The Impact of Osteopathic Treatment on Increased Intraocular Pressure in Primary Chronic Open-Angle Glaucoma

MASTER THESIS

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Affirmation

I hereby certify that the work submitted is my own and was written by myself.

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Date Signature

1. Abstract

The aim of this thesis is to investigate whether increased intraocular pressure in primary chronic open-angle glaucoma can be reduced through osteopathic treatment.

In order to investigate this topic a match-controlled study was performed with 20 patients, who had to comply with the defined inclusion or exclusion criteria. Depending on the date of registration the patients were divided into two groups: an experimental group and a control group.

In all patients the primary parameter – intraocular pressure – was measured and recorded in the first and the fifth week by means of Goldmann applanation tonometry through an ophthalmologist. A questionnaire was used to ask the experimental group for the secondary parameters such as headaches, eye pain, neck pain or other symptoms, visual performance and the use of medication including their side effects.

The patients of the experimental group underwent an osteopathic examination in the second, third and fourth week and then received a holistic osteopathic treatment which was matched with their individual state. In the control group only intraocular pressure was measured.

The present study reveals that the treatment results with regard to the primary parameter were slightly better in the experimental group than the control group. With regard to the secondary parameters in the experimental group the osteopathic treatment was very efficient.

2. Preface

Glaucoma is one of the most common causes of blindness and is therefore attracted my interest. Visual loss related to glaucoma is irreversible and for this reason at a certain age eye examination should be part of routine care (Teuchner, 2005). In orthodox medicine all therapeutic interventions in the treatment of primary chronic open-angle glaucoma – be it medication or laser and conventional surgery – aim at the reduction of intraocular pressure. As these interventions are often connected with severe side effects this study investigates in how far intraocular pressure, as one of the major factors in the development of glaucoma, can be influenced by osteopathic treatment (Pfeiffer, 2005).

From an osteopathic viewpoint the reduction of intraocular pressure would be the objectively measurable result of improved microcirculation. Improved microcirculation in the retina and the optic nerve appears to be crucial for balancing fluctuations of blood pressure. Improved functional and structural metabolism could prevent further destruction of the concerned cells.

Osteopathic treatment could then be a possible alternative or a complementary method to lifelong medication.

Osteopathy could be a possibility to improve life quality of glaucoma patients and to prevent them from threatening blindness and loss of the vision field.

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3. Introduction

Glaucoma is an eye disease that damages the optic nerve and affects an estimated 70 million people worldwide. According to literature increased intraocular pressure caused by obstruction of the outflow of aqueous humor is one of the most important but not the only risk factor for the development of glaucoma (Pfeiffer, 2005). Open-angle glaucoma, the most common type, often remains unnoticed by the patient for a long time as the eye pressure rises slowly to 20 – 30 mmHg (sometimes higher). A slowly rising eye pressure is painless and the loss of the visual field progresses from the margin towards the centre. Therefore central vision remains unaffected for a long time and thus the disease often goes undetected. Due to its insidious development glaucoma is often diagnosed very late and for this reason ranks as a leading cause of blindness. As loss of vision caused by glaucoma is irreversible, people of advanced age should have periodic eye examination as part of their routine care (Teuchner, 2005). Besides the measurement of intraocular pressure the ophthalmologist performs visual field testing, evaluation of the optic nerve head and examination with the slit lamp (Berufsverband der Augenärzte BVA 2003, guideline 15c, p. 4).

In the treatment of chronic glaucoma medication with eye drops is still the most common therapy and it aims at lowering intraocular pressure. Today there are several classes of medication which on the one hand decrease aqueous humor production and on the other hand increase the outflow of aqueous humor into the trabecular meshwork. In case the eye drops are not tolerated by the patient or the effect on the elevated intraocular pressure is not satisfactory, Dr. Teuchner suggests that only surgical treatment remains (Teuchner, 2005).

Although there is only little specific literature in osteopathy about this topic, already in the 19th and 20th centuries osteopaths formulated their

theories about this disease. Already Sutherland considered glaucoma an obstruction of the venous outflow due to cranial membranous lesion.

> *In the case of glaucoma, one may reason that the accumulation of fluid points to a condition somewhere back along the intracranial membranous wall of the cavernosus sinus, or in the walls of the petrosal sinus, to a membranous restriction affecting the venous return, and back of that, the possibility of a cranial lesion as an etiological factor (Sutherland, 1998).*

Also Magoun considered glaucoma a dysfunction of the essential vascular mechanism of the eye which is caused by structural lesion.

> *Es heißt, dass ein erhöhter Augeninnendruck von einer Anschwellung des intraokularen Inhalts oder von einer exzessiven Flüssigkeitsansammlung im Augapfel herrührt, was das Auge bei der Palpation spürbar hart erscheinen lässt. Eine strukturelle Läsion, die den vaskulären Mechanismus des Auges angreift, ist die logischste Erklärung (Magoun 1976, p. 295).*

In osteopathic literature methods for the improvement of circulation in the eye and the drainage of aqueous humor are described. Furthermore, methods for the improvement of the arterial supply and the venous and lymphatic drainage in the eye as well as exudate drainage are explained. However, before therapeutic measures are applied in the eye, thorough eye examination and diagnosis by the ophthalmologist are necessary (cf. Liem 2003, pp. 535–546). One of the major principles of osteopathy is that structure and function are reciprocally inter-related. If dysfunction occurs – increased intraocular pressure – structure will be impaired too.
Consequently the question arises if intraocular pressure can be influenced positively through osteopathic treatment methods taking into consideration anatomy and physiology of the eye.

The aim is to influence structures responsible for a normal circulation in the eye in a way that the dysfunctional, elevated intraocular pressure becomes normal intraocular pressure, which is the precondition for a normal microcirculation in the eye.

4. Anatomy and Physiology of the Eye

The following chapter gives a brief explanation of those parts of the anatomy and physiology of the eye which are most relevant for this study as a basis for understanding and applying osteopathic treatment methods. Then the causes of raised intraocular pressure as well as the disease glaucoma will be described.

4.1. Orbit

The orbit is the protecting bony housing of the bulbus with its optic nerve, ocular muscles, nerves and blood vessels as well as the lacrimal gland. These structures are surrounded by layers of fatty tissue. The bony walls of the orbit are made up of seven bones: frontal bone (os frontale), sphenoid bone (os sphenoidale), zygomatic bone (os zygomaticum), lacrimal bone (os lacrimale), ethmoid bone (os ethmoidale), maxillary bone (os maxillare) and the palatine bone (os palatinum) (Lang, 2004).

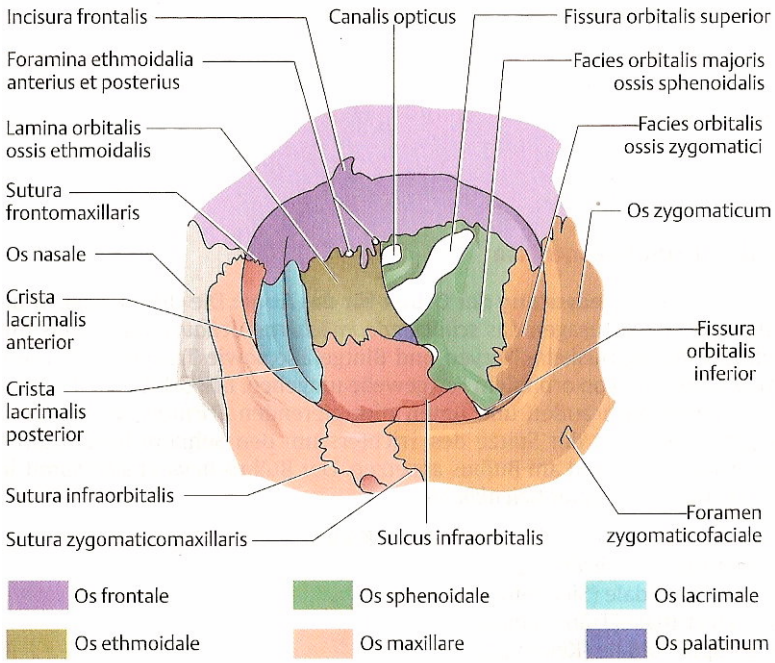


Fig. 1: Front view of the left orbit and the orbital openings

On the top of the bony orbit there are three openings: The **optic canal** gives passage to the optic nerve and the ophthalmic artery into the eye socket. The superior ophthalmic vein leads the blood from the orbit and the eye through the **superior orbital fissure**, which is placed in the lateral wall, into the cavernous sinus. Also the cranial nerves III (oculomotor nerve), IV (trochlear nerve) and VI (abducent nerve) as well as the three branches of the first trigeminal nerve (frontal nerve, lacrimal nerve, nasociliary nerve) pass through this fissure. The **inferior orbital fissure** transmits the infraorbital vessels and its zygomatic branch as well as the inferior ophthalmic vein (Liem, 2003).

Additionally, the vicinity of the orbit to its close structures such as the frontal lobe of the cerebral cortex, frontal sinus, ethmoidal cells, maxillary sinuses, temporal fossa and lower temporal fossa as well as the closeness to the middle temporal fossa and the sphenoidal sinuses. Also optic chiasm, pituitary gland and cavernous sinus are placed in the immediate vicinity of the orbit are of clinical importance (Waldeyer, 2003).

4.2. The Organ of Sight

The organ of sight consists of the two eyes with their protective and auxiliary organs, the visual paths and the visual centres.

4.2.1. Bulbus Oculi

The bulbus oculi consists of three layers: The tunica fibrosa bulbi corresponds to the firm dura mater of the brain, the uvea (tunica vasculosa bulbi) corresponds to the vascularized arachnoid and pia mater and the tunica nervosa bulbi corresponds to the nervous tissue of the cerebral cortex.

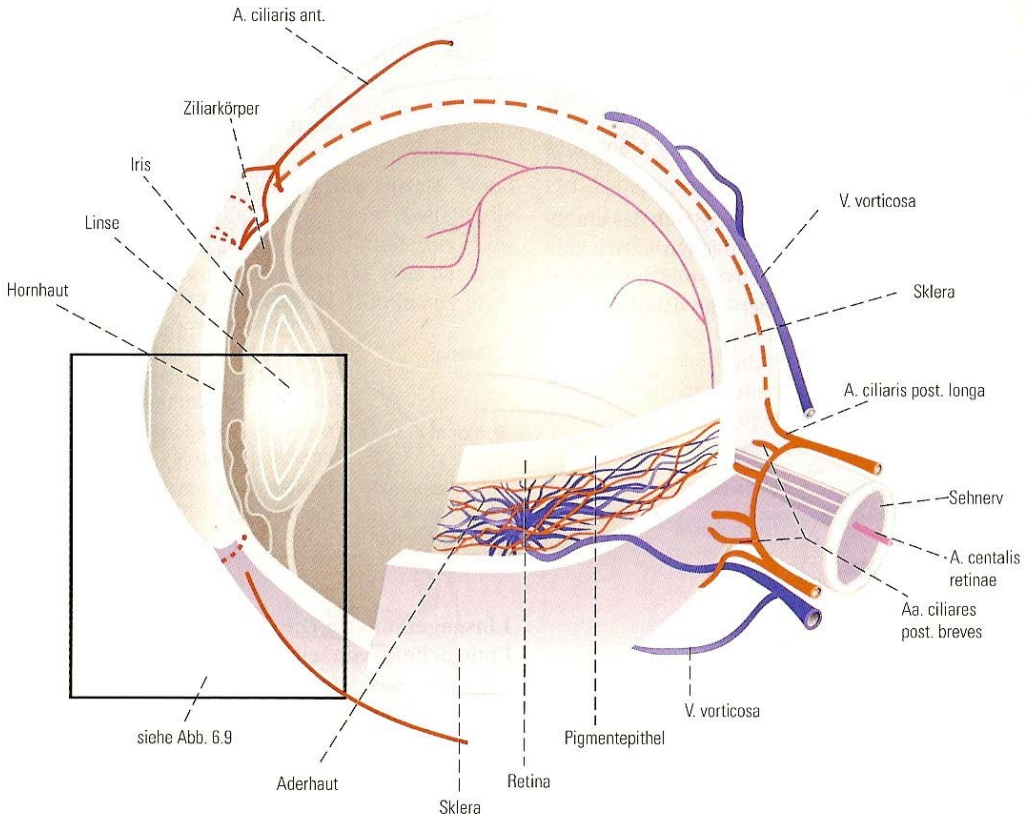


Fig. 2: Bulbus oculi (Waldeier, p. 554)

The **tunica fibrosa bulbi** consists of a white covering called sclera and the avascular transparent cornea. Near the edge of the sclera the canal of Schlemm (sinus venosus sclerae) is located, which is responsible for the drainage of the aqueous humor. The sinus venosus sclerae which is located in the chamber angle drains the aqueous humor from the trabecular meshwork into the episcleral veins.

The uvea (**tunica vasculosa bulbi**) consists of the iris, the ciliary body and the choroid. The iris is a pigmented disc which is perforated by the pupil and regulates the amount of light entering the eye. The ciliary body contains the ciliary muscle which is responsible for the accommodation of the lens and the ciliary processes which secrete the aqueous humor. The choroid consists of a spongy tissue that furnishes blood supply to the photoreceptors of the retina. According to Waldeyer (2003) the choroid is the most vascularized tissue of the human body.

The **tunica nervosa bulbi** consists of the pigment epithelium and the retina. The choroid nourishes the outer third of the retina. The pigment

epithelium facilitates the interchange processes between choroid and retina. The retina converts the entering light into neural impulses (Liem, 2003; Waldeyer, 2003; Lang, 2004; Schlote, 2004).

4.2.2. Chambers

The anterior chamber is the space between the cornea, the iris and the lens. The posterior chamber is located between the lens, the iris and the ciliary body. The two chambers are filled with a gel-like cell-free watery fluid (aqueous humor) and they are connected through the pupil (Liem, 2003).

4.2.3. Chamber Angle

At the chamber angle the front of the iris meets with sclera and cornea. The chamber angle is lined with the trabecular meshwork (Waldeyer, 2003).

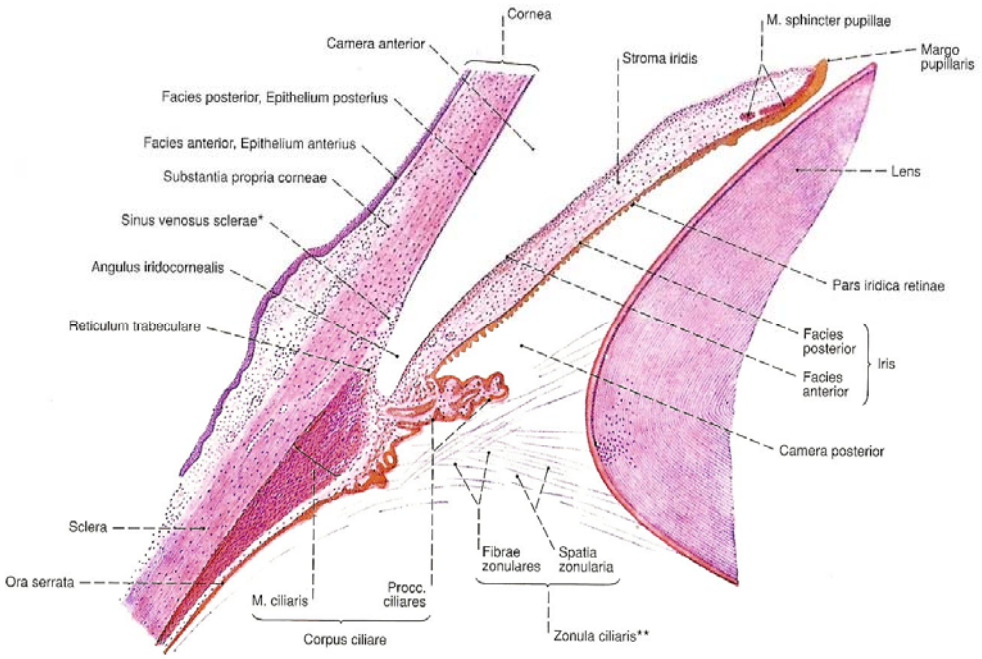


Fig. 3: Chamber angle, angulus iridocornealis (Sobotta 2000, p. 368)

4.2.4. Optic Nerve

The optic nerve is a continuation of a cranial nerve. It originates from retinal ganglion cells which leave the bulbus through the lamina cribrosa of the sclera. The site where the retinal ganglion cells leave the eye is called optic papilla. It is not supplied with photoreceptors and is therefore a physiological "blind spot". The optic nerve is covered by the meninges. The subarachnoid space contains cerebrospinal fluid and thus increased pressure is transmitted to the optic papilla (Patzelt, 2005).

The right and the left optic nerve cross at the optic chiasm which is placed at the diaphragma sellae. The optic nerve rests in close proximity to the internal carotid artery, cavernous sinus, third ventricle, pituitary stalk and pituitary gland. The fibres of the optic tract pass to the thalamus and to the visual centre in the cortex of the occipital lobe (Liem, 2003).

4.3. Blood Vascular System

The **arterial supply** of the eye is furnished by the ophthalmic artery which is a branch of the internal carotid artery. The ophthalmic artery branches into two separate vascular systems, the central artery of retina, which mainly supplies the inner layer of the retina, and the ciliary arteries, which mainly supply the tunica vasculosa bulbi (Waldeyer, 2003). In the pia mater of the optic nerve there is an artery plexus which together with some intraneural arteries nourishes the optic nerve and the retina (Carreiro, 2004).

