30 dB	30 dB	25 dB	25 dB	25 dB	30 dB	35 dB	35 dB	35 dB
Measurement 2	10 dB	10 dB	15 dB	15 dB	10 dB	10 dB	15 dB	30 dB	25 dB	25 dB	20 dB
Improvement	20 dB	15 dB	15 dB	15 dB	15 dB	15 dB	10 dB	0 dB	10 dB	10 dB	15 dB

Subject 6	125 Hz	250 Hz	500 Hz	750 Hz	1000 Hz	1500 Hz	2000 Hz	3000 Hz	4000 Hz	6000 Hz	8000 Hz
Measurement 1	15 dB	15 dB	10 dB	10 dB	5 dB	5 dB	10 dB	10 dB	10 dB	10 dB	15 dB
Measurement 2	10 dB	10 dB	5 dB	5 dB	0 dB	0 dB	0 dB	5 dB	5 dB	10 dB	0 dB
Improvement	5 dB	5 dB	5 dB	5 dB	5 dB	5 dB	10 dB	5 dB	5 dB	0 dB	15 dB

Subject 7	125 Hz	250 Hz	500 Hz	750 Hz	1000 Hz	1500 Hz	2000 Hz	3000 Hz	4000 Hz	6000 Hz	8000 Hz
Measurement 1	25 dB	25 dB	20 dB	20 dB	20 dB	20 dB	15 dB	15 dB	20 dB	20 dB	25 dB
Measurement 2	10 dB	10 dB	10 dB	10 dB	5 dB	5 dB	5 dB	10 dB	10 dB	20 dB	20 dB
Improvement	15 dB	15 dB	10 dB	10 dB	15 dB	15 dB	10 dB	5 dB	10 dB	0 dB	5 dB

In table 2 the values of **improvement** in the **frequency ranges** are confronted. Maximum, medium and minimum values are marked and in tables 3 – 5 the diagrams of maximum, medium and minimum values are shown.

Table 2. Improvement in decibel (dB) in the frequency ranges

Improvement	125 Hz	250 Hz	500 Hz	750 Hz	1000 Hz	1500 Hz	2000 Hz	3000 Hz	4000 Hz	6000 Hz	8000 Hz
Subject 1	25 dB	20 dB	20 dB	20 dB	10 dB	25 dB	20 dB	15 dB	10 dB	10 dB	30 dB

Subject 2	0 dB	10 dB	5 dB	5 dB	5 dB	5 dB	10 dB	0 dB	-5 dB	10 dB	0 dB
Subject 3	5 dB	10 dB	5 dB	5 dB	10 dB	10 dB	10 dB	5 dB	10 dB	10 dB	10 dB
Subject 4	5 dB	10 dB	5 dB	15 dB	10 dB	15 dB	15 dB	10 dB	15 dB	5 dB	15 dB
Subject 5	20 dB	15 dB	15 dB	15 dB	15 dB	15 dB	10 dB	0 dB	10 dB	10 dB	15 dB
Subject 6	5 dB	5 dB	5 dB	5 dB	5 dB	5 dB	10 dB	5 dB	5 dB	0 dB	15 dB
Subject 7	15 dB	15 dB	10 dB	10 dB	15 dB	15 dB	10 dB	5 dB	10 dB	0 dB	5 dB
Maximum value	**25 dB**	**20 dB**	**20 dB**	**20 dB**	**15 dB**	**25 dB**	**20 dB**	**15 dB**	**15 dB**	**10 dB**	**30 dB**
Medium value	**13 dB**	**13 dB**	**11 dB**	**12 dB**	**11 dB**	**14 dB**	**13 dB**	**7 dB**	**9 dB**	**7 dB**	**15 dB**
Minimum value	**0 dB**	**5 dB**	**5 dB**	**5 dB**	**5 dB**	**5 dB**	**10 dB**	**0 dB**	**-5 dB**	**0 dB**	**0 dB**

The maximum values of improvement of hearing were measured in the frequency ranges of 125 Hz, 1500 Hz und 8000 Hz. The reached maximum improvements are in the range of 10 – 30 dB. The reached medium improvements are in the range of 5 – 12 dB. The reached minimum improvements are in the range of -5 – 10 dB.

Table 3. Maximum values of improvement of the hearing curve in the single frequency ranges

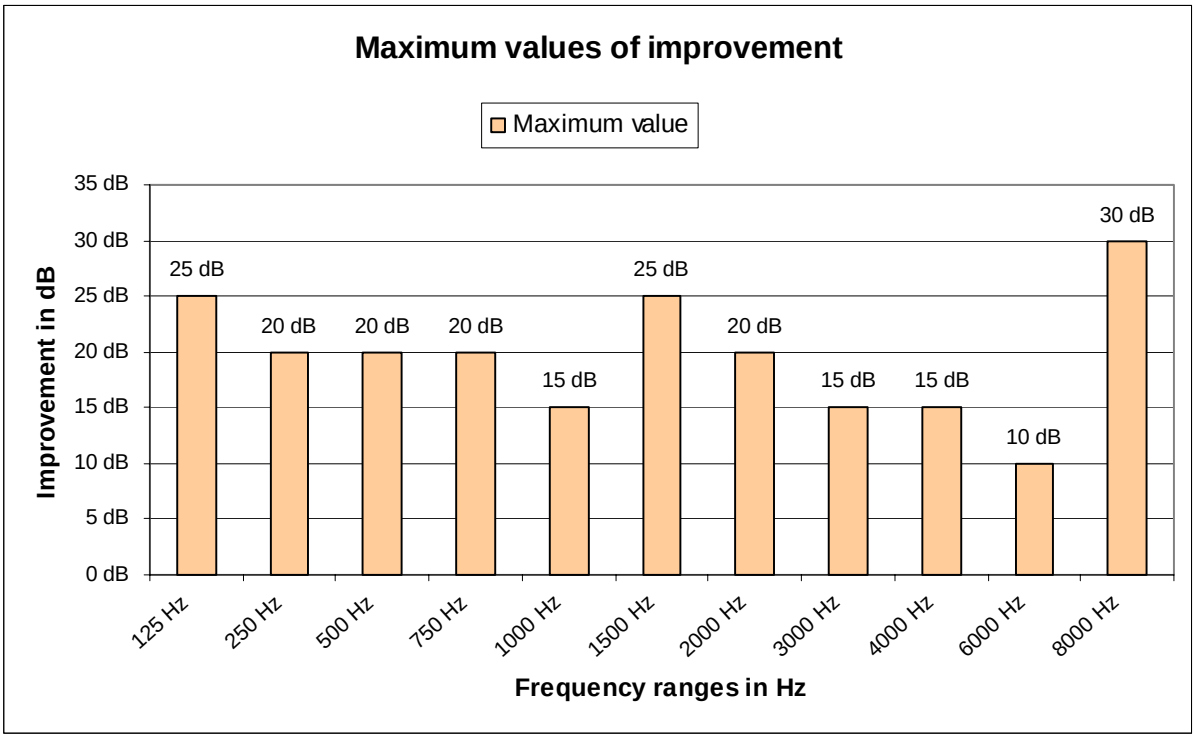


Table 4. Medium values of improvement of the hearing curve in the single frequency ranges

