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## POSTOPERATIVE VISUAL RECOVERY FOLLOWING SURGICAL TREATMENT OF SUPRASELLAR MENINGIOMAS

*VIDNA OŠTRINA NAKON OPERATIVNOG LEČENJA MENINGEOMA OPTOHIJAZMALNE REGIJE*

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**Summary – Introduction.** The purpose of this study was to investigate pre- and postoperative visual acuity in patients with meningioma in the area of optic chiasm. **Material and Methods.** This retrospective study included 43 patients with meningioma in the area of optic chiasm, who had been found to have impaired visual function according to anamnestic data and neuro-ophthalmologic examination which excluded the presence of any other eye diseases. The visual status was analyzed both preoperatively and postoperatively, i.e. 10 days, one month and six months after surgery. **Results.** An improvement in visual acuity was recorded in 50% of the examined eyes (68.42% of patients), the most expressed changes being in terms of higher number of the eyes with normalized visual acuity and lower number of the eyes with severely reduced visual acuity after surgery. These changes were particularly prominent immediately after surgery, during the first ten days. **Conclusion**. The recovery of visual acuity after decompression in the area of optic chiasm is possible in cases where mechanical pressure on the nerve fibres and resulting fibre ischemia have not lasted long enough to lead to their irreversible damage.
**Key words**: Visual Acuity; Visual Fields; Meningioma; Optic Chiasm + pathology; Treatment Outcome; Decompression, Surgical

### Introduction

Meningeal tumours are slow growing, generally benign tumours of extra cerebral localisation. They most frequently occur in the middle-aged, in the fifth or sixth decade of life, with female predominance, making 17% to 20% of all intracranial neoplasms [1-4]. Meningiomas, which affect the visual pathway, are the ones with insertion in the area of and next to the midline of the floor of anterior cranial fossa (olfactory meningioma, meningioma of sphenoidal plane, sellar tubercule, clinoid, diaphragm), as well as the ones located on the cranial base para medially and laterally – on the edges of lesser wings of sphenoid bone.

A decrease in visual acuity and visual field scotoma are most frequently the first, and, for a long time, the only signs of the pathological process of this region [1-8]. Optic nerve head atrophy develops as a consequence of a longer compression of the nerve fibres of optic nerve and chiasm. One of the primary indications for surgical removal of meningioma is progressive damage of the visual function [3-8]. The aim of surgical treatment of these tumours is decompression of optochiasmal complex, by which further visual loss is prevented and its postoperative recovery is provided [5,6,9-14].

The recovery of visual acuity and visual field after decompression in chiasmal region is possible in cases where mechanical pressure to nerve fibres and ischemia due to the pressure on the blood vessels of the nerve itself has not lasted long enough to cause their irreversible damage. However, besides the well-known symptoms of chiasmal syndrome, progressive visual loss, due to late diagnosis, is a very frequent situation [1,3,5,6]. Late diagnosis of lesions of optochiasmal region lowers the possibility of visual function recovery [15-16], and decreases the possibility of recovery of hormonal and neurological disorders, which are often a part of chiasmal syndrome, sometimes life threatening, as well.

The aim of this paper is to determine the degree of postoperative visual acuity and to monitor the state of visual acuity after surgical decompression of optochiasmal region immediately after surgery, and one month and six months afterwards.

### Material and Methods

The study sample included the patients with computed tomography (CT) and/or nuclear magnetic resonance (NMR) diagnosed tumour in optochiasmal brain region, operated during 2002 at the Institute of

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***Abbreviations***

| | |
|---|---|
| CT | – computed tomography |
| NMR | – nuclear magnetic resonance |
| VA | – visual acuity |
| CF | – finger counting |
| HM | – hand motion |
| LP | – light perception |
| NLP | – no light perception |

Neurosurgery of the Clinical Centre of Serbia, Belgrade, and at the Institute of Neurosurgery of the Clinical Centre of Novi Sad. Based on postoperative pathohistologic sample examination, the patients with supra and parasellar localised meningioma were selected from the initial group of 160 patients.