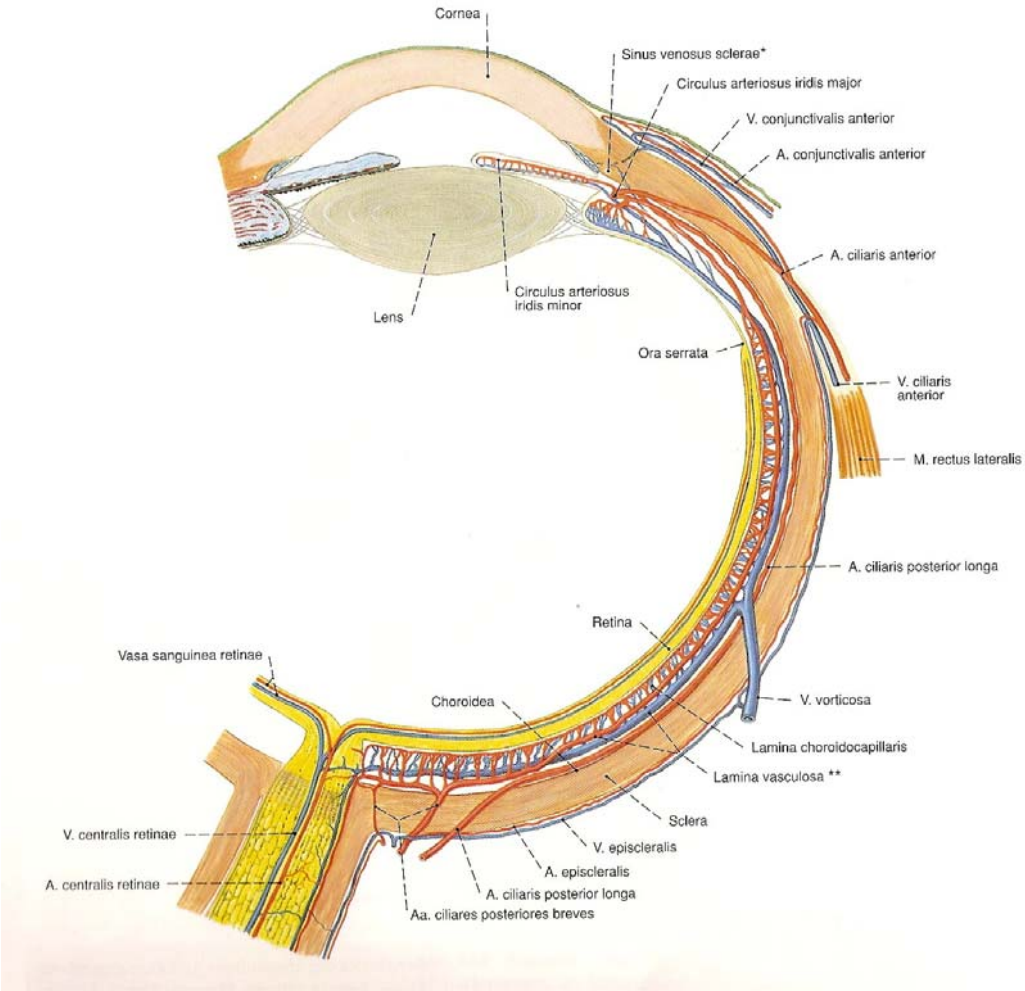


Fig. 4: Blood vessels of the bulbus oculi; schematic representation (Sobotta, 2000; p. 367)

The **venous blood** from bulbus and orbit is carried through the ophthalmic superior and ophthalmic inferior vein to the cavernous sinus. The central vein of retina receives the temporal veins, nasal veins, macular venules and medialis venules of retina and flows into the ophthalmic superior vein, which runs forward through the superior orbital fissure to the cavernous sinus (Waldeyer, 2003). The superior ophthalmic vein, the nasofrontal vein and the angulary vein are connected with the veins of the superficial and lower facial area. Ciliary veins run forward together with the anterior ciliary arteries which also drain conjunctiva and episclera. All the other veins of the uvea (iris, ciliary body, choroids) flow into the vorticose veins (Waldeyer, 2003).

The inferior ophthalmic vein runs through the inferior orbital fissure into the superior ophthalmic vein or directly into the cavernous sinus. The inferior ophthalmic vein is closely connected with the pterygoid plexus (Liem, 2003).

The fact that the superior and inferior ophthalmic veins as well as the central artery of retina flow into the cavernous sinus jointly seems of great importance.

The **sinuses of the dura mater** are relatively inflexible venous channels which do not posses valves. They drain the venous blood from the brain, the dura mater, the orbit and the inner ear. The veins of the brain flow into the venous blood channels. The internal jugular vein drains the blood through the foramen jugulare out of the scull. Tensions in the dura mater can reduce the diameter of the sinuses and therefore obstruct venous drainage (Liem, 2001).

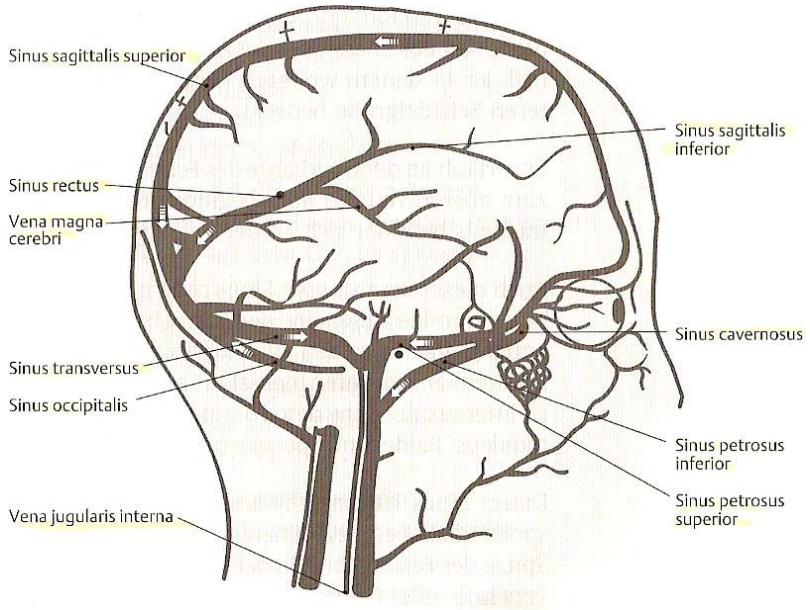


Fig. 5: Lateral view of the sinuses of the dura mater (Liem 2001, p. 205)

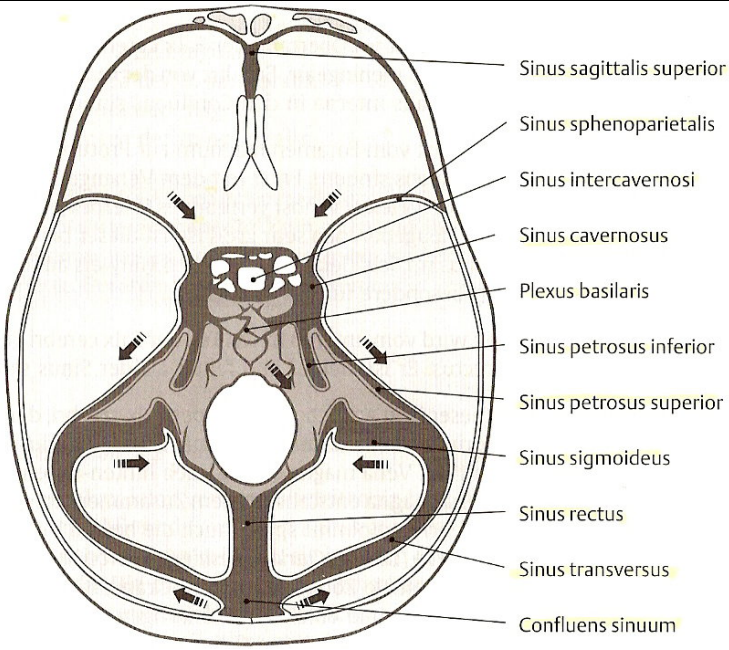


Fig. 6: Sinuses of the dura mater from above (Liem 2001, p. 2006)

Superior saggital sinus: begins at the crista galli posterior and runs along the border of the falx cerebri, continues to the internal occipital protuberance and terminates at the confluence of sinus;

Occipital sinus: commences at the foramen magnum and continues to the confluence of sinus. It is connected with the small venous channels at the foramen magnum and with the internal vertebral venous plexuses;

Inferior saggital sinus: courses along the border of the falx cerebri and continues to the straight sinus;

Straight sinus: is situated at the line of junction of the falx cerebri, the falx cerebelli and the tentorium cerebrelli; it receives the great cerebral vein which is formed by the union of the two internal cerebral veins and it ends in the confluence of sinuses;

Basilar plexus: consists of several interlacing venous channels which are located on top of the clivus and serve to connect the cavernous sinus and the petrosal sinus with the venous channels of the vertebral canal;

Confluence of sinuses: is found beneath the occipital protuberance and drains the superior sagittal sinus, straight sinus, transverse sinus and occipital sinus;

Intracavernous sinus: connects the cavernous sinuses;

Transverse sinus: commences at the confluence of sinuses and passes along the lateral attachment of the tenterium cerebelli and ends at the petrous portion of the temporal bone.

Sigmoid sinus: follows a tortuous course in the mastoid portion and the petrous portion of the temporal bone; it connects the transverse sinus and the internal jugular vein;

Superior petrosal sinus: runs along the upper edge of the petrous portion and continues to the cavernous sinus and the upper part of the sigmoid sinus; it receives blood from the ophthalmic vein;

Inferior petrosal sinus: runs between the apex of the petrous portion and the occiput – sphenoid base; at the foramen jugulare it receives the internal jugular vein; it receives blood from the ophthalmic vein;

Cavernous sinus: collection of veins creating a cavity bordered by the corpus sphenoidale; this sinus receives the eye veins; from this site the venous blood is drained into the petrosal sinus; on the medial wall of this sinus the carotid artery and cranial nerve IV are located; the cranial nerves III, IV and V1 pass at the lateral wall.

4.3.1. Lymphatic System

Also the drainage of the lymphatic system is of great importance for well functioning physiological processes in the area of the head. Congestion causes accumulation of metabolites in the extracellular environment and therefore a dysfunctional cell metabolism. Various factors are necessary for the drainage of interstitial fluid into the venous system, such as balanced muscular activity, the functioning of the diaphragm as lymphatic pump, the arterial vascular pulse as a pump, innervation to the lymphatic vessels by the autonomic nervous system, the tension of the connective tissue and the fasciae, the difference of the filtration rate of the blood from the vessel into the tissue as well as the state of the thoraco cervical diaphragm (Liem, 2001).

The regulation of the lymphatic system is essential for a physiological cell metabolism in the eye. In this connection particularly the parotid lymph nodes and the submandibular lymph nodes have to be mentioned as major outflow for conjunctiva and eyelids, and the cervical lymph nodes as outflow for all lymph nodes of head and neck.

4.4. The Autonomic Nervous System

The eye is innervated by sensitive, sympathetic and parasympathetic nerve fibres (Waldeyer, 2003). This section describes the most important sympathetic and parasympathetic innervation to the eye.

4.4.1. Sympathetic Nerve

The sympathetic fibres commence at the ciliospinal centre (spinal segments C8 – TH2) and cross the superior cervical ganglion until they reach the internal carotid plexus. This sympathetic root passes the ciliary ganglion, does not synapse with the ganglion and runs through the superior orbital fissure into the orbita (Liem 2003). The sympathetic fibres find their way by the long and short ciliary nerves to the eye. They pierce the sclera and accompany the vessels of iris and ciliary body where they cause vasoconstriction.

The dilitator pupillae muscle is supplied with sympathetic nerves fibres. (Waldeyer, 2003).

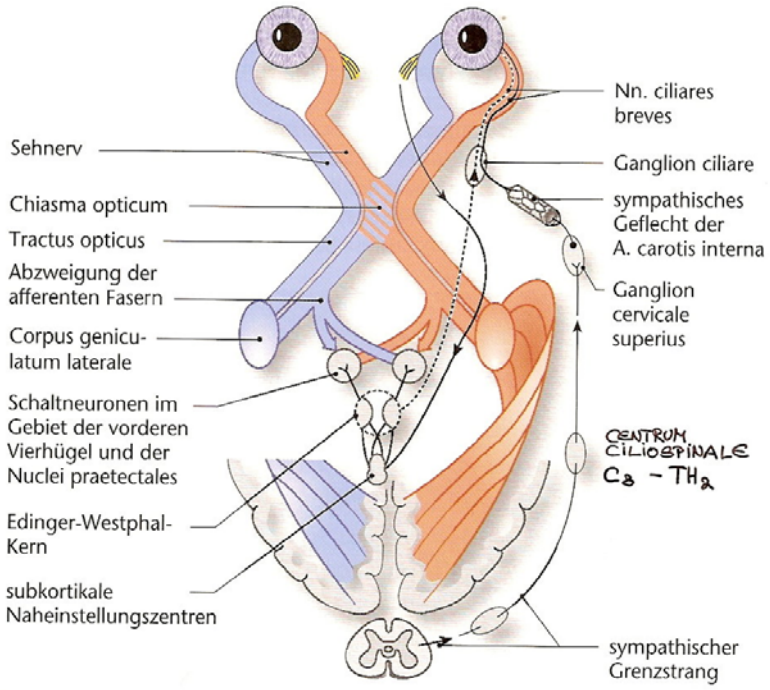


Fig. 7: Sympathetic nerve supply to the eye (Patzelt 2005, p. 80)

4.4.2. Parasympathetic Nerve

The parasympathetic fibres originate from the parasympathetic nucleus of cranial nerve III (oculomotor nerve) or at the pterygopalatine ganglion. Secretory parasympathetic fibres innervate the lacrimal gland.

Fibres of the oculomotor nerve synapse with the ciliary ganglion and travel to the eye as short ciliary nerves where they innervate the sphincter pupillae muscle and the ciliary muscle (Waldeyer, 2003). According to Esser (2002) the stimulation of the third cranial nerve provokes the drainage of the aqueous humor, but does not influence its formation.

The eye is not only supplied by the oculomotor nerve but also by parasympathetic fibres of the cranial nerve VII (facial nerve). Postganglionic fibres of the facial nerve commence at the pterygopalatine ganglion and travel as orbital branches through the inferior orbital figure into the eye socket (Liem, 2003). According to Esser (2002) the inhibition of the pterygopalatine ganglion has caused a reduction of the intraocular pressure in glaucoma patients.

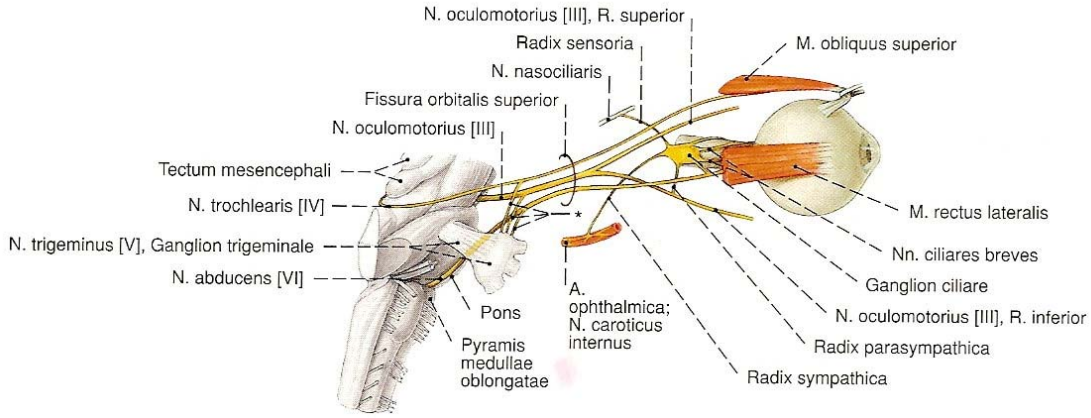


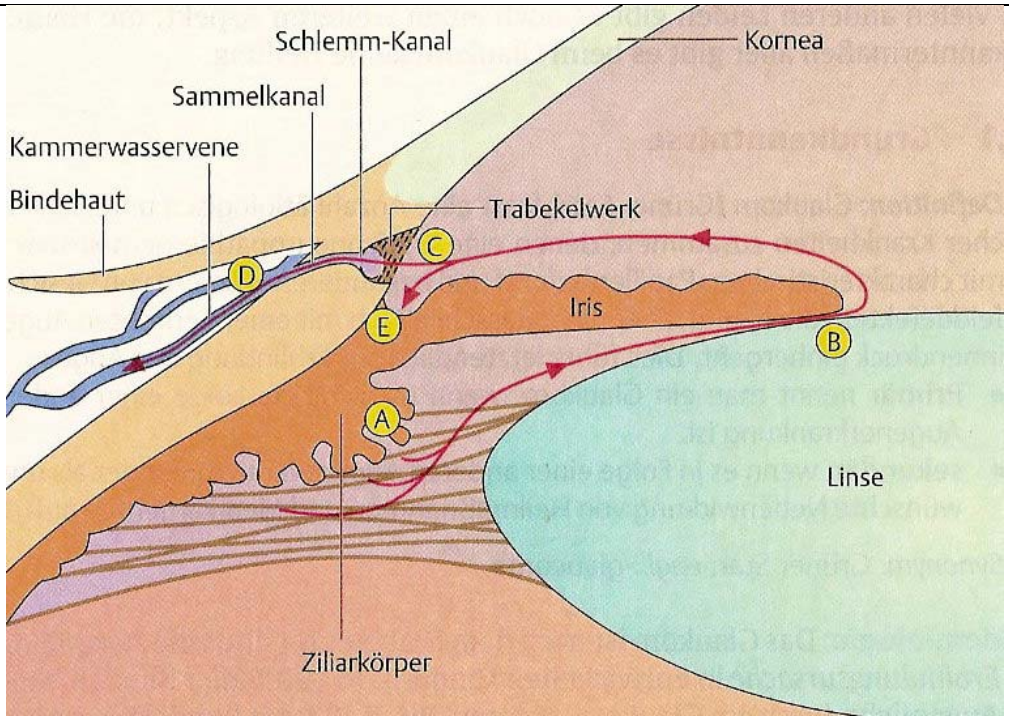
Fig. 8: Oculomotor nerve, trochlear nerve and abducent nerve; lateral view (Sobotta 2000, p. 271)

5. Intraocular Pressure

Normal intraocular pressure (IOP) of an adult lies at 15 mmHg at an average, which is significantly higher than the average tissue pressure in almost all the other organs in the human body. Intraocular pressure is important for the optical image, because it maintains not only the smooth curvature of the cornea, the constant distance between cornea – lens – retina, but also facilitates balanced alignment of the retinal photoreceptors and the pigment epithelium (Lang, 2004).