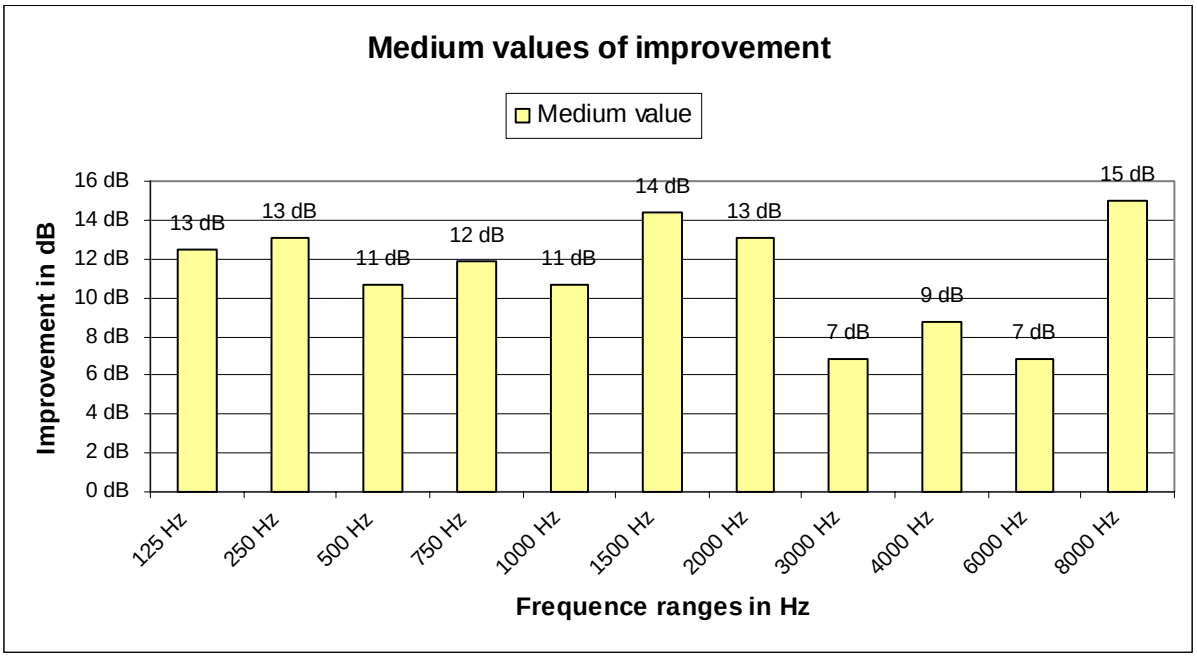


Table 5. Minimum values of improvement of the hearing curve in the single frequency ranges

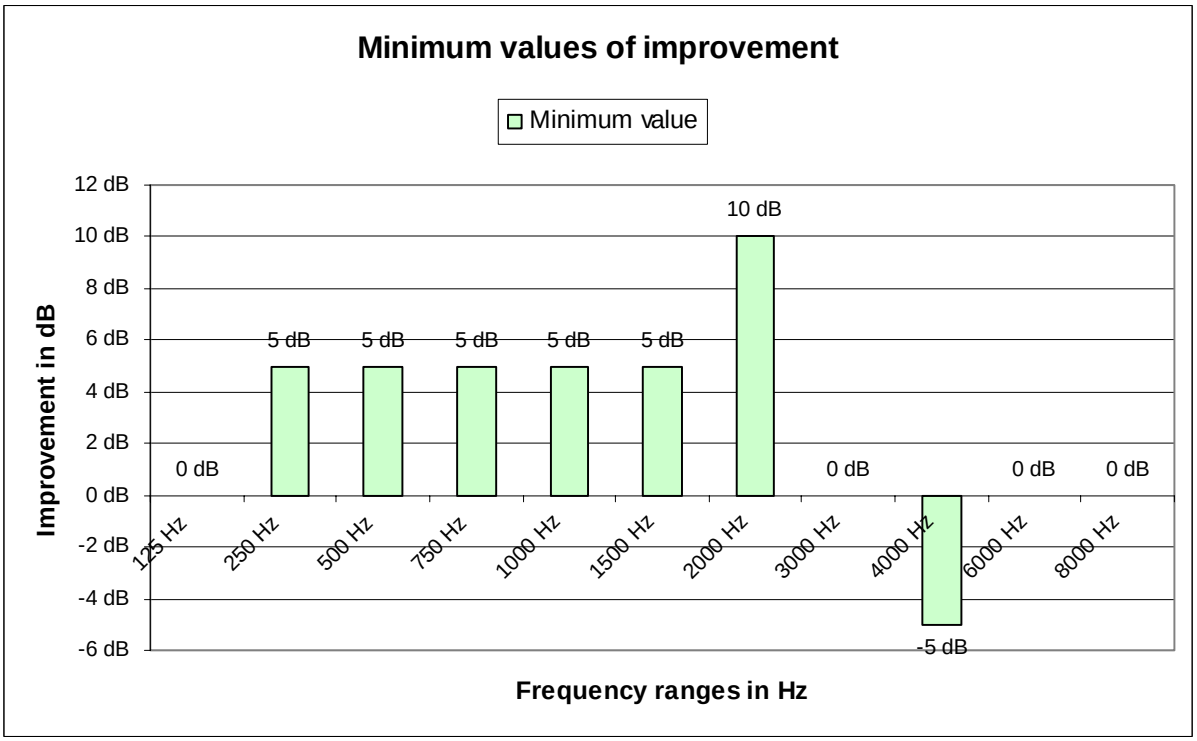
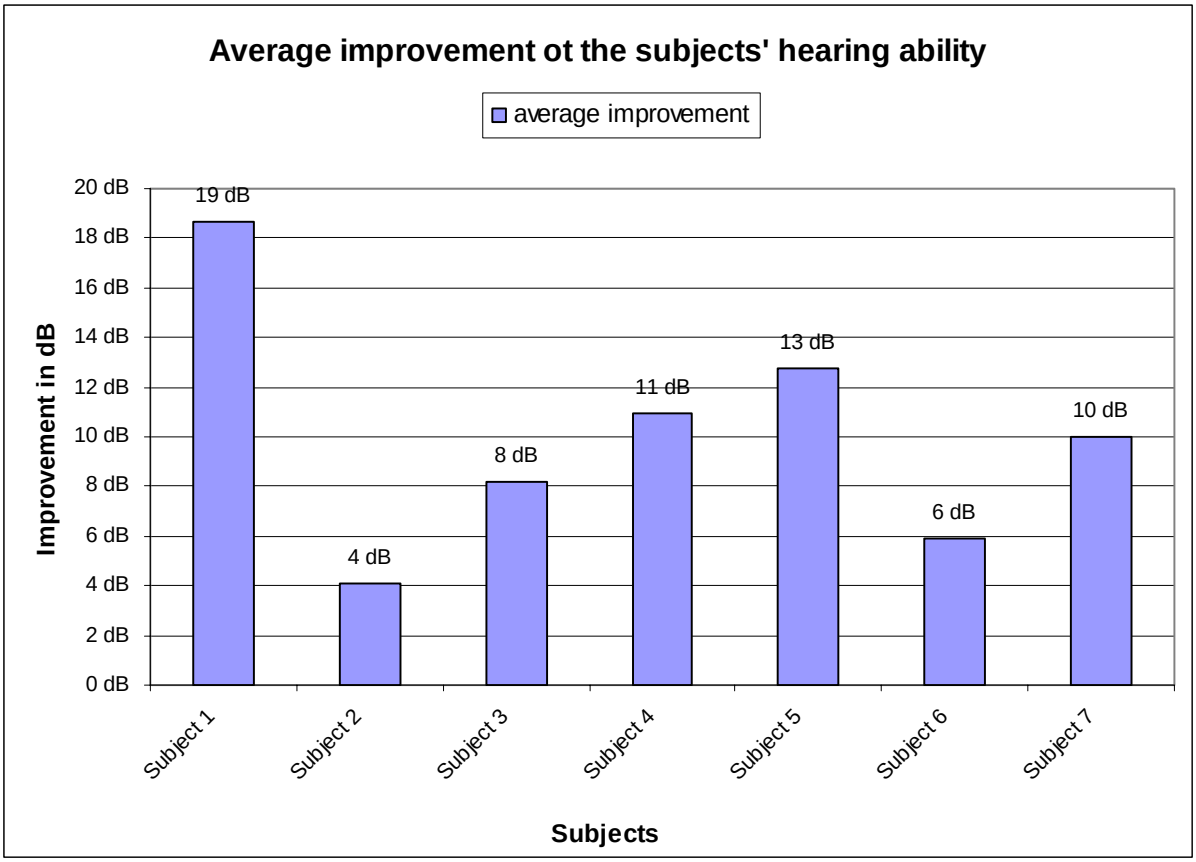