5.1. Physiology and Pathophysiology of Aqueous Humor Circulation

Aqueous humor is a gel-like cell-free transparent fluid (Liem, 2003). It nourishes the avascular tissues like the lens, the inner layer of the cornea and the structures of the chamber angle. A constant intraocular pressure of 15-20 mmHg results from the balance between the production and drainage of aqueous humor. The pressure is maintained by the resistance provided by the trabecular meshwork and it facilitates smooth drainage into the episcleral veins (Waldeyer, 2003).



On its way from the non-pigmented ciliary epithelium A to the conjunctiva D the aqueous humor has to overcome two physiological resistances: Pupillary resistance B and trabecular resistance C.

Fig. 9: Physiology of aqueous humor circulation

The aqueous humor is produced by the ciliary processes and excreted into the posterior chamber. On its way from the non-pigmented ciliary epithelium to the conjunctiva the aqueous humor has to overcome two physiological resistances: The pupillary resistance and the trabecular resistance. The first resistance, the pupillary resistance, is found at the site where the aqueous humor flows through the pupil into the anterior chamber. The iris is located at the front face of the lens and it can only lift off the lens when the pressure in the posterior chamber is sufficiently high. The aqueous humor then flows intermittently into the anterior chamber. An increase of the pupillary resistance provokes a pressure increase in the posterior chamber, and thus the root of the iris moves in front of the trabecular meshwork and causes congestion. This mechanism is of great importance in pathogenesis of angle-closure glaucoma (Lang, 2004). Approximately 85% of the aqueous humor flow from the anterior chamber through the trabecular meshwork, which is located in the chamber angle, into the canal of Schlemm. The aqueous humor is directed

through the canal of Schlemm into the episcleral aqueous veins. The trabecular meshwork is an elastic, spongy, avascular tissue. The trabecular meshwork is the second physiological resistance. In open-angle glaucoma the trabecular resistance is increased (Lang, 2004). The remaining 15% of the aqueous humor pass through the uveoscleral vascular system towards the ciliary body and choroids where the humor is resorbed by venous vessels (Waldeyer, 2003).

As already mentioned, IOP is a result of the aqueous humor production on the one hand and the drainage of the same on the other hand. Elevated IOP is not caused by increased production but results from reduced outflow capacity of the aqueous humor (Pfeiffer, 2005).

6. Glaucoma

The term *glaucoma* covers a wide range of eye diseases, which cause progressive damage of the optic nerve and thus lead to the loss of its visual function. "Der individuell zu hohe Augeninnendruck ist ein wichtiger pathogenetischer und Risikofaktor der Erkrankung, aber kein unabdingbarer Bestandteil der Glaukomdefinition mehr" (Pfeiffer 2005, p. 1). Also IOP fluctuations as well as vascular factors such as poor circulation in the papilla are of great importance. Today it is known that elevated IOP is almost always caused by inadequate drainage of the aqueous humor (Pfeiffer, 2005). The ratio between intraocular pressure and blood pressure within the retinal blood vessels is crucial for the nutrition of the retina. Microcirculation in the retina and the optic nerve is increasingly receiving attention as an important factor. If microcirculation cannot balance fluctuations of blood pressure sufficiently this leads to poor circulation which causes impairment of functional metabolism. Impaired structural metabolism eventually results in damaging the concerned cells (Mutschler et al, 2001).

6.1. Definition of Glaucoma

Glaucoma is a collection of disorders in the eye characterized by the following three factors:

- Elevated IOP
- Visual field loss
- Papillary excavation with atrophy of the optic nerve head (DOG, 2005)

6.2. Epidemiology

Glaucoma affects an estimated 70 million people worldwide (Teuchner 2005, p. 10). Prevalence of glaucoma in Europe and the United States is an estimated 0.5 - 2% of individuals aged 40 and over, and it increases significantly with age. Also in industrial countries approximately 50% of

glaucoma cases remain undiagnosed. Whites suffer more frequently from primary open-angle glaucoma while in Asia angle-closure glaucoma is prevailing. Glaucoma is the leading cause of blindness worldwide and therefore represents a considerable socioeconomic challenge (DOG, 2005).

6.3. Risk factors

For a long time elevated intraocular pressure was considered the main cause for the development of glaucoma. Today it is known that increased IOP is only one of many other risk factors (Mutschler et al, 2001). Nevertheless elevated IOP continues to be considered one of the major causes in the development of glaucomatous damage. Normal IOP lies between 10.5 and 21 mmHg. However, pathologically increased IOP is not anymore defined through a certain pressure level, but rather relates to those cases where there is glaucomatous damage (Pfeiffer, 2005). As the risk of further progression of the disease reduces by approximately 10% per each 1 mmHg by which IOP is lowered, it is crucial to investigate the exact intraocular pressure level in order to prevent further development of the glaucoma (DOG, 2005).

Besides individually elevated intraocular pressure genetics (ethnic differences, positive family anamnesis), myopia (near-sightedness), age and especially vascular dysregulation are considered to play a role as involved risk factors (DOG, 2005). Furthermore, it is known that abnormal fluctuations of IOP may lead to further progression of the glaucomatous damage (DOG, 2005). Strong fluctuations of IOP are more damaging than an elevated but more stable IOP level (Pfeiffer, 2005).

6.4. Types of Glaucoma

Glaucomas can be classified according to their pathophysiology. According to the anatomical configuration of the anterior chamber glaucoma types

are differentiated between angle open-angle glaucomas and angle-closure glaucomas. Further distinction is made between primary glaucomas (primary open-angle glaucoma, primary angle-closure glaucoma, primary congenital glaucoma) and secondary glaucomas, which occur as a consequence of other ocular or general diseases (Burk, 2005). Accounting for approximately 90% of all glaucoma cases, primary open-angle glaucoma is the most common type. The primary chronic open-angle glaucoma (glaucoma chronicum simplex) is sub-divided into primary chronic open-angle glaucoma (POAG) with increased intraocular pressure and POAG with normal intraocular pressure, the normal-tension POAG (Pfeiffer, 2005). In the sense of differential diagnosis ocular hypertension has to be mentioned, in which symptoms like increased IOP and other characteristic symptoms in the optic nerve and the visual field are missing.

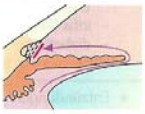
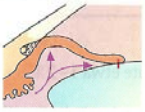
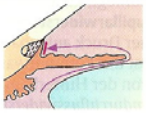
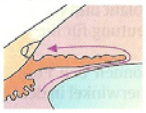
Glaukomform		Häufigkeit	Kammerwinkel anatomisch	Kammerwinkel gonioskopisch	Abflussbehinderung
Offenwinkel-glaukom	primär 	über 90% aller Glaukome	offen	voll einsehbar; unauffällige Strukturen	im Trabekelwerk
	sekundär 	2–4% aller Glaukome	offen	voll einsehbar; Trabekelwerk und sekundär verlegende Zellen erkennbar	durch Erythrozyten, Pigment, Entzündungszellen, die das Trabekelwerk verlegen
Winkelblock-glaukom	primär (Pupillar-block-glaukom) 	etwa 5% aller Glaukome	blockiert	nicht einsehbar, keine Kammerwinkelstrukturen erkennbar	durch Irisgewebe, das das Trabekelwerk verlegt
	sekundär 	2–4% aller Glaukome	blockiert	nicht einsehbar, keine Kammerwinkelstrukturen erkennbar, verlegende Strukturen erkennbar	durch Verlegung des Trabekelwerkes durch vordere Synechien, Narben sowie neugebildete Gefäße (= Rubeosis iridis)
kindliches Glaukom		1% aller Glaukome	nicht ausdifferenziert	einsehbar; verlegendes embryonales Gewebe und mangelnde Ausdifferenzierung erkennbar	im Trabekelwerk, welches nicht voll ausdifferenziert ist und/oder durch embryonales Gewebe verlegt ist
absolutes Glaukom	keine eigene Glaukomform, sondern beschreibt ein am Glaukom erblindetes, oft schmerzhaftes Auge				

Fig. 10: Types of glaucoma (Lang, p. 254)

6.5. Primary Open-angle Glaucoma

6.5.1. Definition

The primary chronic open-angle glaucoma (POAG) usually occurs in persons of advanced age and it is characterized by slowly progressive development. The chamber angle is always open (Lang, 2004).
According to Burk (2005) POAG is a neuropathy of the optic nerve through the slowly progressing loss of retinal ganglion cells and ensuing visual field defects with a normally developed chamber angle.

The German Professional Association of Ophthalmologists (BVA - Berufsverband der Augenärzte Deutschlands) defines the **primary chronic open-angle glaucoma (POAG)** and the **normal-tension glaucoma (NTG)** as diseases occurring in both eyes and has the following features:

- Characteristic damage of optic nerve and/or visual field
- In many patients untreated IOP exceeds 21 mmHg at least occasionally
- In one-sixth to one-third of all patients IOP is permanently below 21 mmHg (NTG)
- Development of the disease in adults
- Open anterior chamber angle without pathological findings
- Absence of other causes of the so called secondary open-angle glaucoma

According to the Collaborative Normal-Tension Glaucoma Study (1998) also in the normal-tension glaucoma IOP lowering therapy is useful.

Ocular hypertension is defined by the BVA as follows:

- IOP exceeds 21mmHg frequently
- Absence of characteristic glaucomatous damage in optic nerve and visual field
- Development of the disease in adults

- Open anterior chamber angle without pathological findings
- Absence of other causes of the so called secondary open-angle glaucoma

Ocular hypertension may develop into glaucoma if it remains untreated. Lowering IOP by more than 20% to values of <=24 mmHg reduces the risk for developing glaucoma by an average of 50%.

6.5.2. Current Aspects in Pathogenesis

In primary chronic open-angle glaucoma IOP increases only slowly to values between 20 and 30 mmHg and occasionally reaches even 40 mmHg. A slowly increasing IOP even this high does not cause pain. Visual field impairment is not noticed at first because the loss progresses from the margin towards the centre. Thus, the centre of vision remains intact for a long time. The patient is unaware of the vision loss until severe damage occurs and he or she is slowly losing vision (Teuchner 2005, p. 11).

In POAG and NTG the following factors play an important role in pathogenesis:

- Relative IOP increase; increased outflow resistance in the trabecular meshwork into the anterior chamber angle
- Local circulation and ability to regulate circulation are impaired as a consequence of locally and/or systemically caused perfusion problems
- Structural weakness in the collagen structure of the optic disc (Pfeiffer, 2005).

6.5.3. Glaucoma Screening

Screening for glaucoma includes the investigation of risk factors, stereoscopic examination of the papilla and the peripapillary nerve fibre layer, Goldmann applanation tonometry, slit lamp examination of the

anterior and middle structures of the eye as well as documentation of the findings by the ophthalmologist (BVA 2003, guideline 15c, p. 4).
Glaucoma is suspected when IOP level exceeds >=22 mmHg, vertical cup/disc ratio of the papilla of >=0.6, diffuse or focal constrictions of the neuroretinal vessels, hemorrhages at the rim of the papilla, side asymmetry of glaucoma specific changes in the papilla as well as diffuse anomalies of the nerve fibre layer occur (Pfeiffer, 2005).

Goldmann Applanation Tonometry

The upper "suspect reading" for applanation tonometry is an IOP level of >=22 mmHg. However, it is also important to investigate the profile of diurnal pressure because variations greater than 8 mmHg are to considered as being critical. According to Saccà (1998) the highest pressure findings are in the morning (Pfeiffer 2005, p. 32). It is known that the central cornea thickness (the thicker the cornea the higher IOP and vice versa) is a disruptive factor in IOP measurement (Pfeiffer, 2005).

6.5.4. Methods of Diagnosis

Diagnosis methods include slit lamp examination, visual field testing, evaluation and documentation of the optic nerve head and measurement of the intraocular pressure.
For the confirmation of the diagnosis of primary chronic open-angle glaucoma besides an open and normal anterior chamber angle at least two of the following criteria have to apply (Berufsverband der Augenärzte 2003, guideline 15c, p. 7):

- Characteristic optic nerve damage
- Characteristic visual field defects
- Intraocular pressure at least occasionally above 21 mmHg

6.5.5. Therapy

Although the importance of IOP in the different types of glaucoma has not yet been completely clarified, lowering increased IOP is currently the only recognized therapeutic concept (Teuchner, 2005). Pressure reduction may be achieved by medication, laser treatment or through microsurgery (Patzelt, 2005). According to the DOG the risk of further progression of the glaucoma reduces by approximately 10% per each 1 mmHg the IOP is lowered (DOG, 2005).

Medical Therapy

Medical treatment is often the first line of therapy. Only if medical therapy fails, surgery is performed. Medical treatment mainly aims at lowering IOP. The level of IOP is determined by three factors: aqueous humor production, drainage resistance and episcleral veins pressure (Pfeiffer, 2005). The effects of the medications are on the one hand reduction of aqueous humor production and on the other hand increase of trabecular and uveoscleral outflow (Lang, 2004). Reduction of aqueous humor production is achieved by the use of beta-blockers or carbo anhydrase inhibitors. The reduction of outflow resistance through the use of substances such as for example pilocarpine, sympathomimetic agents and prostaglandin analogs improves the outflow of aqueous humor. The choice of the substance depends amongst others on the risk factors and concomitant diseases in the patient and on potential side effects of the medication (Pfeiffer, 2005). Side effects occur either locally in the eye (irritation, burning, redness, miosis, accommodation spasm, allergy, mydriasis) or systemically (bronchospasm, bradycardia, sweating, gastrointestinal discomfort, dry mouth, hypotension, acidosis, hypotassaemia, paresthesia, blood picture changes, headaches, hypotonia, asthma).

Surgical Therapy

When medication is insufficient in showing a normalizing effect on intraocular pressure then argon laser trabeculoplasty (ALT) is performed. In the ALT procedure, laser spots (laser coagulation) are applied into the trabecular meshwork in the anterior chamber angle. The effect is an improvement of the aqueous humor outflow and thus intraocular pressure reduces by approximately 3 – 10 mmHg. However, only about 50% of all patients respond to the therapy and the positive effect wears off after about two years (Lang, 2004).

Trabeculectomy and/or goniotrephination are surgical procedures that create a new drainage path for the aqueous humor. In the area of the trabecular meshwork a small opening is created in the anterior chamber which drains out the aqueous humor through the sclera and is absorbed by the conjunctiva (Patzelt, 2005).

7. Osteopathic Literature on Glaucoma

This chapter provides an overview on osteopathic literature on glaucoma. There is only little specific osteopathic literature available about the eye, especially on glaucoma. Nevertheless, on condition that one understands anatomy, physiology and pathophysiology of the eye the general principles of osteopathy are applicable to the eye and its treatment. So far, osteopathic investigations of the chronic open-angle glaucoma concentrated on the venous outflow in the region of eyes and head and on the vegetative component which is essential for the eye.
The following sections describe the theories of the founders of osteopathy with regards to glaucoma. Then the current theories are described in detail, and finally the studies that were elaborated on this topic previously will be analysed.

7.1. Statements of the Founders of Osteopathy on Glaucoma

A. T. Still, the founder of osteopathy claims that most of the eye problems are only symptoms which are caused by poor blood and nervous supply. It seems crucial to him to examine the whole neck, the upper thoracic spinal column and the upper ribs and clavicles in order to grant a free flow of blood from the heart to the eye (Jolandos, 2002).

> *„Heute wie vor 50 Jahren glaube ich, dass die Arterien den Fluss des Lebens, der Heilung und der Linderung darstellen und ihre Verstopfung oder Verletzung Krankheit zur Folge haben“* (Still, p. 17).

W. G. Sutherland considered glaucoma an obstruction of the venous outflow due to cranial membranous lesion.

> *In the case of glaucoma, one may reason that the accumulation of fluid points to a condition somewhere back along the intracranial membranous wall of the cavernosus sinus, or in the walls of the petrosal sinus, to a membranous restriction affecting the venous*

> *return, and back of that, the possibility of a cranial lesion as an etiological factor* (Sutherland, 1998).

Also Magoun considered glaucoma a dysfunction of the vascular mechanism in the eye caused by structural lesion.

> *Es heißt, dass ein erhöhter Augeninnendruck von einer Anschwellung des intraokularen Inhalts oder von einer exzessiven Flüssigkeitsansammlung im Augapfel herrührt, was das Auge bei der Palpation spürbar hart erscheinen lässt. Eine strukturelle Läsion, die den vaskulären Mechanismus des Auges angreift, ist die logischste Erklärung* (Magoun 1976, p. 295).

7.2. Contemporary Literature

7.2.1. Vascular Dysfunctions

In the following the most frequent vascular dysfunctions will be explained in detail. Different mechanisms can be responsible for the impairment of function of the **superior ophthalmic vein**. Dysfunction can be caused by the constriction of the superior orbital fissure or by intracranial venous congestion, for example by abnormal dural tensions or osseous dysfuntions in the scull bones (especially in the foramen jugulare), as well as increased tensions in the cranio-cervical and thoraco-cervical areas. Dysfunction of the **cavernous sinus** may cause congestion in the superior ophthalmic vein. The inferior ophthalmic vein can be impaired by congestion in the pterygoid plexus. The outflow in the **canal of Schlemm** can be obstructed near the anterior chamber angle. The whole system of sinuses has to be taken into account (see point 4.3 The Blood Vascular System).

In osteopathic literature methods for the improvement of circulation within the eye and the drainage of the aqueous humor are described. Furthermore, methods for enhancing the arterial supply, the venous and lymphatic outflow in the eye as well as exudate drainage are described (Liem, 2003).

7.2.2. Nervous Dysfunctions

As defects in the **optic nerve** itself can be mentioned for example optic nerve defects caused by a position change of the sphenoid body, the obstruction of the intracranial venous outflow, abnormal tension of the dura mater in the optic canal or a venous congestion in the cavernous sinus.