Table 6. Average improvement of the subject's hearing ability in the frequence range 125 – 8000 Hz.



Subject 1 showed the greatest average improvement of hearing ability on the left ear. With subject 2 and 3 an average improvement of 4 dB was reached, with subjects 4, 5, 6, 7 an average improvement could be observed between 6 – 13 dB.

A significant improvement of hearing ability could be proved with all subjects.

4.4. Tympanogram

In table 7 the measurable parameters “Pressure” (in Dekapascal, daPa) and “Compliance” (in millilitre, ml) of the subjects are compared with each other. The improved parameters of the tympanogram are confronted. The improvement results out of the different values between measurement 2 and measurement 1.

Table 7. Survey of results out of the tympanogram

Course of Curve – Valuation Index [1)]							
	Subject 1	**Subject 2**	**Subject 3**	**Subject 4**	**Subject 5**	**Subject 6**	**Subject 7**
Measurement 1	0	0	0	0	0	1	0
Measurement 2	3	0	1	0	2	3	1
Improvement	3	0	1	0	2	2	1
Pressure							
	Subject 1	**Subject 2**	**Subject 3**	**Subject 4**	**Subject 5**	**Subject 6**	**Subject 7**
Measurement 1	-285 daPA	-285 daPA	-164 daPA	-10 daPA	-187 daPA	-81 daPA	-295 daPA
Measurement 2	-16 daPA	-276 daPA	-260 daPA	-10 daPA	-205 daPA	-19 daPA	-295 daPA
Improvement	269 daPA	9 daPA	-96 daPA	0 daPA	-18 daPA	62 daPA	0 daPA
Compliance							
	Subject 1	**Subject 2**	**Subject 3**	**Subject 4**	**Subject 5**	**Subject 6**	**Subject 7**
Measurement 1	0,08 ml	0,04 ml	0,26 ml	0,00 ml	0,00 ml	0,55 ml	0,08 ml
Measurement 2	0,99 ml	0,02 ml	0,07 ml	0,02 ml	0,55 ml	1,13 ml	0,16 ml
Improvement	0,91 ml	-0,02 ml	-0,19 ml	0,02 ml	0,55 ml	0,58 ml	0,08 ml

[1)] The course of curve of the tympanogram was described by means of a valuation index on a scale from 0 – 3.

Table 8. Valuation Index

Valuation Index	**Tympanogram / Course of Curve**	**Meaning**
0	Flat, no maximum	Strongly impaired oscillation of the tympanic membrane
1	Flat with light maximum, deviation to the left	Impaired oscillation of the tympanic membrane, negative pressure in the middle ear
2	Clear maximum, deviation to the left	Lightly impaired oscillation of the tympanic membrane, negative pressure in the middle ear
3	Optimal maximum	Normal oscillation of the tympanic membrane