Literature on glaucoma focuses furthermore on the **vegetative component**. By ortho**sympathetic** stimulation the **superior cervical ganglion** (C1 – C4) and the **preganglionic neurons at C7 – TH12** (ciliospinal centre) may cause vasoconstriction, reduced secretion, reduced venolymphatic drainage and metabolic dysfuntions in the tissue. Sympathicotonia treatment methods are described, for example rib raising techniques for Th1 and Th2 where the ciliospinal centre is placed. Increased **parasympathetic** activity (for example increased lacrimation and accommodation defects) may be provoked through the irritation of the **pterygopalatine ganglion**. Intraoral treatment methods of the same are described in osteopathic literature (Liem, 2003).

7.2.3. Osseous Dysfunctions

Not only vascular dysfunctions (for example congestion in inferior ophthalmic vein in the pterygoid plexus) are mentioned but also osseous dysfunctions such as constriction of the superior and inferior orbital fissure that causes a congestion of the superior ophthalmic vein are described (Liem, 2003). In this context particularly good mobility in the skull base area and the seven bones of the orbit appear to be crucial.
Furthermore it is recommended to examine the sphenopetrosal suture, the occipitomastoid suture and the lacrimal bone, as their flexibility is of great importance for a functional drainage of venous congestions in the head region (Liem, 2001).

7.2.4. Muscular Dysfunctions

Muscular dysfunctions such as of the occipitalis muscle or the temporalis muscle may lead to pain in the eye region. There are also described techniques for the extraocular muscles, because myofascial regulation of tension is equally important for improved fluid circulation in the eye (Liem, 2003).

7.2.5. Dural Dysfunctions

Dural tension can proceed into the orbit through the continuity of the dura mater with the optic nerve and the sclera. For this reason, high mobility of the dura spinalis and the intracranial membranous system are essential. For the treatment of the dura mater Dr. Becker suggests cerebrospinal fluid techniques such as compression of the fourth ventricle (CV4) and transversal fluctuation techniques (Liem, 2003).

7.3. Osteopathic Studies on Glaucoma

The following chapter describes previously elaborated studies on glaucoma.

Cipolla made a preliminary study in 1975 about the effects of osteopathic manipulative therapy on intraocular pressure. The study group consisted of 20 men and women between the ages of 20 and 30 years. Ten subjects were used for controls and 10 for the experimental group. The osteopathic manipulative therapy consisted of cervical myofascial techniques to the cervical and upper thoracic areas and was administered by one person for 3 to 5 minutes. Intraocular pressure was measured on a study group immediately preceding, immediately following, and for 4 consecutive hours after osteopathic manipulative therapy. The experimental group showed a significant decrease in intraocular pressure not seen in a control

group. Most probably this decrease occurred by means of an influence of the autonomic nervous system (Cipolla et al., 1975).
The study design of Cipolla seems to be very useful. However, he only concentrated on one treatment method which is not in line with the osteopathic concept, but this serves to reduce complexity. Furthermore one could observe that one more measurement one or two weeks after the treatment would be beneficial in order to investigate whether the reduction IOP is showing a long-term effect.

Misischia evaluated intraocular tension following osteopathic manipulation in 1981. The intraocular tension of the experimental subjects were recorded prior to, immediately following, and 60 minutes after myofascial release techniques were applied to the cervical and upper dorsal vertebrae for a period of 10 minutes. Preliminary results have demonstrated a mean tension elevation of 2 - 4 mmHg immediately postmanipulation, followed by a mean decrease of 3 - 5 mmHg below the initial tension recordings 60 minutes after manipulative treatment. It is proposed that this diminution in tension is the direct result of influence on the autonomic control of aqueous humor outflow (Misischia, PJ , 1981).

In 1982 **Feely** hypothesized that osteopathic manipulative treatment of the paravertebral muscles and myofascia of the cervical and upper thoracic regions can alter intraocular pressure. Ten subjects, five with diagnosed chronic open-angle glaucoma and five nonglaucomatous controls were evaluated. Subjects were divided into one experimental group and five control groups. The experimental group comprised glaucoma subjects administered manipulative treatment in the cervical and upper thoracic region. Control group 1 comprised glaucoma subjects who were not administered manipulative treatment. Control group 2 glaucoma subjects were given manipulative treatment to the lower thoracic and lumbar regions. Control group 3 of nonglaucomatous subjects were administered manipulative treatment like the experimental group. Control group 4 comprised normal subjects with no manipulative

treatment. Control group 5 of normal subjects received a treatment similar to group 2. Measurements were made prior to and after the manipulative procedures at intervals of 5, 10, 20, 30 and 60 minutes. The IOP increased 3 – 7 mmHg at 5 minutes after treatment in a majority of all glaucoma groups, followed by a varied pressure response during the 60-minute time course (Feely et al., 1982).

In this study the small group of patients is subdivided into too many subgroups. Additionally, again the treatment is reduced to only one method.

Fowler analysed the role of the sympathetic nervous system in ocular hypertension in 1984. The purpose of this study was to investigate the effect of osteopathic manipulative treatment (OMT) of the lower cervical, upper thoracic region (C8–T2) on the sympathetic control of the eye and, thus, on the IOP. 10 subjects in this study were diagnosed as having ocular hypertension without the typical characteristics of glaucoma. They were not on medication and only subjects with somatic dysfunction at C8-T2 were included. They were divided into three groups. The experimental group was treated to the cervico thoracic region. Control group 1 was treated to the lower thoracic and upper lumbar region. Control group 2 got no treatment. Tonometric readings were made prior to OMT, immediately following the OMT and at intervals of 5, 15 and 30 minutes following the procedure. There was a significant increase in intraocular pressure at 15 minutes following the manipulation. There was no significant change in aqueous outflow in either C8-T2 treated subjects. Fowler concluded that (1) the treatment affected the autonomic nervous system to the eye; (2) a wider range of OMT, extended to the upper cervical vertebrae, is needed to affect the autonomic nervous system to the eye; and (3) the effects of the OMT may be more noticeable at a time later than 30 minutes (Fowler et al., 1984).

The further division of such a small group of patients into three subgroups does not appear useful. Fowler has already criticised the study himself by mentioning that he only treated one centre of the autonomous nervous

system and thus has reduced the treatment to the application of one single method.

In 2001 **Hürlimann and Wanner** investigated the effects of osteopathic treatment on intraocular pressure in subjects with physiological pressure values. 24 subjects aged between 18 and 65 were recruited. Each of them received two blind and two osteopathic treatments; intraocular pressure measurement was made prior and after the treatments. The subjects were divided into three groups and each group was treated with another osteopathic treatment method (CV4, vomer pump, sacrum induction). Measurements showed no essential difference between blind and osteopathic treatment. Both treatment methods achieved a reduction of pressure by 2 mmHg, which equals a normal reduction in the state of relaxation (Hürlimann, Wanner, 2000-2002).
From an osteopathic point of view it is questionable if one can reduce such a complex problem to the application of a single technique. Secondly, the division of such a small group of subjects into three subgroups does not seem beneficial. An additional difficulty in this study is the fact that the pressures of the subjects are physiological values. It is difficult to improve values which are already physiological.

Esser's study was an open treatment study with one group (pre and post study). On the first, the 7th and the 21st day of the study Esser treated 25 patients with diagnosed primary chronic open-angle glaucoma and intraocular pressures up to 30 mmHg with seven pre-defined osteopathic methods. Measurement of intraocular pressure was performed by Esser himself prior and after the treatment. In the period of the therapy intraocular pressure was reduced from 22 mmHg by approximately 1 – 2 mmHg (Esser, 2002).
Esser has performed a great study, however, one could question the fact that one and the same person performs both the measurement of the intraocular pressure and the treatment. Secondly, the patients were only treated applying pre-designed osteopathic methods. Furthermore, it is

difficult to interpret the results without a control group, because also a blind treatment as described by Hürlimann and Wanner may cause reduction of intraocular pressure.

In 2004 **Vochmyakov** carried out a study that is named "Sinus veineux et glaucome". The study is written in French and it is only mentioned here for French speaking persons who are interested in glaucoma (Vochmyakov et al 2004).

8. Materials and Method

8.1. Patients

The patients of the study were recruited by an ophthalmologist near my osteopathic consulting rooms. 20 patients who fulfilled the inclusion criteria were included in this study. The patients were listed in the randomisation list, which divided the patients into two groups – depending on the date of registration: an experimental group and a control group.
Intraocular pressure was measured in all patients in the first and the fifth week by the ophthalmologist. The experimental group received a holistic osteopathic treatment in the second, the third and the fourth week. Both groups continued to use their eye medication during the course of the experiment. During the course of the experiment and at least six month before its start in neither of the two groups medication was changed.

Inclusion criteria:

- Ophthalmologic diagnosis: primary chronic open-angle glaucoma (with characteristic optic nerve damage, visual field impairment, intraocular pressure >=22mmHg) since at least six months
- Intraocular pressure up to 30 mmHg
- During the course of the study no change in current medication (medication administration since more than six months is no exclusion criterion)

Exclusion criteria:

- Angle-closure glaucoma, juvenile glaucoma
- Intraocular pressure above 30 mmHg
- Expected medication change in the close future
- Blindness
- Tumour in head area

- Recently suffered stroke, central nervous system disorders, scull fractures, craniocerebral trauma, therapy with anticoagulantion
- Previous eye surgeries

8.2. Method

The study was performed applying match-controlled study. The primary parameter was changes in intraocular pressure, which was measured through the ophthalmologist by Goldmann applanation tonometry.
The secondary parameters were the subjectively felt symptoms in the patients and affected by the osteopathic treatment. By means of a questionnaire the patients were asked about the secondary parameters such as headaches, eye pain, neck pain and other pains as well as visual performance prior to and after the osteopathic treatments. Furthermore, the questionnaire asked for age and sex as well as usage of medication including possible side effects.

8.2.1. Measurement of Intraocular Pressure

During this study Goldmann applanation tonometry was performed by an ophthalmologist. The readings prior to the first and after the last treatment were carried out at the same time of the day in order to avoid circadian pressure variations.

8.2.2. Osteopathic Diagnosis and Examination

Before starting with the first osteopathic examination and treatment the patients were explained whole procedure and asked to sign a declaration of consent. The patients were informed and asked not to change eye medication if they applied any during the course of the study. The patients were asked to fill in the questionnaire as described under point 8.2 (please refer to the patients' questionnaire under 13.1.7). Then the case history was documented (refer to findings sheet under 13.1.8) and the first

examination and treatment were performed. In the osteopathic examination and treatment those structures were focused which are relevant for the eye (see chapter 7) and on the organism as a whole.

8.2.3. Osteopathic Treatment

For three weeks the patients of the experimental group received an osteopathic treatment unit after intraocular pressure measurement. After the last treatment the patients were asked to fill in the second part of the questionnaire.

The patients were administered a holistic osteopathic treatment, which included examination and treatment in accordance to the individual findings.

Treatment Methods:

1. Treatment of body statics if necessary
2. Treatment of the cervical spinal column if necessary, especially the upper cervical spinal column (C1-C4) in order to influence the superior cervical ganglion as well as the 7th cervical till the 2nd thoracic vertebra (preganglionic neurons of the superior cervical ganglion in the spinal segments C8-Th2).
3. Improvement of the venous outflow:
   a) Thoraco-cervical diaphragm (including upper costovertebral articulation, sternoclavicular joints)
   b) Treatment of the atloido-occipital joint
   c) Venous sinus technique (especially cavernous sinus and petrosal sinus)
   d) Compression of the fourth ventricle
   e) Drainage of the pterygoid venous plexus
4. If necessary special focus upon synchondrosis sphenobasilaris, occipitomastoid suture, sphenopetrosal suture
5. General treatment of the orbit

6. If necessary dural treatment and integration of skull and sacral bone. If necessary special emphasis is laid on the tentorium cerebelli.
7. Specific treatment of each of the orbita bones
8. Treatment of the bulbus (myofascial)
9. Venolymphatic pumping technique in the eye
10. Neurovegetative Integration of the eye

a) CV4 (stimulation of the parasympathetic nerve, general regulation method)
b) Inhibition of the superior cervical ganglion (Liem, 2003)

For this study a conversation was held with **Mr. van der Heijden D.O.** about this topic. In 2002 van der Heijden had performed a study about the effectiveness of osteopathic intervention in children with convergent/divergent strabismus. His recommendation was to first of all concentrate on the **eye axes**. He divided the axes into an axe responsible for vision (occiput-orbita), and an axe which is important for the stability of the eye (zygoma-petrous portion).

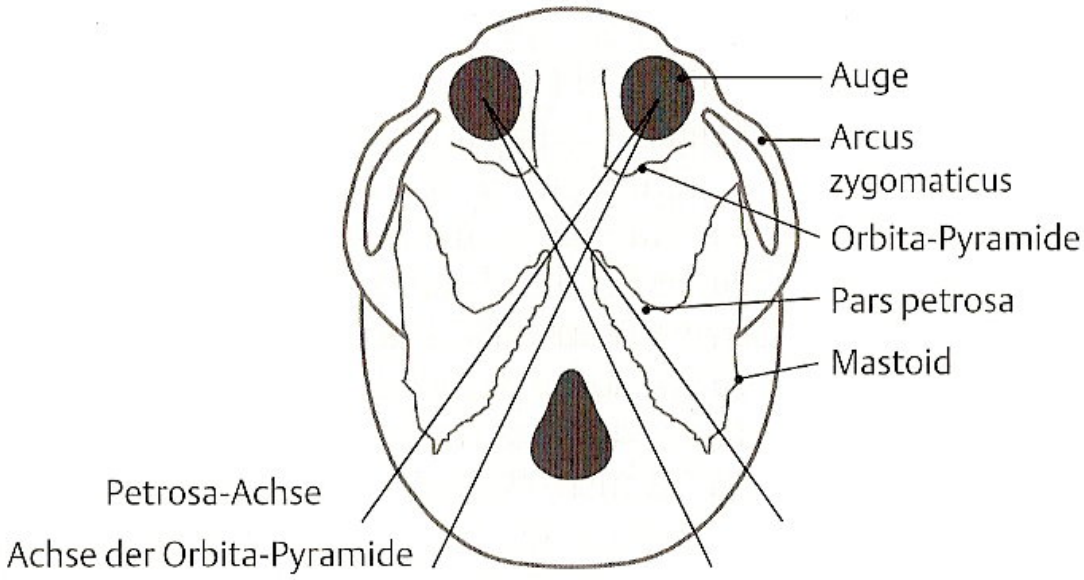


Fig. 11: Axes of orbita and petrous portion according to V.M. Frymann (Liem 2003, p. 521)

Futhermore van der Heijden naturally talked about the venous field (posterior ciliary veins – ophthalmic vein – foramen jugulare – truncus brachiocephalicus), which was already described above.

Scleral fixation in the orbit he called a **traumatic field**.

The **neurovegetative** information seemed important to him, as sympathicotonia causes vasoconstriction in the vessels and therefore reduction of the aqueous humor outflow. This point was described in chapter 4.4.

Van der Heijden also talked about a **neuroindocrine field**, which is important for the eye, and in this connection he mentioned insulin resistance (diabetes II) and dysfunction of the thyroid gland. At the occurrence of diabetes type II he recommended examining pancreas and digestive tract. In case of a thyroid gland dysfunction emphasis should be laid on pituitary gland, hypothalamus, the thyroid gland itself as well as the liver, the lung and the blood.

The natural **ageing processes** should also be considered when treating glaucoma, as tissues become more inflexible, arteriovenous exchange is reduced and so is lymphatic venous exchange, as the prevalence of open-angle glaucoma significantly increases with advanced age.

Eventually van der Heijden mentioned **deficits in the action of the heart** as well as high and low blood pressure. Good microcirculation in the retina and the optic nerve are necessary for balancing blood pressure fluctuations. If fluctuations are significant or circulation or microcirculation in the eye are poor then functional and structural metabolism in the eye can be disturbed (van der Heijden, 2006, personal conversation).

8.2.4. Performed Treatment

Before starting treatment the patients were asked to remove contact lenses and sets of dentures.

As most of the patients showed a certain degree of hypomobility in the cervico thoracic region as well as in the upper cervical spinal column, treatment was started to these regions. Frequently, a certain degree of

restriction in the diaphragm region was detected which has an important function as a pump mechanism for the whole fluid system. In order to improve inflow and outflow of heart – head – heart the diaphragm, thoracic outlet and atloido-occipital joint were treated. In order to improve the venous outflow of the head, it was decided to treat the sinuses of the dura mater and the foramen jugulare (occipitomastoid suture, s. petrojugularis, s. petrobasilaris, s. sphenopetrosa). An increased tonus of the sympathetic nerve causes the constriction of the vessels and thus causes a decrease of venous outflow. In order to provoke a regulation by neurovegetative methods the ciliospinal centre (C8 – TH2), the superior cervical ganglion and the fourth ventricle were treated.

Many patients showed a slowed down or interrupted rhythm of primary respiratory mechanism. In order to provoke an improvement the treatment was started with the compression of the fourth ventricle and the integration of the skull and the sacral bone.

In most of the patients tensions of the dura mater were detected, which have an effect on the eye, as described in chapter 7.2.5. These tensions were treated and additional focus was laid on the intracranial tension of the membrane (especially tentorium cerebelli). When treating the cranial bones special emphasis was laid on the synchondrosis sphenobasilaris and the above described sutures of the foramen jugulare, which are important for venous outflow.

Furthemore, the orbit including all orbit bones and their axes were treated. The sphenoid is a particularly important component of the orbit, which has openings for the inflow and outflow as well as for the supply of the eye.

The bulbus itself was treated by myofascial techniques. In order to improve aqueous humor outflow venolympthatic pumping and tapping techniques were applied to the eye region.

9. Study Results

The following chapter describes the results of the study. The statistic analysis and editing of data were done in Excel 2003.

9.1. Patients

The experimental group was composed of 10 female persons with an average age of 60.3 years. The patients had been receiving ophthalmic treatment to glaucoma since five years at an average.
The control group was composed of two male and eight female persons at an average age of 61.7 years.