Table 9. Changed course of curve of tympanogram

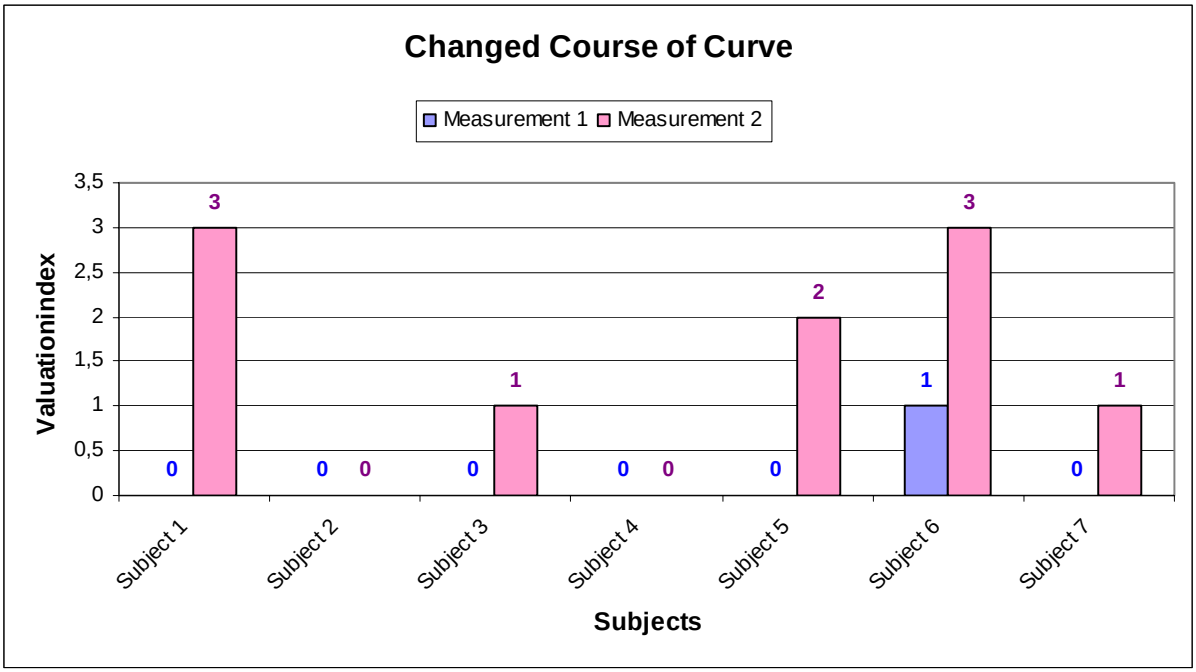
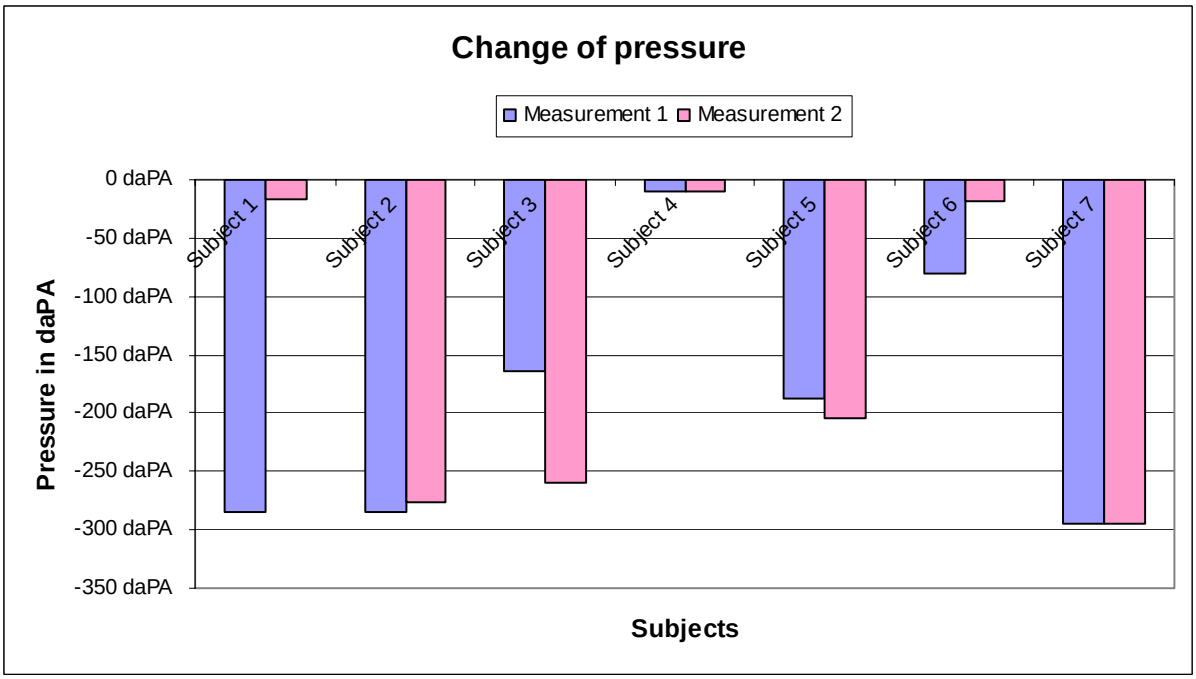


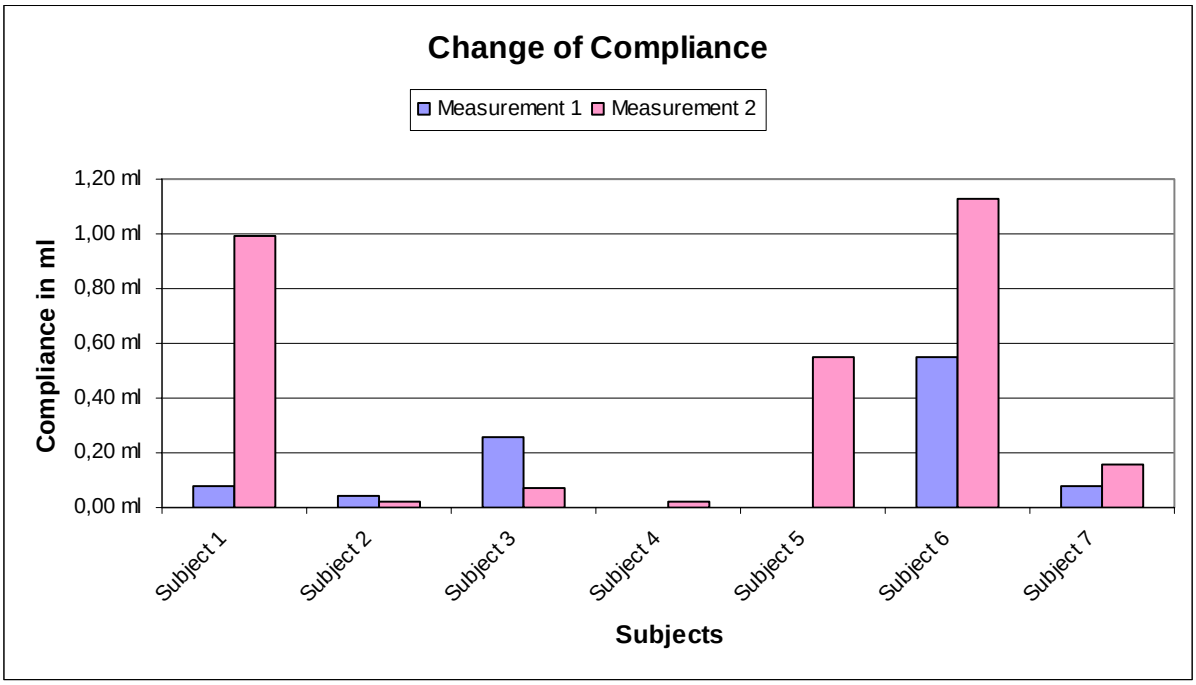
Table 9 demonstrates an improvement of the changed course of the curve of the tympanogram. Subject 1 showed the greatest improvement. Subject 2 and 4 did not show any improvement.