9.2. Clinical Initial Situation of the Two Groups

a) Experimental Group

Prior to the treatment intraocular pressure in the patients was at 21.6 mmHg in the right eye and at 20.8 mmHg in the left eye on an average. Figure 12 illustrates primary diseases in the patients of the experimental group.

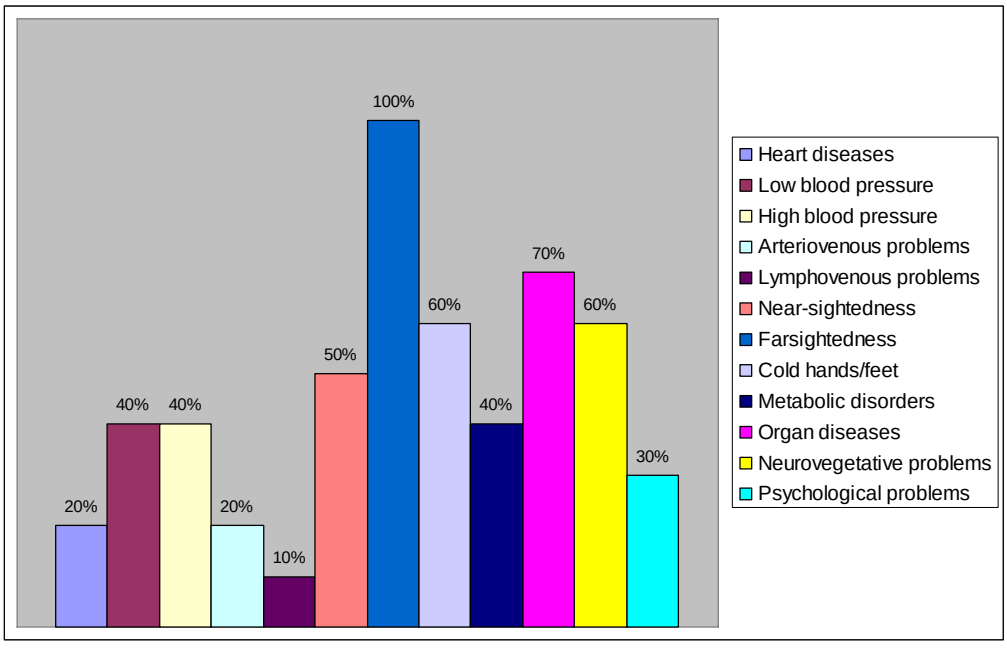


Fig. 12: Primary diseases in the patients of the experimental group in %

20% of the patients of the experimental group reported heart diseases. 40% of patients mentioned low or high blood pressure. 20% of patients suffer from arteriovenous and 10% from lymphovenous problems. 50% of them are nearsighted and 100% suffer from farsightedness. 60% of patients mentioned cold hands or feet, 40% reported to have certain metabolic disorders and 70% mentioned organ diseases. Neurovegetative symptoms were mentioned by 60% of patients and only 30% of patients mentioned psychological problems.

80% of the patients of the experimental group had been using eye medication for a longer period (more than six months).

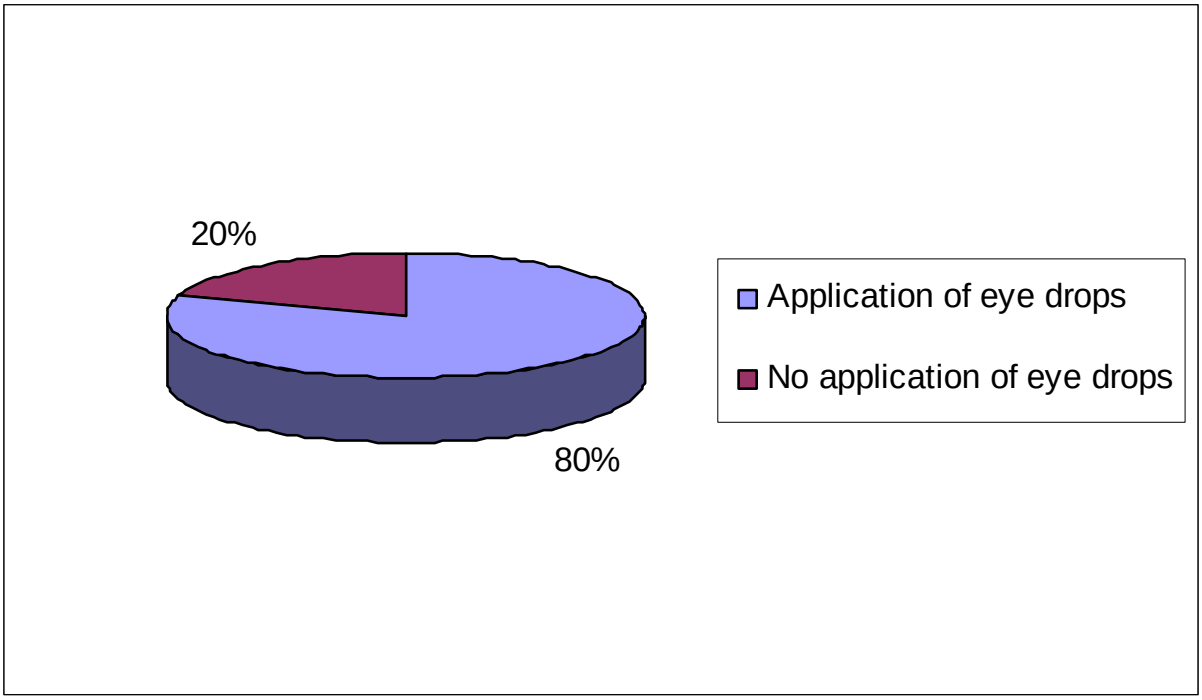


Fig. 13: Percentage of experimental group patients applying eye drops

37% of the patients using eye drops reported various side effects (red eyes, heart discomforts, blood pressure fluctuations, increased salivation, impaired night vision, burning, foreign body sensation) caused by the eye medication. The following diagram shows the percentage in patients suffering side effects caused by application of eye drops.

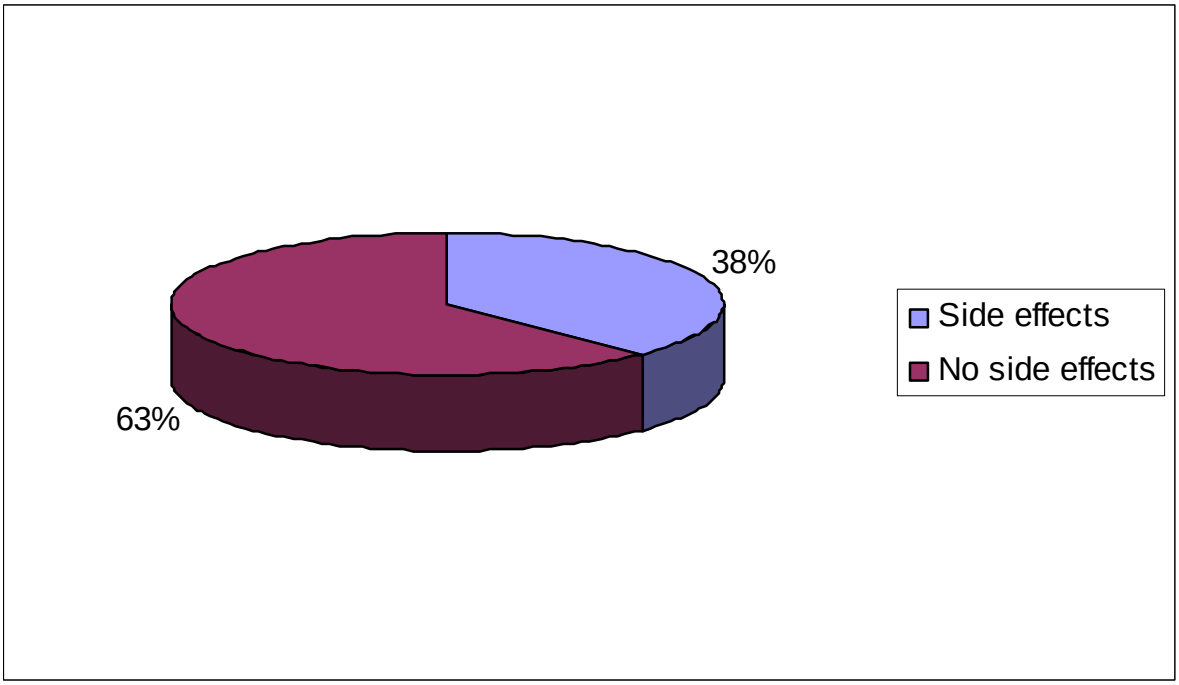


Fig. 14: Percentage of experimental group patients with side effects due to eye drops application

Further secondary parameters which were mentioned by 30% of the experimental group's patients were headaches, 40% mentioned neck pain and 20% referred to other discomforts such as dizziness and dysphagia. All patients of the experimental group were using vision aids (glasses or contact lenses). 20% of the patients reported that in spite of the vision aids their vision was impaired slightly. None of the patients suffered from eye pain.

a) Control Group

Prior to the study intraocular pressures in patients were 19.8 mmHg in the right eye and 20.1 mmHg in the left eye on the average.

9.3. Changes in the Groups

9.3.1. Primary Parameter

The primary parameter of the study was intraocular pressure, which was measured by the ophthalmologist through Goldmann applanation tonometry.

a) Experimental Group

The following graph shows the intraocular pressure changes after three osteopathic treatments in percent (%).

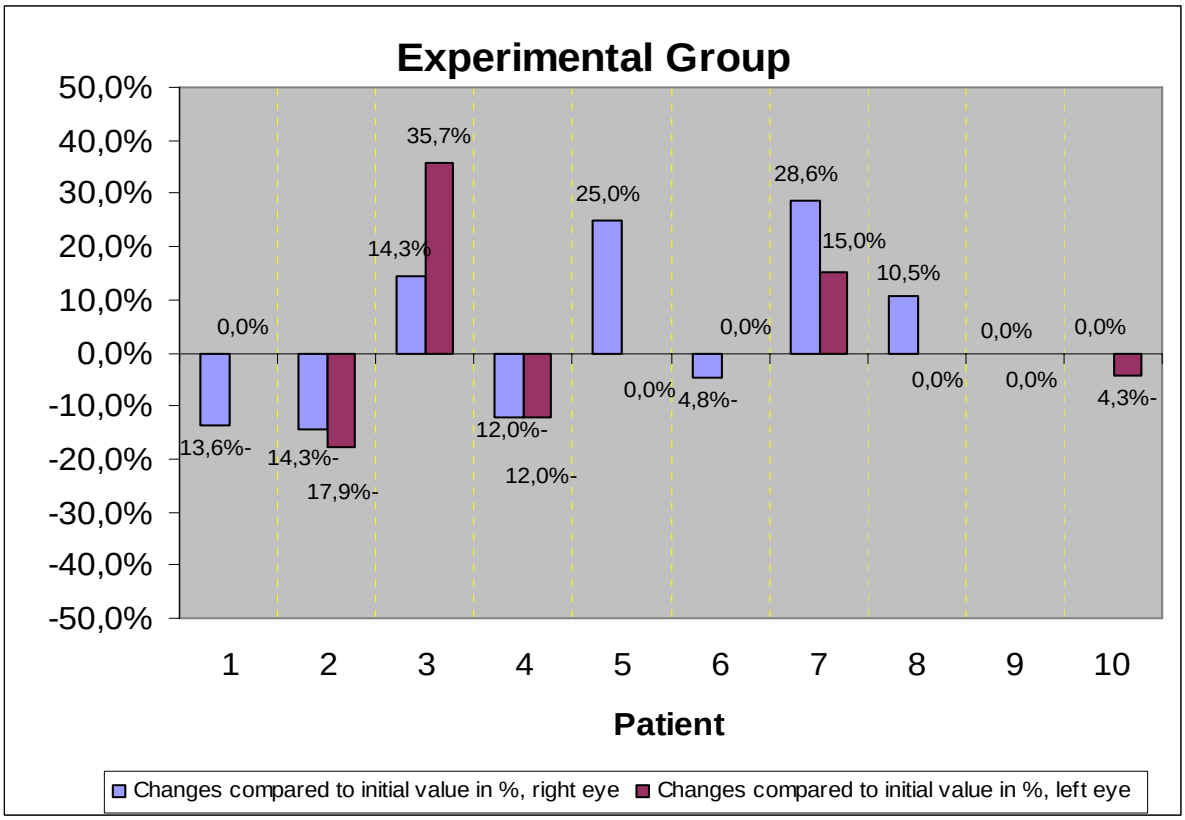


Fig. 15: Intraocular pressure changes in the experimental group after the third osteopathic treatment in %

Intraocular pressure values in patients measured after osteopathic treatments were at 21.2 mmHg in the right eye and at 20.9 mmHg in the left eye on an average. Pressure values improved by 19.6% on the average in the right eyes of four patients, in three patients no changes were found and in four persons the values deteriorated by 11.2% on the

average in spite of the treatment. In two persons the pressure values in the left eyes improved by an average of 25.4% while in five patients IOP values remained unchanged. In three patients IOP values deteriorated by 11.4% on an average in spite of the treatment.

b) Control Group

In the second reading of intraocular pressure (four weeks after the first reading) the values were at 20.3 mmHg in the right eye and at 19.9 mmHg in the left eye on an average.

The following graph shows intraocular pressure changes in the control group after four weeks in percent (%).

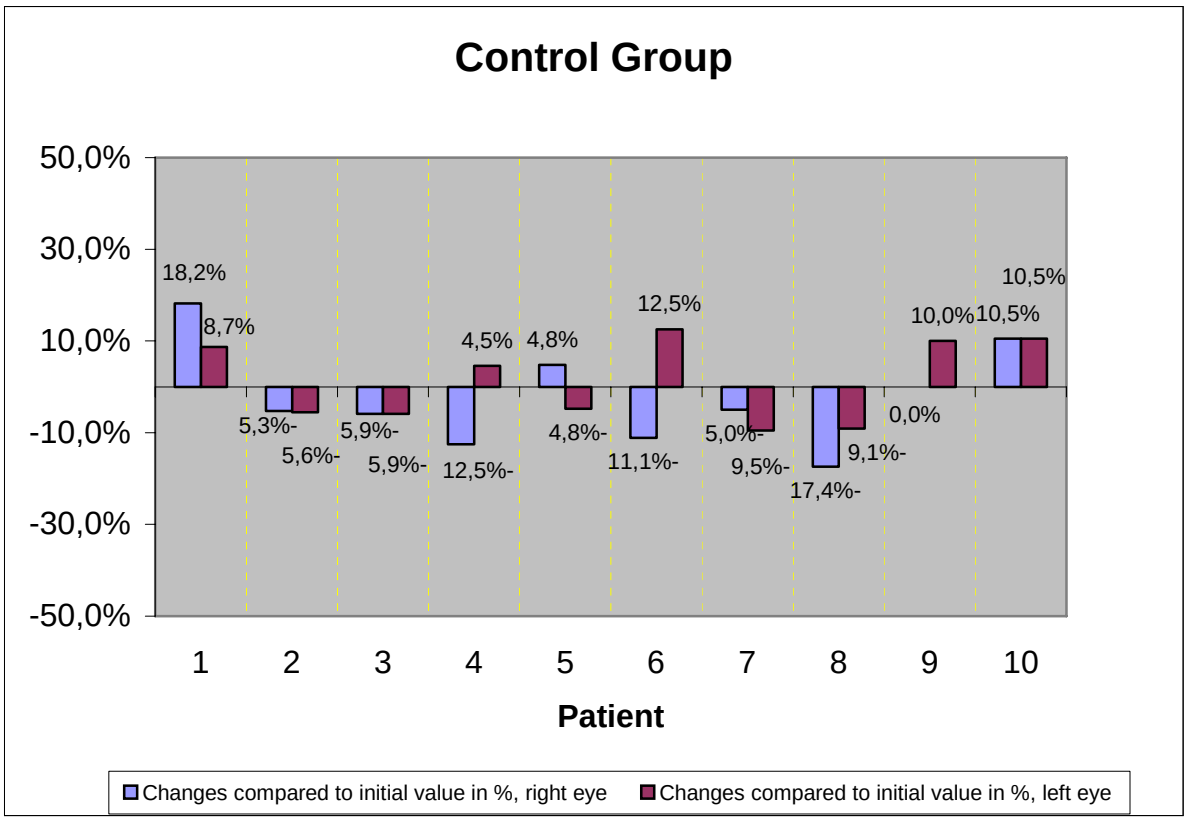


Fig. 16: Intraocular pressure changes in the control group detected in the second reading in %

As the graph illustrates the values of the right eye improved by 11.2% on an average in three patients, remained unchanged in one patient and worsened by 9.5% in six persons. In the left eye the values of five patients improved by 9.3% on an average and in five patients of the

control group worsened by 7% on the average. In none of the patients the value in the left eye remained unchanged.

9.3.2. Secondary Parameters (Experimental Group)

The secondary parameters such as headaches, neck pain, eye pain and other discomforts as well as impaired vision were investigated through the patient's questionnaire.

Headaches

40% of the experimental group's patients mentioned headaches. The following graph shows the intensity of the headaches prior to and after the three osteopathic treatments.