Table 10. Change of the pressure conditions in the middle ear



A significant improvement of the pressure conditions could be observed with subject 1.

Table 11. Change of the oscillation of the tympanic membrane (compliance)



With subject 1, 5, 6 a significant improvement of the compliance happened.

5. Discussion

Three points were for my osteopathic treatment, as for the osteopathic evaluation before, of great importance: the **mechanical** situation of the **auditory tube** with its anatomical connections, the **trophic** situation of the **mucous membrane** of middle ear, mastoid cells and auditory tube and the general **drainage** of lymph and cerebrospinal fluid, which cannot be separated from the venous drainage and the artery supply.

All over these three points there was the question about the **osteopathic lesion**.

Osteopathic lesion with the children was varying: mechanic traumas in the area of the scull, resp. the sacrum; metabolic problems with impairment of liver mobility; excretion deficiency, involving kidneys and bladder. Almost every child showed an interference of lesions.

Every child showed increased tensions in the diaphragms including tentorium cerebelli and a reduced vitality of tissue; and an increased tension in the area of the temporomandibular joint and the cervical fascias at the neck. These can be named as the “common denominator of the osteopathic evaluation“. With the structural, visceral, craniosacral tests, the children showed different results.

After the treatment of the general subject matter of circulation and the affectation of the trophism of the mucous membrane, I was concerned with the mechanic problem in the area of the ear. Since in my judgement secretory otitis media is the outcome of a drainage dysfunction via the tuba auditiva to the pharynx, it is necessary also for the osteopathic treatment to put the (more or less concentrated) liquid in motion again, which means to ensure the drainage from the tympanum via the tuba auditiva into the pharynx. The drainage of the secretion from the tympanic cavity via the tuba auditiva again allows pressure compensation between the exterior auditory canal and the tympanum. Because of the close contact, the segments of the tuba auditiva have with the temporal and the sphenoid bone, a good pumping motion of the tuba indicates on the one hand a good mobility between the sphenoid and the temporal bone and on the other hand appropriate intraosseous elasticity of the particular bones. The named bones are also locations of insertion for Musculus tensor et levator veli palatine and Musculus salpingopharyngeus, whose activity and therefore their trophic can be improved through treatment of the sutures. Musculus tensor tympani has its insertion at the tuba auditiva, its tendon starts at the handle of the malleus. Its function is the bending of the tympanic membrane. Musculus tensor tympani und Musculus stapedius are the two muscles

of the auditory ossicle chain. At a contraction, Musculus stapedius presses the basis of the stapedial bone in the Fenestra vestibule; it leads to a reduction of the air conduction. Through maintaining of a good tension of the auditory ossicle chain both muscles can ensure optimal air conduction. Blood supply and activity of these two little muscles are also dependent on the good elasticity of the tympanum and therefore the temporal bone.

In the charts of the previous chapter, I have schematically demonstrated the changes in the tympanogram and the audiogram before and after my osteopathic treatment.

Within the group of subjects an improvement of the drainage by the tympanogram can be observed. With all children the measurement of the tympanic membrane showed evident improvement towards a normal curve. With two children an improvement could not be observed on the right ear. With one subject there was a significant improvement of the negative pressure in the middle ear, which was determined by the tympanogram, with all other subjects the pressure in the middle ear remained almost unchanged. An improvement of drainage was gained in most of cases after individual osteopathic treatment.

A significant improvement of hearing ability in the audiogram in the frequency range of 125 – 8000 Hz could be proved with all subjects after osteopathic treatment.

With this I could confirm my second hypothesis: Individual osteopathic treatment results in improved drainage from the tympanic cavity. This improvement is shown in tympanogram and audiogram with a group of subjects with otitis media with effusion.

Statistical computation would not have been convincing due to the small number of test persons. The life of the children in my subject group was already a life of suffering and their parents was recommended to undergo an operative procedure in form of a paracentesis mostly with setting of a tympanic cavity wash tube. Only those parents, who wanted to delay or denied the procedure, were sent to me. Five boys remained for my subject group; two of them had problems on both ears.

For sure it would be interesting to repeat the study, with a bigger subject group and randomized, and to take another results after a certain period of time.

This would provide an opportunity to get to know how the immune system could be improved further and maybe prevent relapses.

For my study the question about the osteopathic lesion was very significant. A comparison between different techniques, e.g. craniosacral versus diaphragm techniques could also be

interesting. From my osteopathic examination was evident that with all subjects the tension of the diaphragms was too high and hence the circulation was impaired.

Besides the improved faculty of hearing, which could be proved in the audiogram and immediately was experienced by the children and improved proportions of pressure in the ear, evident from the tympanogram and named by the children as “free, wide” ears, parents recorded that the children were feeling better, were calm and well-balanced. Parents and teachers judged the increased ability of concentration and efficiency, especially in the days after the osteopathic treatment, as very positive. The children would approach tasks directedly and more secure and could solve them in a constructive way. Three of them made major progresses in reading in the time of the osteopathic treatment. The parents of those two children with enuresis nocturna stated that the children did not wetten the bed anymore from the time of the first osteopathic treatment on.

It was noticeable that in a period of 10 weeks all children made a big step in their development in terms of social maturity. The acted more self-confident and target-oriented in their posture and communication with adults.

One boy described his development as follows: “It is not only that I hear better, I also understand better and fell better. Before, I was always scared of reading out aloud at school. But now I can read better and I am even happy, when I am allowed to read.”

The advantage of the osteopathic over a conventional treatment lies therein that the child is in the centre of attention and not otitis media; it is searched for resources in the child to enable an improvement of its condition; and the body gets the opportunity back to work on its healing.

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7. Index of Illustrations and Tables

8. Collection of Reports and Data

On the following pages I have enclosed the information sheet and the statement of agreement for the parents of the subjects as wells as the report.

8.1. Statement of Agreement and Information

Statement of Agreement

I have read the information sheet and agree to the procedure of measuring the hearing curve (audiogram), measuring the tympanic membrane (tympanogram) and the osteopathic treatments of my daughter/son.

Name: Signature:

Name of the child:

Date of birth:

Address:

Phone:

Doctor in Charge:

INFORMATION FOR THE PROCEDURE OF OSTEOPATHIC TREATMENT

WITHIN THE SCOPE OF MY THESIS

In the course of my osteopathic education is necessary to write a thesis in order to achieve international recognition. I am a certified physiotherapist having finished six years of osteopathic education at International School of Osteopathy in Vienna (WSO). The requirements for an internationally recognised finish of the education are on one hand a practical examination for a diploma with the patient in front of an international commission and on the other hand writing a thesis.

Within the scope of my thesis I have put the question to what extent a disordered tubal function resp. a chronic middle ear infection may be positively influenced by an osteopathic treatment.

For the procedure of my thesis a sufficient number of subjects is required in order to prove measurable changes by an osteopathic treatment.

I should appreciate very much your support for my work.

In this respect the following information in particularly important for you:

- Your medical doctor has to agree to the procedure of the osteopathic treatments
- You are not charged with any costs for the osteopathic treatments.
- Since a disordered tubal function resp. middle ear infection reduces audition a hearing curve (audiogram) and measuring of the tympanic membrane (tympanogram) are to be effected, in order to check the result after the undergone osteopathic treatment by repeated issue audiogram and tympanogram.
- The procedure of audiogram and tympanogram as well as the osteopathic treatment are free of pain.
- The process:
    - In the week before the first osteopathic treatment the tests of audiogram and tympanogram are to be executed with your ENT-specialist.
    - The osteopathic treatment takes 60 minutes. In this time a detailed taking of osteopathic findings and treatment are affected.
    - After two weeks there will be the second osteopathic treatment, after three weeks another treatment.
    - After three further weeks: osteopathic final report and irrespectively a check with your ENT-specialist by means of audiogram and tympanogram.
- You agree with your signature to the procedure of audiogram and tympanogram as well as the execution of the osteopathic treatment of your child.

You are given my cordial thanks for the willingness to support my thesis. It is a pleasure for me to be at your disposal for any further information.

Yours faithfully,

Karin Stadler

8.2. Osteopathic Findings Report

Name:	Date:

OSTEOPATHIC FINDINGS REPORT

POSTURE IN STANDING

☐ Anterior type ☐ Posterior type

⇧ Curve of the spine:
☐ Cervical spine
☐ Thoracic spine
☐ Lumbar spine

⇩ Curve of the spine:
☐ cervical spine
☐ Thoracic spine
☐ Lumbar spine

GENERAL LISTENING IN STANDING:

.....

MOBILITY OF THE SPINE:

Cervical spine: .....

Thoracic spine: .....

Lumbar spine: .....

Sacrum: .....

GENERAL LISTENING IN SUPINE POSITION:

.....

EXTREMITIES, PELVIS:

….....

DIAPHRAGMS:

Diaphragm of the thorax: .....

Diaphragm of the pelvis: .....

Thoracic inlet: .....

Tent of cerebellum: .....

VISCERA:

Chapman Reflexes of the viscera:

Organ	Anterior Reflex	Posterior Reflex
MIDDLE EAR		

MANUAL THERMAL DIAGNOSTIC OF FACE AND NECK:

SINUS FRONTALIS		LIVER	
SINUS MAXILLARIES		KIDNEYS	
BRONCHI/LUNGS		BLADDER	

VITALITY/QUALITY OF THE TISSUES:

.....

CRANIAL TESTING:

SSB: ☐ Compression ☐ Adaptation

Bones	Mobility	intraosseous
Sphenoid bone		
Occipital bone		
Temporal bone		
Frontal bone		
Face		
Sacrum		

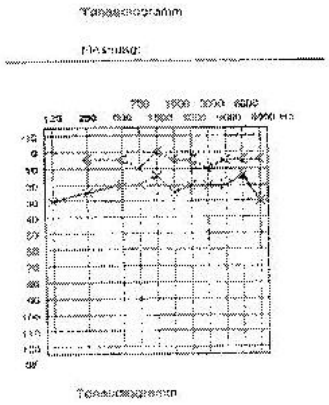
RELATION	MOBILITY	RELATION	MOBILITY
Sacrum – occipital bone		Temporozygomatic suture	
Sphenopetrous suture		Maxillozygomatic suture	
Petrobasilar suture		Frontozygomatic suture	
Petroiugular suture		Temporomandibular Joint	

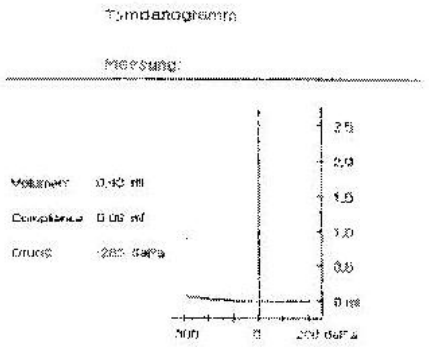
RESULTS	
STRUCTURE	
VISCERAL	
CRANIAL	

8.3. Audiograms and Tympanograms

Subject 1

Measurement 1





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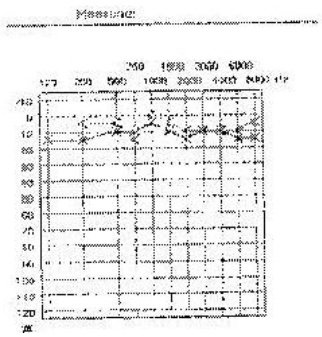
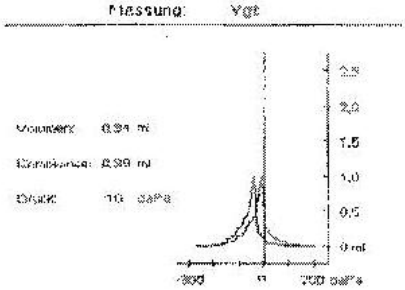
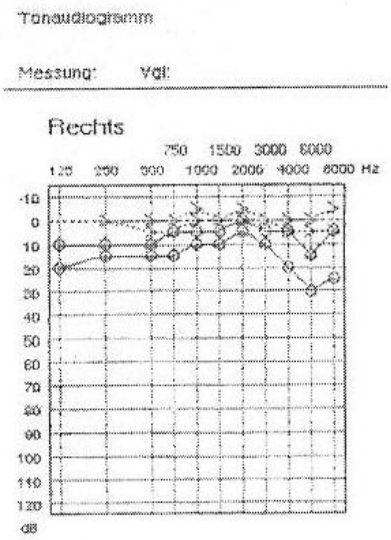
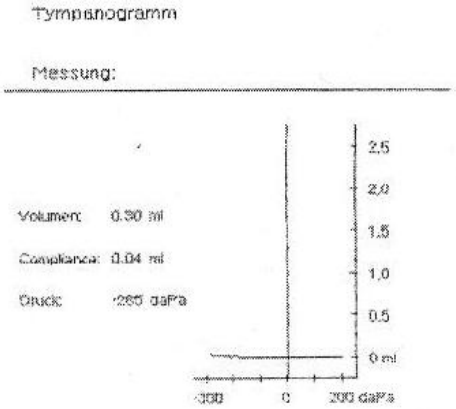