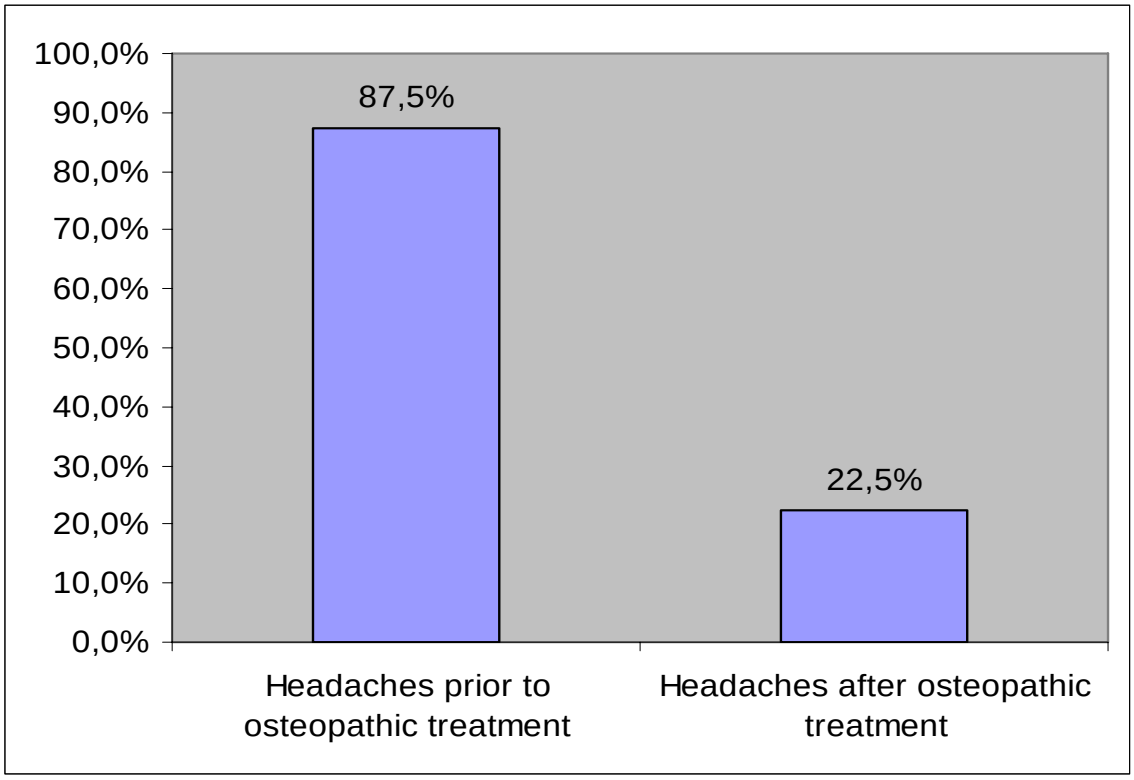


Fig. 17: Intensity of headaches prior to and after osteopathic treatment in %

Figure 17 proves that the intensity of the headaches has reduced from 87.2% to 22.5% through the three osteopathic treatments. That means that headaches improved by 76% on the average.

Neck Pain

50% of the experimental group's patients suffered from neck pain. The following graph shows the intensity prior to and after the osteopathic treatment.

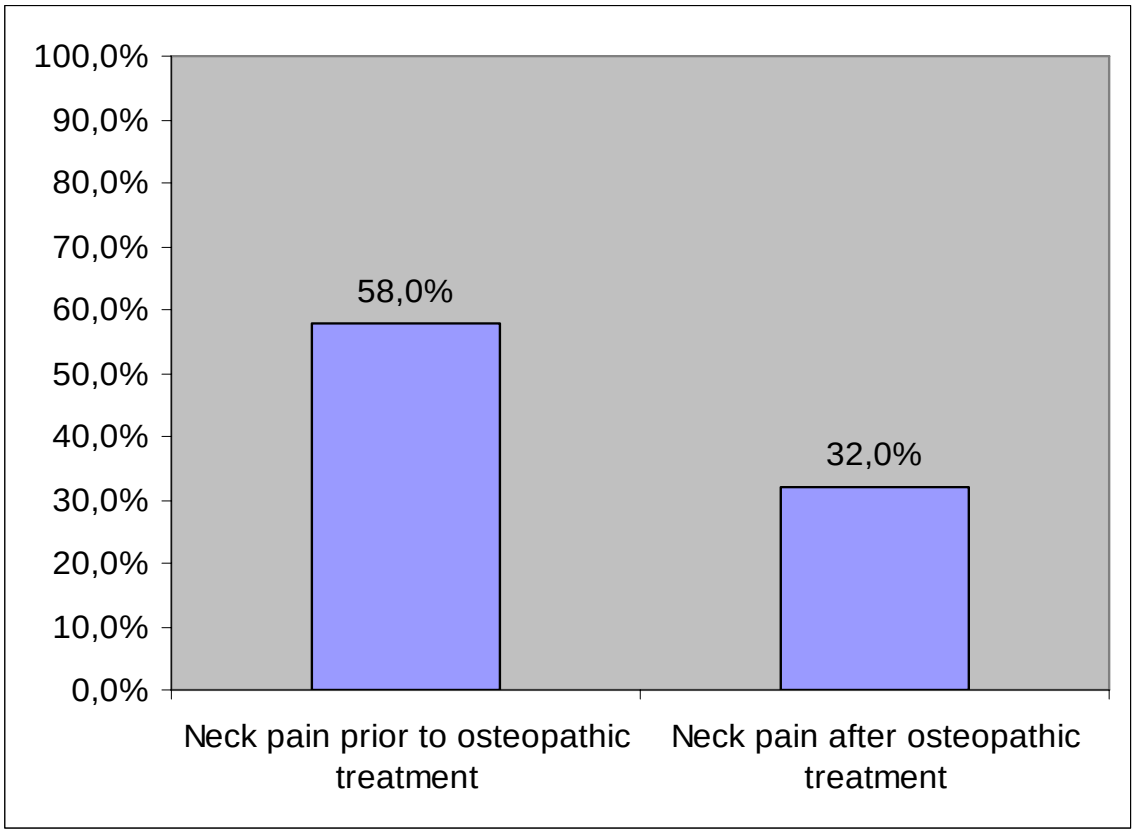


Fig. 18: Intensity of neck pain prior to and after osteopathic treatment in %

As figure 18 shows intensity of neck pain reduced from 58% prior to osteopathic treatment to 32% after the treatment. Thus, neck pain had improved by an average of 39%.

Other discomforts

20% of the patients of the experimental group suffered other discomforts such as dizziness or dysphagia. The following graph shows the intensity of these symptoms prior to and after the osteopathic treatment in percent.

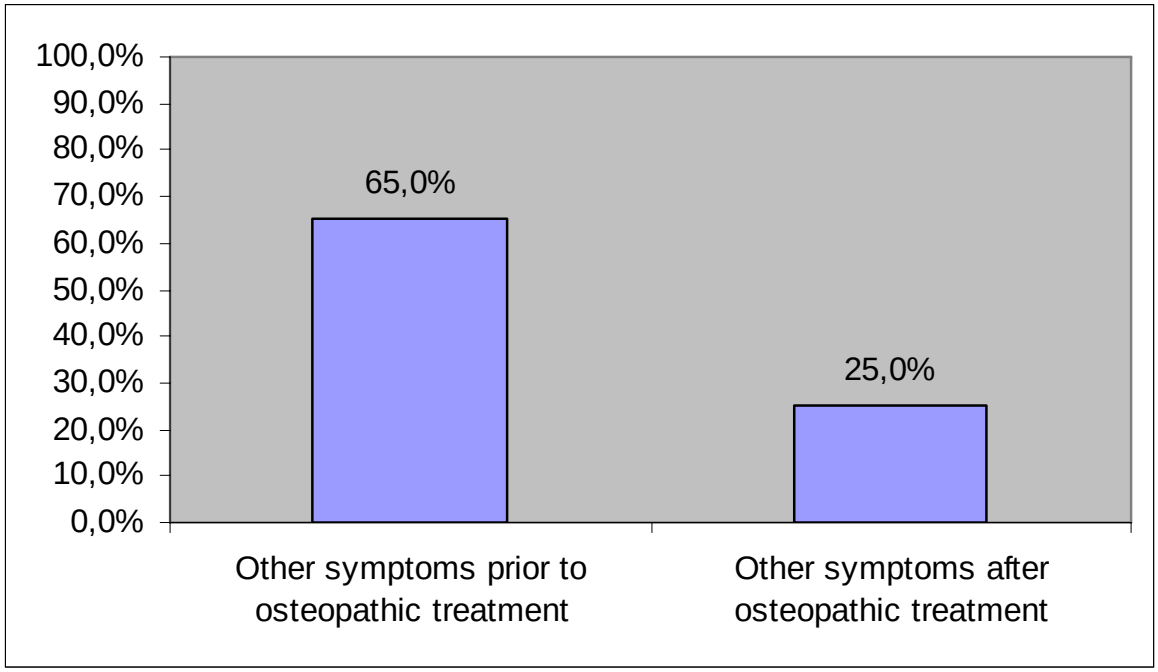


Fig. 19: Intensity of other discomforts prior to and after osteopathic treatment in %

As figure 19 shows intensity of the other symptoms was reduced from 65% before the treatment to 25% after the treatment. This means that average reduction of the other symptoms amounted to 58%.

Visual Performance

20% of the experimental group's patients reported impairment of vision in spite of using vision aid. The following graph shows the impairment of visual performance prior to and after osteopathic treatment in percent.

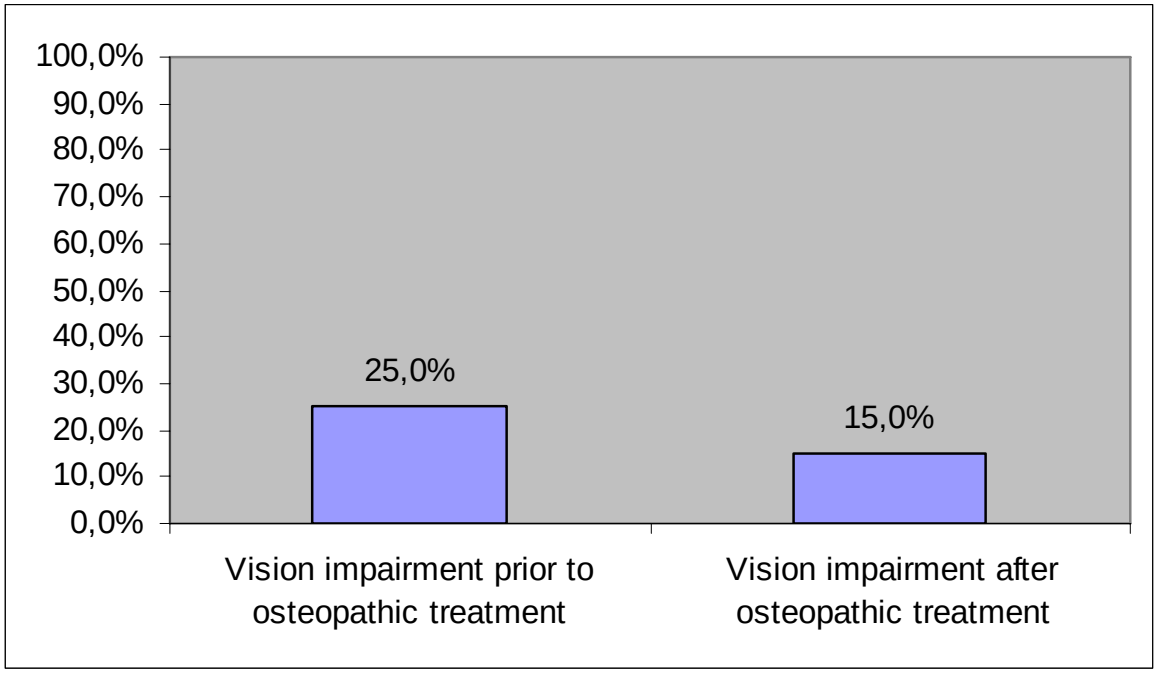


Fig. 20: Vision impairment prior to and after osteopathic treatment in %

Figure 20 illustrates that the impairment of vision after osteopathic treatment had reduced from 25% to 15%. This implies an average improvement of visual performance of 42%.

9.4. Comparison of Groups

The aim of the following chapter is the comparison of the two groups, experimental group (EG) and control group (CG). The following graphs show the division of experimental group and control group to three groups depending on mean IOP changes.

Groups:

Group 1: Percentage of patients with improvement of Ø IOP

Group 2: Percentage of patients with unchanged Ø IOP

Group 3: Percentage of patients with deterioration of Ø IOP

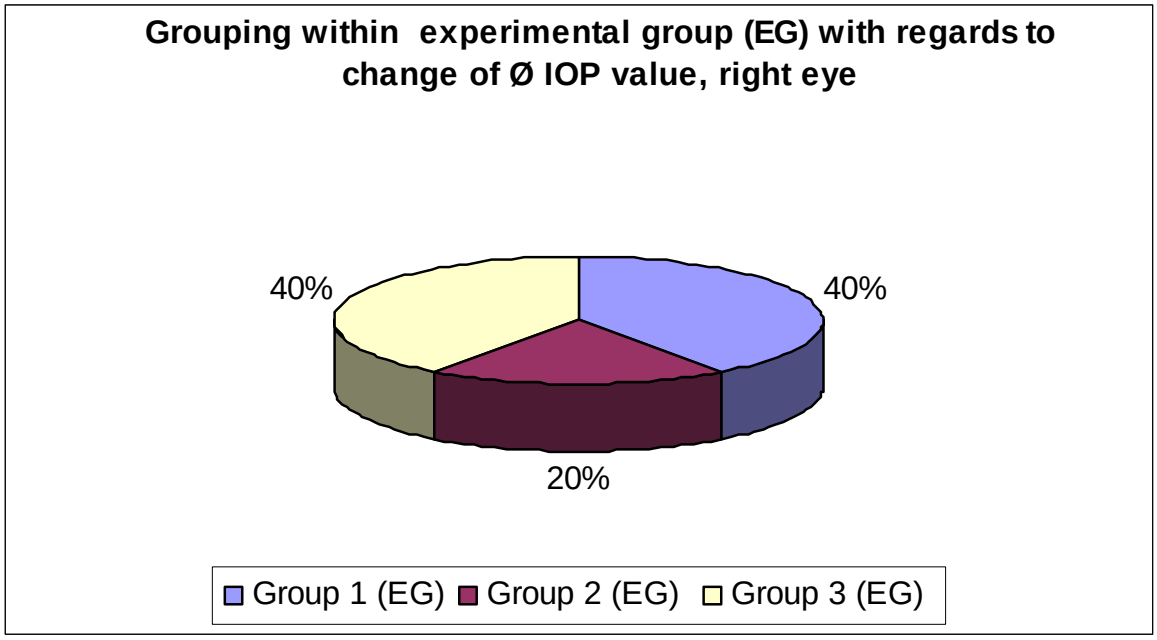


Fig. 21: Grouping within experimental group with regards to ø IOP change, right eye

As figure 21 shows, in 40% of patients in the experimental group had IOP values had improved, in 20% values remained unchanged and in 40% of patients IOP values had deteriorated in the second reading.

As the following diagram shows the control group was divided into the same three groups for the analysis of the right eye's results.

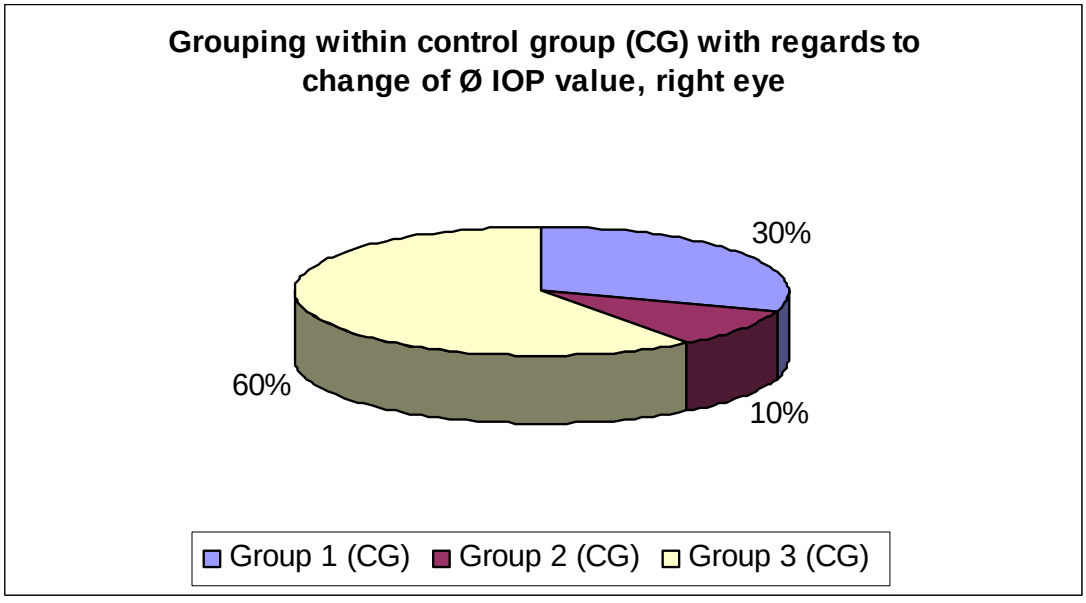


Fig. 22: Grouping within control group with regards to Ø IOP change, right eye

As figure 22 shows, the IOP values in the control group improved in 30% of patients, in 10% they remained unchanged and in 60% the values deteriorated.

The following diagram shows the grouping of the experimental group with regards to mean IOP change in the left eye.

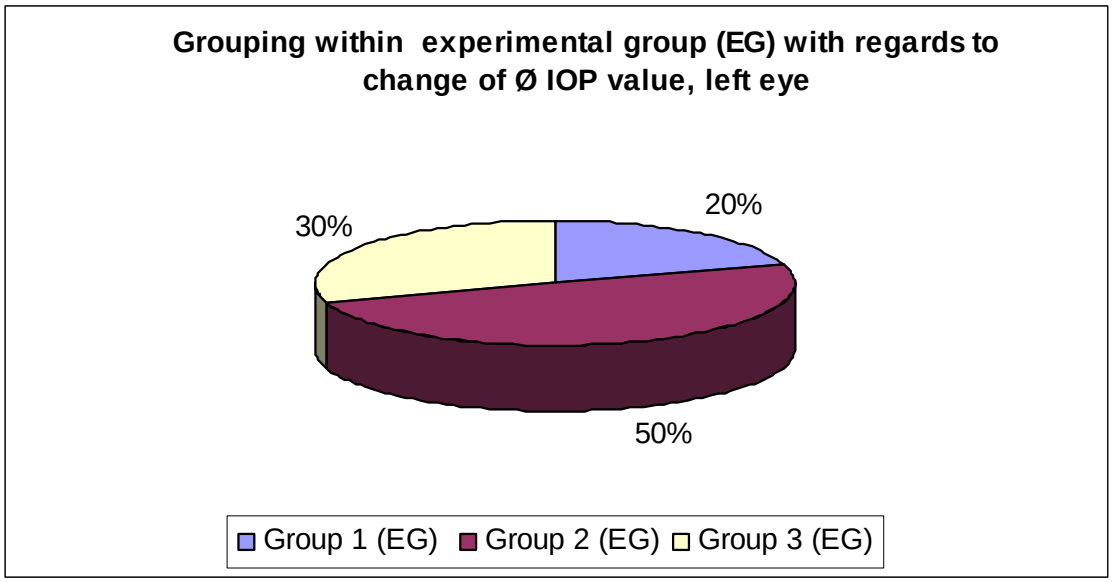


Fig. 23: Grouping within experimental group with regards to Ø IOP changes, left eye

As figure 23 shows, IOP values in the left eye in the experimental group improved in 20% of patients, in 50% they remained unchanged and in 30% values deteriorated.