Subject 2

Measurement 1





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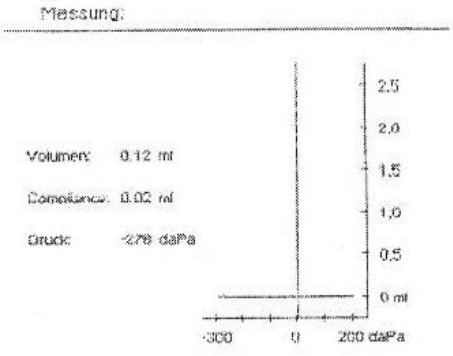

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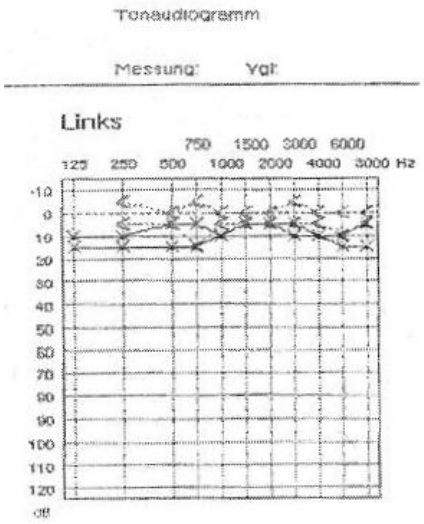
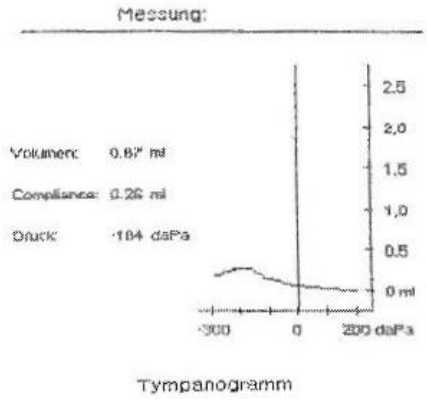
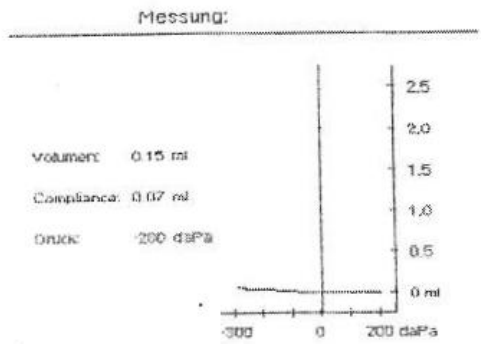
Measurement 1





Tympanogramm

Measurement 2



Subject 4

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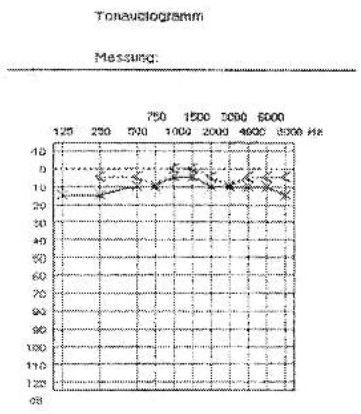
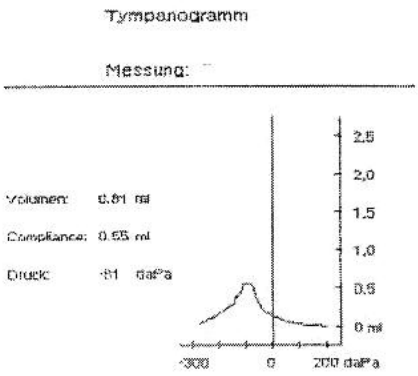
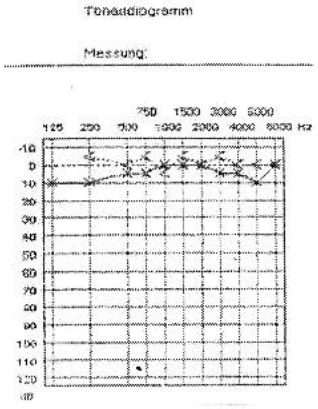
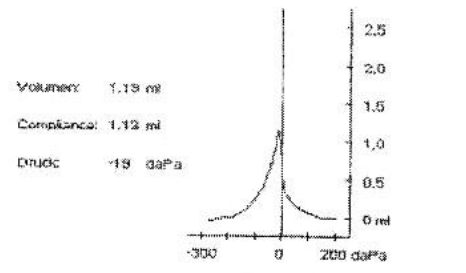




Tympanogramm

Measurement 2





Subject 5

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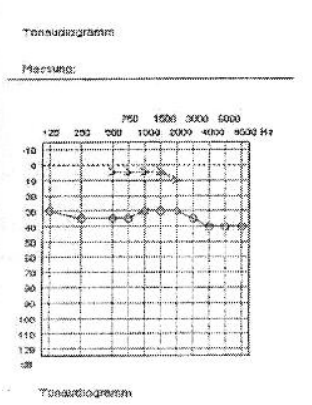

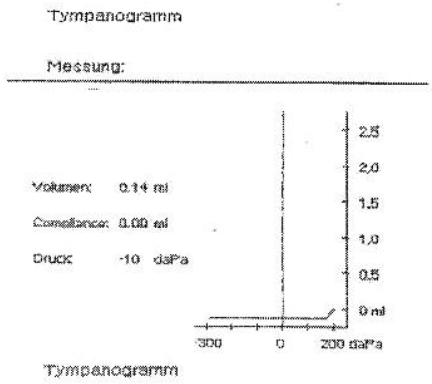

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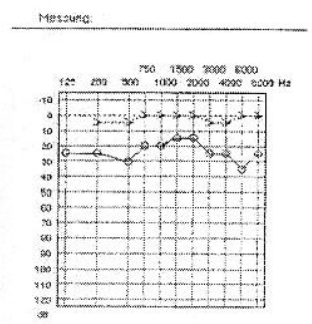
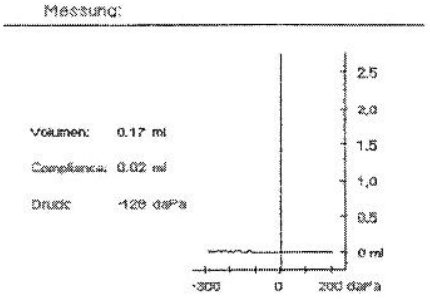
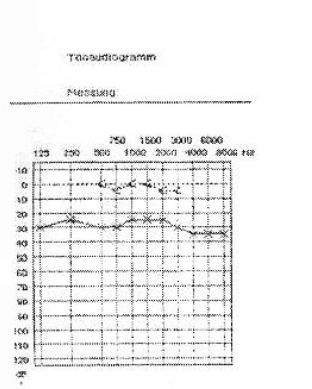
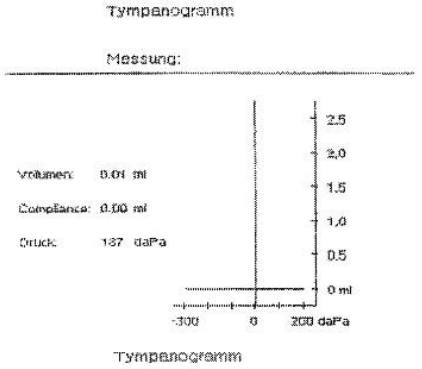




Subject 6

Measurement 1





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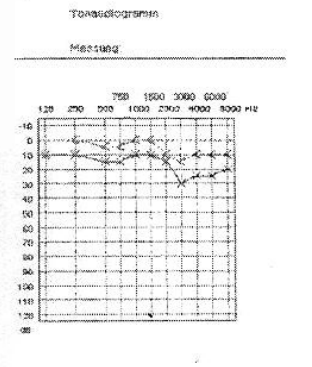
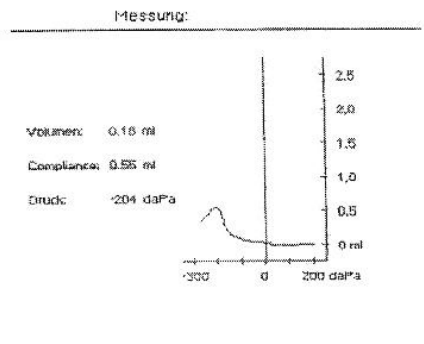
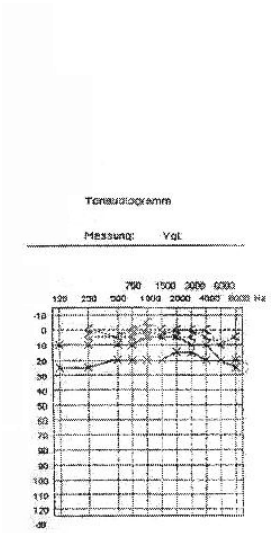
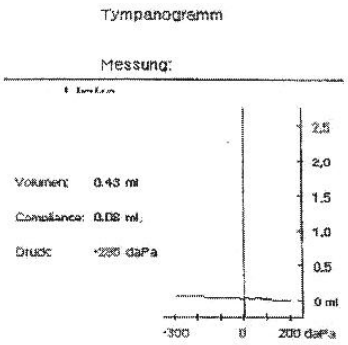




Subject 7

Measurement 1





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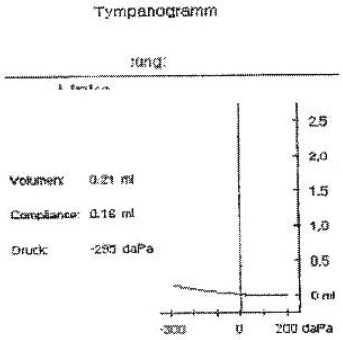

9. Gratitude

First of all I should like to express my very cordial thanks to the subjects and their parents. Thanks to the children for having undergone the tests and treatments and to the parents having been confident in my treatment and having motivated the children all the time.

The practical part of my thesis was a special challenge. Looking for specialists in ear, nose and throat diseases who I informed about my thesis and who were asked to refer patients to me for osteopathic treatment and to effect the measurements before and after the treatments, I often faced refusal and missing understanding. It was said, osteopathy was not recognized and would not achieve anything. The doubts about an “alternative” therapeutic method were big.

In this respect I am particularly grateful to Mrs. Dr. Edith Kundrat, ENT-specialist in Traun, Upper Austria, for her cooperation and support. She enabled the practical part of my thesis by referring seven subjects to me and making audiograms and tympanograms.

Thanks also to Mrs. Claudia Ziegler for translating and to my niece Mrs. Sarah Geißbauer for translating and proofreading my thesis.

The professional development of my thesis was attended by Mrs Katja Twyford, DO, MRO. Thank you very much for your support!

10. Abstract

Favourable results by osteopathic treatment with single children suffering from recurrent middle ear infections were the reason for writing a thesis about secretory otitis media.

Studying medical literature, the wide scope of the chosen theme became evident. Besides the numerous definitions of the problem “recurrent tympanic effusion” in the various publications I found lot of information particularly in osteopathic literature.

Studying special literature war the basis for my reflection and hypotheses. In my study I wanted to find an approval for otitis media being the result of reduced drainage out of the tympanic cavity via the auditory tube. Subsequently recurrent tympanic effusion (secretory otitis media) may easiliy occur again. This flow impairment produces as a consequence a changed tympanogram and audiogram.

The basis for my osteopathic treatment was a well-founded taking of findings within the fields of structural, visceral and cranial osteopathy with the aim for applying osteopathic treatment exactly within these bounds.

Following basic problems became quite apparent during my taking of findings:

- **In general poor drainage of body fluids** caused by blockage in the cervical region, tensions of cervical fascias, the floor of the mouth with its connections to the hyoid bone and the inlet to the thorax and restrictions in the cervical spine on the affected side. Blockage was also found in the region of thoracic and pelvic diaphragms with increased tension of the tissues (lymph) and impaired motion of the sacrum (allergy, cerebrospinal fluid). The tent of the cerebellum showed restrictions with reduced cranial rhythm.
- **Cranial restrictions** in the region of sphenobasilar junction, sphenopetrous suture and the connections of petrous portion of the temporal bone to the occiput, as well as intraosseous lesions of the temporal bone, internal rotation lesion of the temporal bone and restrictions between occiput and C1.
- **Restrictions of the region of the mandibular joint**
- **Visceral parameters** were found in impaired motion of the liver (allery, immune system, detoxification), kidney (drainage) and bladder.
- **Restrictions of the vertebral column** could especially be found in the transition regions (cervicodorsal and dorsolumbal) and in the cercical spine

My test group in the study with the typus within subject design included seven subjects with recurrent tympanic effusion. Inclusion criteria were the age between 6 and 9 years, otitis media with effusion has existed longer than three months, tested in audiogram and tympanogram. Exclusion criteria were acute otitis media and treatment with antibiotics during the osteopathic treatment.

During a period of 8 – 10 weeks the subjects received osteopathic treatments after a detailed taking of findings. Afterwards a re-test of audiogram and tympanogram was executed.

The control tests showed an improvement of the drainage from the tympanic cavity by individual osteopathic treatment. This was shown by tympanogram and audiogram. In the control test of audiogram there was found an improvement of hearing ability in all subjects.

Additionally the parents mentioned an improved concentration power of the children and better emotional control in relation to beginning of the treatments.

The children, themselves, said that they hear better and feel “simply better” (quotation of one boy of the test group).