The following diagram shows the grouping in the left eye of the control group.

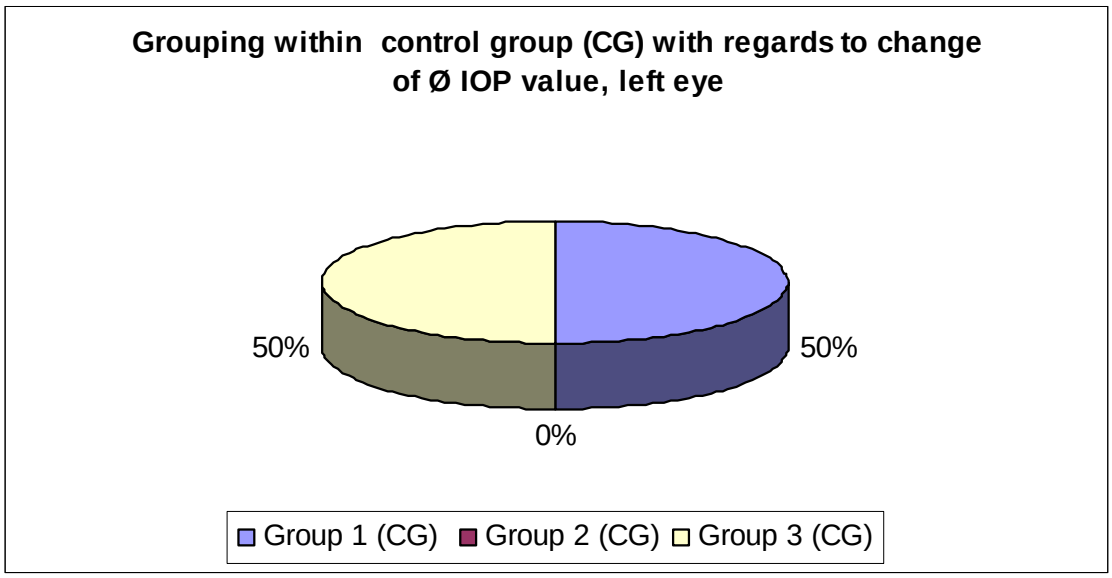


Fig. 24: Grouping in control group regarding Ø IOP changes, left eye

Figure 24 proves that IOP values in the left eye of the control group improved in 50% of patients and worsened in 50% of patients. Compared to the first reading in none of the patients IOP value had remained unchanged in the second reading.

The following two diagrams show a comparison of average improvement of IOP values in groups 1 of the experimental and of the control group.

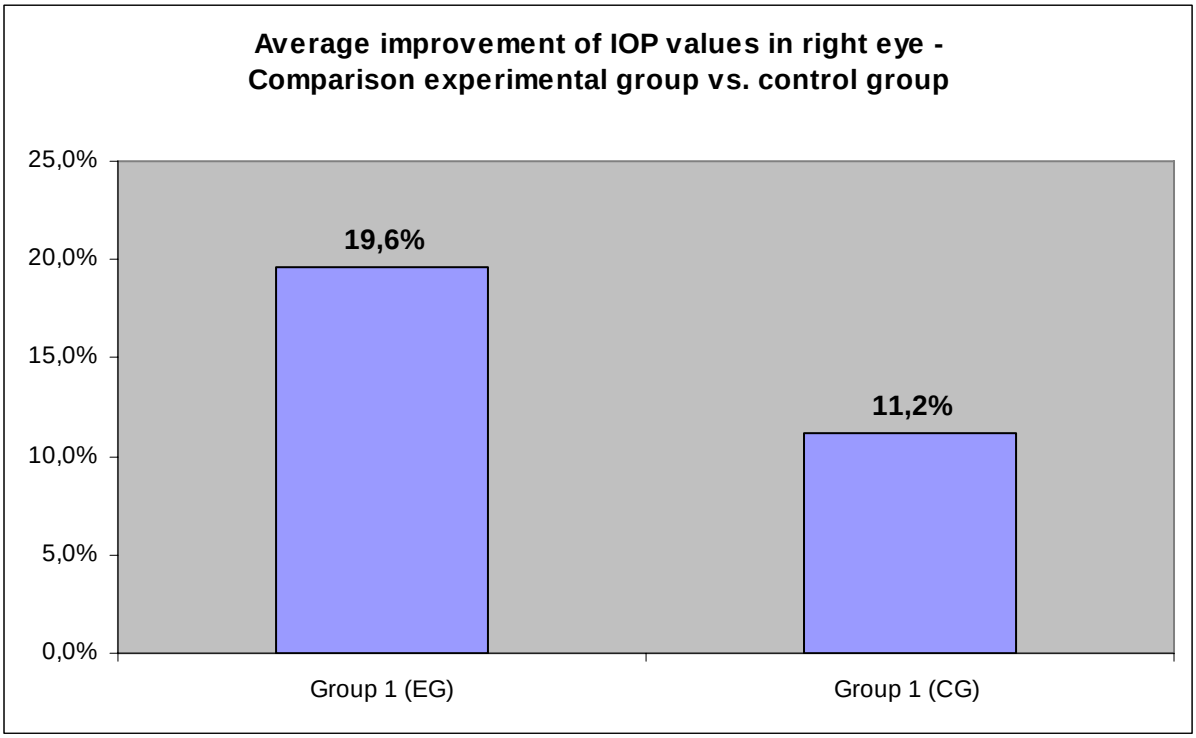


Fig. 25: Comparison groups 1 of experimental (EG) and control group (CG); average improvement of IOP values, right eye

As figure 25 shows, in group 1 of the experimental group IOP values in the right eye improved by 19.6% on an average and in group 1 of the control group values improved by 11.2% on an average.

The following figure 26 shows an average improvement of IOP value in the left eye in groups 1. IOP values in the experimental group improved by 25.4% and in the control group values improved by only 9.3%.

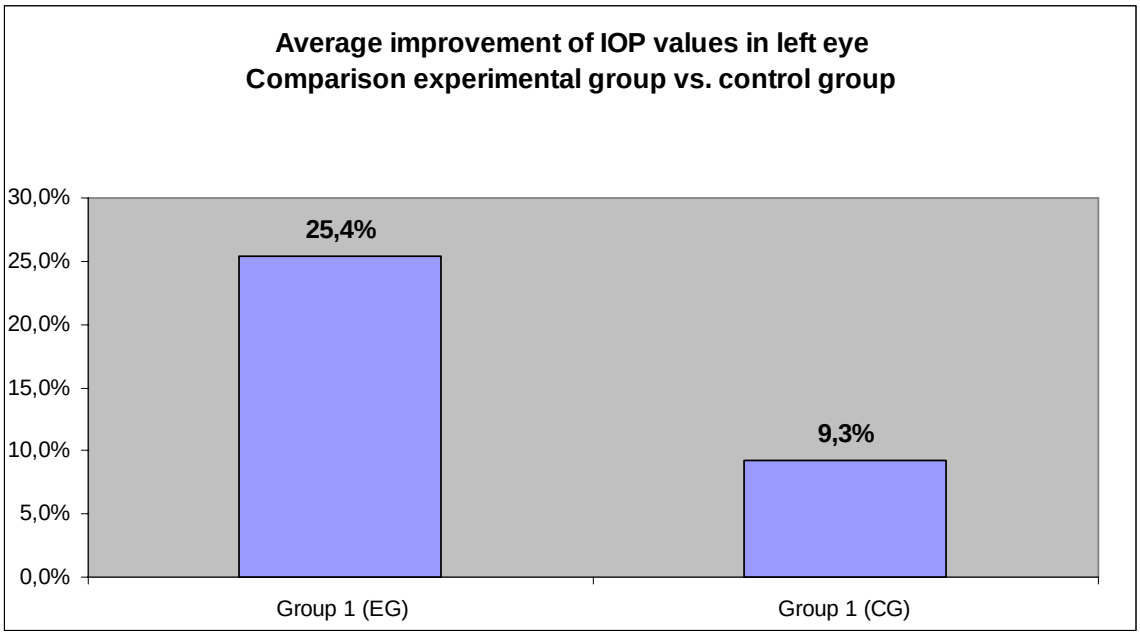


Fig. 26: Comparison of groups 1 of experimental (EG) and control group (CG); average improvement of IOP values, left eye

The following two diagrams show the comparison of average deterioration of IOP values in groups 3 of the experimental group and of the control group.

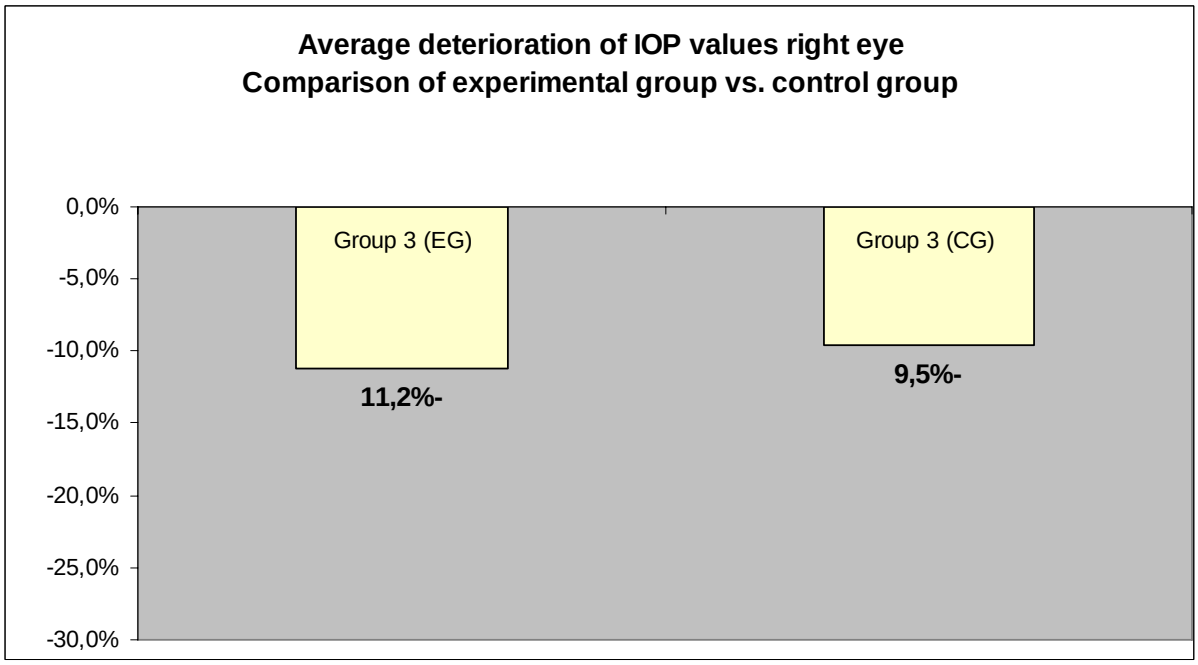


Fig. 27: Comparison groups 3 of experimental (EG) and control group (CG); average deterioration of IOP values, right eye

Figure 27 shows the deterioration of IOP values in the right eye in 11.2% of group 3 of the experimental group and in 9.5% of group 3 of the control group.

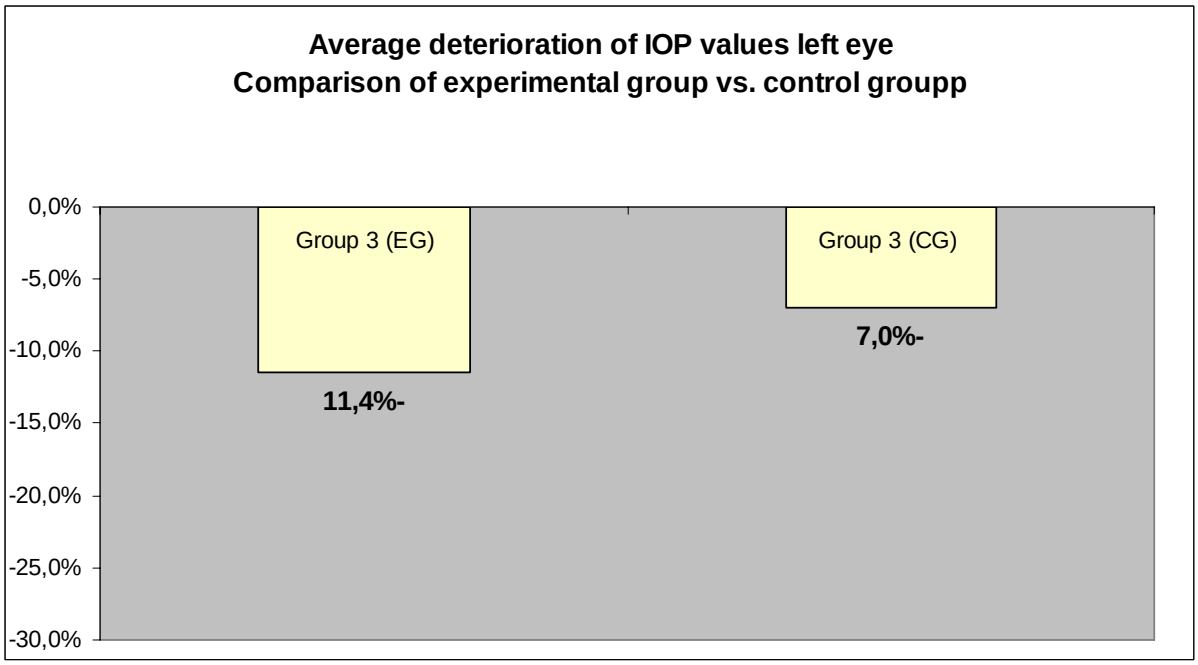


Fig. 28: Comparison of groups 3 of experimental (EG) and control group (CG); average deterioration of IOP values in left eye

Figure 28 shows average deterioration in IOP values in the left eye. In group 3 of the experimental group IOP values deteriorated by 11.4% at an average, in group 3 of the control group the values deteriorated by 7% at the average.

Figure 29 shows mean IOP changes in both groups in comparison to the initial values in percent.

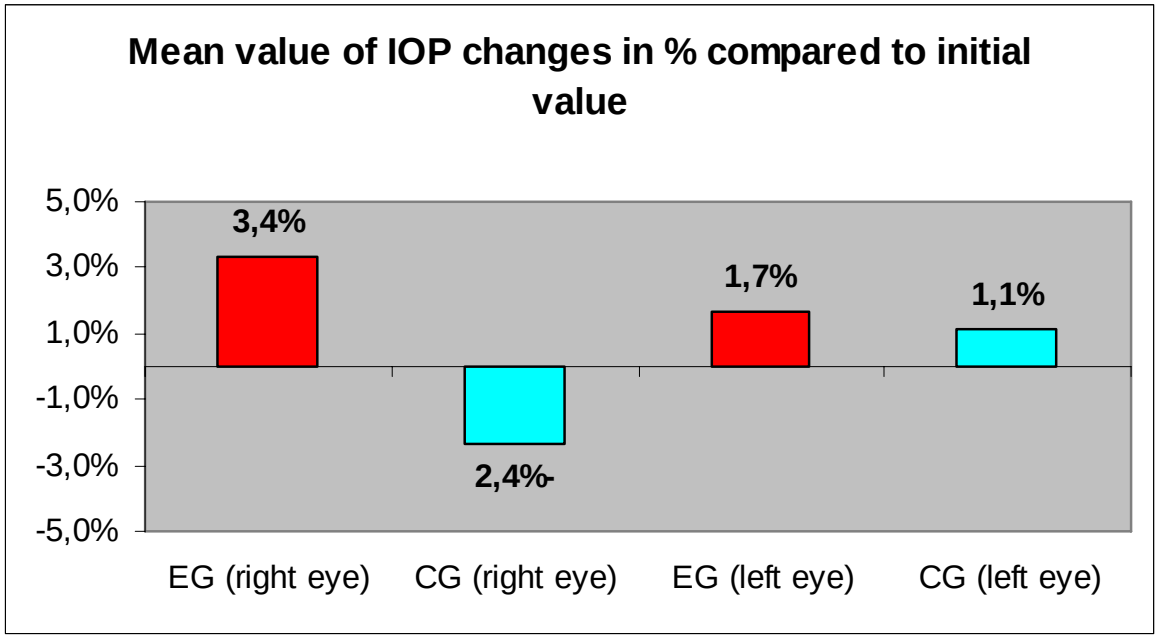


Fig. 29: Mean IOP value changes in % compared to the initial value in %; comparison of experimental (EG) and control group (CG)

As figure 29 illustrates mean IOP values in the experimental group improved by 3.4% in the right eye and by 1.7% in the left eye in comparison to the initial values.

In the control group mean IOP values in the right eye improved by 2.4% and by 1.1% in the left eye.

9.5. Study Dropouts

Fortunately, no patient from the experimental group dropped out of the study. In the control group three patients dropped out. One patient could not participate in the second IOP reading for health reasons. Two patients came to the ophthalmologist for the second reading only three months after the first reading and therefore had to be excluded from the study.

10. Discussion

In the following chapter the study will be discussed in order to draw conclusions and be able to provide a possible outlook for further studies.

10.1. Dicussion of the Selected Method

This study was carried out as a match-controlled study. The assignment of the patients to the groups was known by the patients, the ophthalmologist and the osteopath. For organisational and financial reasons blinding of the study was not possible. In order to improve the validity of the study the best option would have been to perform a randomised double-blind experiment.

As a further point of criticism low number of participants has to be mentioned (ten persons in each group) which puts the result of the study into perspective.

Grouping of patients in the randomisation list was done by the secretariat of the ophthalmologist. With regards to gender of patients the groups were not completely balanced while regarding age the groups were well balanced.

Additionally I noticed that the inclusion criteria regarding intraocular pressure were not complied in all cases. In some of the patients intraocular pressure was below 21 mmHg. As the patients' data were only collected from the ophthalmologist's at the end of the study in order not to be influenced during the treatment by knowing the pressure values, it was not possible anymore to take influence.

Intraocular pressure readings by means of Goldmann applanation tonometry served to measure the primary parameter intraocular pressure.

The results depend on many factors such as circadian fluctuations, seasonal fluctuations, position, physical activity or rest, myopia, rubbing of the eye, width of the lid, holding the breath, pressing, closure of lid, and thickness of cornea (Pfeiffer, 2005). The ophthalmologist was asked to perform the first and the second measurement at the same time of the day in order to avoid circadian fluctuations.

In addition it would probably have been useful to perform a number of control measurements at different times (for example directly after the treatments and six hours later, one week after and five weeks after the last treatment). But that was not possible for organisational and financial reasons.

The purpose of the questionnaire was to investigate the secondary parameters. The questionnaire was very targeted and was easily understood by the patients. However, the question on impairment of vision did not take into account that all patients were provided with vision aids and therefore hardly any of them suffered impairment in visual function.

With regards to osteopathic diagnosis, examination and treatment it has to be pointed out that only during this study I collected first experiences on the eye. I had difficulties to decide in how far other lesions (e.g. dysfunction of the calcaneus) had to be taken into account but at the same time not to depart too far from the topic (intraocular pressure). I was eager to integrate specific treatment methods as described in literature in the best possible way into the holistic treatment approach of osteopathy. The number of treatments is considered appropriate for this study.

10.2. Discussion of the Study Results

This section provides an overview about the findings obtained during this study and that are relevant for osteopathy as they support osteopathic approaches in the treatment of glaucoma patients.

The study proves that there was a significant improvement regarding secondary parameters (headaches, neck pain, other discomforts, visual performance) after three osteopathic treatments. With regards to the primary parameter (intraocular pressure) slightly better results could be achieved in the experimental group in comparison to the control group.

In the **experimental group** treatment caused improvement of IOP values in 40% of patients by 19.6% in the right eye and in 20% of patients by 25.4% in the left eye on an average. IOP values were maintained in 20% of patients in the right eye and in 50% of patients in the left eye. IOP values deteriorated in 40% of patients by 11.2% in the right eye and in 30% of patients by 11.4% in the left eye on an average. That means that IOP values in the experimental group improved or remained unchanged in 60% of patients in the right eye and in 70% of patients in the left eye. Average changes of mean IOP value in the experimental group amounted to 3.4% in the right eye (improvement) and to 1.7% in the left eye (improvement).

In the **control group** IOP values improved in 30% of patients by 11.2% in the right eye and in 50% of patients by 9.3% in the left eye on an average. IOP values remained unchanged in 10% of patients in the right eye and 0% in the left eye. IOP values deteriorated in 60% of patients by 9.5% in the right eye and in 50% of patients by 7% in the left eye on an average. That means that in only 40% of experimental group's patients IOP values in the right eye and in 50% of patients in the left eye were improved or remained unchanged. Average changes of mean IOP values amounted to –2.4% (deterioration) in the right eye and 1.1% in the left eye (improvement).

A comparison of the two groups reveals that average change of mean IOP value in the right eye amounted to 3.4% (improvement) in the experimental group and to –2.4% (deterioration) in the control group. In the left eye average change of mean IOP value amounted to 1.7% (improvement) in the experimental group and to 1.1% in the control group. These values demonstrate that mean IOP values of the experimental group showed better results than those of the control group. In 60% of experimental group's patients IOP value of the right eye improved or remained constant and in only 40% of the control group's patients. In the left eye IOP values improved or remained constant in 70% of patients of the experimental group, but in only 50% of patients of the control group. Furthermore it was found that in the case of an improvement of IOP values the results were significantly better in the experimental group (right eye 19.6% and left eye 25.4%) than in the control group (right eye 11.2% and 9.3%).

The results of **secondary parameters** in the experimental group prove that the initially reported symptoms were reduced significantly by means of the three osteopathic treatment units. Headaches were reduced by 76% on an average. Neck pain was reduced by 39% at an average and the reduction of other discomforts such as dizziness and dysphagia was at 58% on an average after the osteopathic treatment. Visual impairment could be reduced by 42% on the average.

Coming back to the key question of this study whether intraocular pressure in primary chronic open-angle glaucoma can be reduced by osteopathic treatment it can be stated that according to the present study results osteopathic treatment in principle has a positive effect on the primary parameter intraocular pressure.

The results of the study prove that with regards to the secondary parameters (headaches, neck pain, other discomforts, impairment of visual performance) osteopathic treatment is highly efficient.

For further studies it would be beneficial to analyse the number of treatments, IOP measurement method, time of measurement, time intervals and number of IOP readings after the treatments, general state of health of the patient, homogeneity of the groups regarding age and gender, as well as experience of the osteopath in order to obtain more relevant results in IOP values.

11. Summary

Glaucoma is one of the most common causes of blindness and therefore attracted my interest. Visual loss related to glaucoma is irreversible and for this reason at a certain age eye examination should be part of routine care (Teuchner, 2005). In orthodox medicine all therapeutic interventions in the treatment of primary chronic open-angle glaucoma – be it medication or laser and conventional surgery – aim at the reduction of intraocular pressure. As these interventions are often connected with severe side effects this study investigates in how far intraocular pressure, as one of the major factors in the development of glaucoma, can be influenced by osteopathic treatment (Pfeiffer, 2005). In order to investigate this topic a match-controlled study was performed with 20 patients. The objective of the study was to investigate the impact of osteopathic treatment on intraocular pressure which is often elevated in primary chronic open-angle glaucoma.

20 patients who complied with the inclusion criteria were participating in the study. The patients were registered in the randomisation list, which divided the patients into two groups, depending on the date of registration: an experimental group and a control group.

Intraocular pressure was measured in all patients in the first and the fifth week by the ophthalmologist. The experimental group received osteopathic treatment in the second, the third and the fourth week. Both groups continued to use their eye medication during the course of the experiment. During the experiment and at least six month before its start in neither of the two groups medication was changed.

The analysis of the **primary parameter** intraocular pressure which was measured by means of Goldmann applanation tonometry by the ophthalmologist showed the following results:

Experimental Group:

Improvement of IOP values in 40% of patients of 19.6% on an average in the right eye.

Improvement of IOP values in 20% of patients of 25.4% on an average in the left eye.

Constant IOP values in 20% of patients in the right eye and in 50% of patients in the left eye.

Deterioration of IOP values in 40% of patients of 11.2% on an average in the right eye.

Deterioration of IOP values in 30% of patients of 11.4% on an average in the left eye.

That means that the average change of mean IOP value amounts to 3.4% (improvement) in the right eye and to 1.7% (improvement) in the left eye.

Control Group:

Improvement of IOP values in 30% of patients of 11.2% on the average in the right eye.

Improvement of IOP values in 50% of patients of 9.3% on the average in the left eye.

Constant IOP values in 10% of patients in the right eye and in none of the patients in the left eye.

Deterioration of IOP values in 60% of patients of 9.5% on the average in the right eye.

Deterioration of IOP values in 50% of patients of 7% on the average in the left eye.

That implies that average change of mean IOP value amounts to –2.4% (deterioration) in the right eye and 1.1% in the left eye (improvement).

The **secondary parameters** such as headaches, eye pain, neck pain, other discomforts, visual performance and use of medication including their side effects were investigated by means of a questionnaire. The analysis of the questionnaire showed the following results:

Experimental Group:

80% of patients had been applying eye medication for a longer period of time (at least six months).

37% of patients using eye drops reported various side effects.

After three osteopathic treatments an average improvement of reported headaches of 76% was registered.

After osteopathic treatments neck pain had improved by 39% on the average.

Average reduction of reported other symptoms like dizziness and dysphagia amounted to 58% on the average after the osteopathic treatment.

Impairment of visual performance was reduced by 42% on an average.

The present study reveals that the experimental group showed slightly better treatment results with regard to the primary parameter than the control group. With regard to the secondary parameters the osteopathic treatment was highly effective.

In summary one can say that osteopathic treatment has a slightly positive effect on the primary parameter intraocular pressure. In addition the osteopathic approach shows a high efficiency in the treatment of the secondary parameters (headaches, neck pain, other symptoms such as dizziness and dysphagia).

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13. Appendices

13.1. Letters to Ophthalmologists

Bludenz, 5 March 2006

Glaucoma Study

Dear Dr. ...,

With reference to our telephone conversation of 3 March 2006 I am sending enclosed the documents of my master thesis.

In order to graduate from Vienna School of Osteopathy and Danube University Krems with the degree of "master of science" the elaboration of a scientific thesis is an obligatory part of the six-year osteopathy education. As a topic I chose "The Impact of Osteopathic Treatment on Increased Intraocular Pressure in Primary Chronic Open-Angle Glaucoma".

For this thesis I want to perform a scientific study with patients with diagnosed primary chronic open-angle glaucoma with increased intraocular pressure. Therefore the participation of 30 patients who comply with the defined criteria (see attachment) is necessary. The osteopathic treatments are free of charge for the patients and the insurance companies.

I would be grateful if you would support the elaboration of my study, and I look forward to our conversation on 15 March 2006.

Yours sincerely,

Sonja Bilgeri

Glaucoma Study – Osteopathy

Inclusion Criteria:

- Diagnosis by ophthalmologist: primary chronic open-angle glaucoma (with characteristic optic nerve damage, visual field impairment, intraocular pressure >=22mmHg) since at least six months
- Intraocular pressure up to 30 mmHg
- During the course of the study no change in current medication (medication existing since over six months is no exclusion criterion)

Exclusion Criteria:

- Angle-closure glaucoma, juvenile glaucoma
- Intraocular pressure above 30mmHg
- Expected medication change in the close future
- Blindness
- Tumor in head area
- Recently suffered apoplexy, central nervous system disorders, scull fractures, craniocerebral trauma, therapy with anticoagulantion
- Previous eye surgeries

Planned Procedure:

Experimental group:

first week:	applanation tonometry by ophthalmologist
second week:	first osteopathic treatment
third week:	second osteopathic treatment
fourth week:	third osteopathic treatment
fifth week:	applanation tonometry by ophthalmologist at the same time as the first tonometry

Control group:

first week:	applanation tonometry by ophthalmologist
fifth week:	applanation tonometry by ophthalmologist at the same time as the first tonometry

During the course of the study both groups continue their eye medication.

13.1.1. Information for Patients

Information for Glaucoma Patients

To all patients with increased intraocular pressure in open-angle glaucoma.

My name is Sonja Bilgeri and I am physiotherapist and osteopath. I am currently elaborating a scientific **study** with glaucoma patients and I am looking for persons who are interested in participating in this study and in receiving osteopathic treatment **free of charge**.

For my master thesis I am investigating **increased intraocular pressure** in primary chronic open-angle glaucoma. The objective of this study is the reduction of intraocular pressure through osteopathic treatment.

Osteopathy is a gentle treatment method in which the osteopath examines and treats the patients exclusively by means of manual treatment techniques.

If you are interested in participating in this study please contact your ophthalmologist or me directly (see contact data below).

Sonja Bilgeri
Osteopathie – Physiotherapie BILGERI
Färberstrasse 10
A-6700 Bludenz
phone: +43 - (0)5552 - 68110
e-mail: osteopathie.bilgeri@tele2.at

13.1.2. Randomisation List Glaucoma Study

Randomisation List

(Please enter name in chronological order of enrolment. Thanks!)

No.	Group C = control group E = experimental group	Name
1	C	
2	E	
3	C	
4	E	
5	E	
6	E	
7	C	
8	E	
9	C	
10	C	
11	E	
12	E	
13	C	
14	C	
15	E	
16	C	
17	E	
18	C	
19	C	
20	E	

13.1.3. Time Schedule for Intraocular Pressure Readings

Name	Date and Time 1st reading	Intraocular Pressure mmHg	Date and Time 2nd reading (5 weeks later)	Intraocular Pressure mmHg
		R: mmHg L: mmHg		R: mmHg L: mmHg
		R: mmHg L: mmHg		R: mmHg L: mmHg
		R: mmHg L: mmHg		R: mmHg L: mmHg
		R: mmHg L: mmHg		R: mmHg L: mmHg
		R: mmHg L: mmHg		R: mmHg L: mmHg
		R: mmHg L: mmHg		R: mmHg L: mmHg
		R: mmHg L: mmHg		Re: mmHg Li: mmHg
		R: mmHg L: mmHg		Re: mmHg Li: mmHg
		R: mmHg L: mmHg		R: mmHg L: mmHg
		R: mmHg L: mmHg		R: mmHg L: mmHg
		R: mmHg L: mmHg		R: mmHg L: mmHg
		R: mmHg L: mmHg		R: mmHg L: mmHg
		R: mmHg L: mmHg		R: mmHg L: mmHg

13.1.4. Declaration of Consent Experimental Group

Declaration of Consent

Herewith I agree to receive osteopathic treatment trough Ms. Sonja Bilgeri. Furthermore, I agree that the values of my intraocular pressure readings and other readings are used in the frame of a scientific study.

Signature:

Date:

13.1.5. Declaration of Consent Controll Group

Declaration of Consent

Herewith I agree that the values of my intraocular pressure readings and other readings may be used in the frame of a scientific study.

Signature:

Date:

13.1.6. Patient Information

Glaucoma Study - Osteopathy

Name of patient:

Inclusion criteria complied: **Yes** **No**

Date:

Signature of ophthalmologist:

13.1.7. Patient's Questionnaire

Questionnaire

Sex: F / M

Age: year

1. How long have you been receiving treatment against increased intraocular pressure through your ophthalmologist?

2. Which medication are you using frequently?

-
-
-
-

3. Have you experienced any side effects in relation with the medication subscribed by your ophthalmologist?

   yes/no

If yes, please specify side effects
(e.g. indisposition, nausea, depression, loss of weight, red eyes, changes in heart rate, bronchial problems, allergy, blood pressure changes, vision disturbance, anomalies of pupil, impaired night vision, near-sightedness....).

-
-
-

4. Have you been feeling pain **before** the osteopathic treatment?
   Please classify intensity of the pain between 1 and 10, with 10 being very intense.

	hardly notable									very intense
□ headache	1	2	3	4	5	6	7	8	9	10
□ eye pain	1	2	3	4	5	6	7	8	9	10
□ neck pain	1	2	3	4	5	6	7	8	9	10
□ any other pain	1	2	3	4	5	6	7	8	9	10

5. Did you feel any pain **after** conclusion of osteopathic therapy?
   Please classify intensity of the pain between 1 and 10, with 10 being very intense.

	hardly notable									very intense
□ headaches	1	2	3	4	5	6	7	8	9	10
□ eye pain	1	2	3	4	5	6	7	8	9	10
□ neck pain	1	2	3	4	5	6	7	8	9	10
□ any other pain	1	2	3	4	5	6	7	8	9	10

6. Was your vision impaired **before** the treatment? **Yes / No**

   If yes:
   Please classify your visual performance between 1 and 10, with 10 being heavily impaired.

	hardly impaired									heavily impaired
□ Visual performance	1	2	3	4	5	6	7	8	9	10

7. Has visual performance improved **after** the treatment?

   Yes / No

   If yes, in which way did your vision improve?

   Please classify your visual performance **after** the treatment between 1 and 10, with 10 being heavily impaired.

	hardly impaired									heavily impaired
□ Visual performance	1	2	3	4	5	6	7	8	9	10

13.1.8. Findings Sheet

Findings Sheet

Name: Profession:
Age: Hobby:
Telephone no.: Family anamnesis:

Discomforts:

Primary diseases:

- Cardiac disease
- Low blood pressure
- High blood pressure
- Arteriovenous problems
- Lymhovenous problems
- Near-sightedness
- Farsightedness
- Cold hands/feet
- Metabolic disorders
  a: Diabetes II (insulin resistance, pancreas, digestive tract)
  b: thyroid gland (pituitary gland, hypothalamus, thyroid gland, liver, lung, blood)
  c: fat metabolism
- Organ diseases (liver, heart, lung, blood, pancreas, digestive tract, kidneys)

- Neurovegetative symptoms (sympathicotonia)
  (sleep, stress, sweating)
- Psychological problems

Other diseases:

Surgeries:

Accidents/trauma:

Findings: structural

visceral

craniosacral

Glossary

German	English
Abflussbehinderung	outflow resistance
absolutes Glaukom	absolute glaucoma
Achse der Orbita-Pyramide	axis of orbit pyramid
Aderhaut	choroid
afferente Fasern	afferent fibres
Auge	eye
Bindehaut	conjuntiva
Edinger-Westphal-Kern	Edinger-Westphal nucleus
Hornhaut; Kornea	cornea
Kammerwasservene	aqueous vein
Kammerwinkel	chamber angle
kindliches Glaukom	infantile glaucoma
Linse	lens
Offenwinkelglaukom	open-angle glaucoma
Petrosa-Achse	axis of petrosa
Pigmentepithel	pigment epithelium
Pupillarblockglaukom	pupillary block glaucoma
Schaltneuron	interneuron
Schlemm-Kanal	canal of Schlemm
Sehnerv	optic nerve
Sklera	sclera
Trabekelwerk	trabecular meshwork
Winkelblockglaukom	angle closure glaucoma
Ziliarkörper	ciliary body

List of Figures