Out of 54 patients with supra and parasellar localised meningioma, 43 had a positive ophthalmologic finding (79.6%). Based on anamnestic data and neuro-ophthalmologic examination the patients with visual function disorder, but without any other eye and optic nerve diseases, were selected. The thorough ophthalmologic examination performed on the patients included: visual acuity, colour vision, visual field, pupillary reaction to light, oculomotor nerve function, and protrusion of globe and ophthalmoscopic examination of the fundus. The examination was performed preoperatively and postoperatively – on discharge of the patients (10 days after surgery), after a month and after six months.

Snellen optotypes and decimal notation of visual acuity (VA) from 0.1 to 1.0 were used to measure visual acuity. Measuring was carried out from the distance of 6m, in constant illumination, separately for each eye, and in case of existing refractive error, with the appropriate refractive correction. If visual acuity was lower than 0.1, finger counting method (CF) from the distance of 1 – 5m and visual acuity notation from 1/60 to 5/60 was used. Visual acuity below 1/60 was labelled hand motion (HM) if the patient was able to see hand movements in front of his eye, light perception (LP) if the patient saw the light and had correct projection of the light source, and no light perception (NLP) if the eye perceived no light, i.e. if it was blind.

The patients were classified into five categories according to their visual acuity: with no visual acuity loss V=1.0; minor loss V=0.9-0.5; medium loss V=0.4-0.1; severe loss V=CF, HM, LP; blindness V=NLP.

When a numerical characteristic is observed in two different periods of time, it is necessary to test the hypothesis whether the value of the characteristic changes differs in different time periods – for example, preoperatively and ten days after surgery t-test was used for testing this dependence. The hypothesis presuming that an expected difference of the value of the characteristic before and after the operation equalled zero was tested. If t-test shows that the null hypothesis is to be rejected that means that there is a statistically significant difference between values of the characteristic in different time periods.

## Results

The female to male patient ratio was 32:11, i.e. 74.4% of the patients were females and 25.5% were males. The age span was from 36 to 71 years of age, the average being 53.3 years: 51.8 for females and 57.4 for males.

The dominating symptom in the clinical picture of suprasellar menangioma was loss of vision, monocular at first, and binocular later. Loss of vision as the most frequent symptom was found in 41 out of 43 patients (95.3%). When the diagnosis was being made, monocular loss of vision was found in 16 out of 43 patients (37.2%). Binocular loss of vision was found in 25 out of 43 patients (58.1%), being asymmetrical in 18 and symmetrical in 7 patients. Headache, as a symptom alone or in combination with loss of vision, was present in 9 out of 43 patients (20.9%). Neurological symptoms, as mental or motor deficit, vertigo, epileptic seizures, hyposmia, were present to a much lesser degree (from 2.3% to 9.3%), as well as oculomotor paresis in combination with subjective diplopia and proptosis.

The time period from the beginning of symptoms until diagnosis was made ranged from 2 months to 11 years (on average 21.5 months). In 18 out of 43 patients the diagnosis was made within 6 months from the beginning of symptoms (in 4 patients within 2 months), in 17 out of 43 patients during the interval from 7 months to 2 years and in 8 out of 43 patients it took more than 2 years to make the correct diagnosis.

The origin, i.e. location of insertion of meningioma, was established radiologically, using NMR or CT and it was confirmed during surgical intervention.

The most frequent location of tumour insertion was at the tuberculum sellae (27.9%), followed by medial and of lesser wings of sphenoid bone (23.25%), including two patients with propagation of tumour into cavernous sinus, and the other two patients with orbital tumour spreading. Sphenoid plane and clinoid process as the location of tumour insertion were represented with 18.6% and meningiomas of olfactory region with 9.3%.

The size of the tumour, determined by its greatest diameter, was also measured according to the NMR or CT imaging.

There are data on the size of tumour for 40 patients, according to which middle-sized tumours, from 30 to 70 mm, were predominant, having been found in 23 patients, then small-sized tumours up to 30 mm were found in 13 patients (32.5%) and big tumours, exceeding 70 mm, were found in 4 patients (10%).

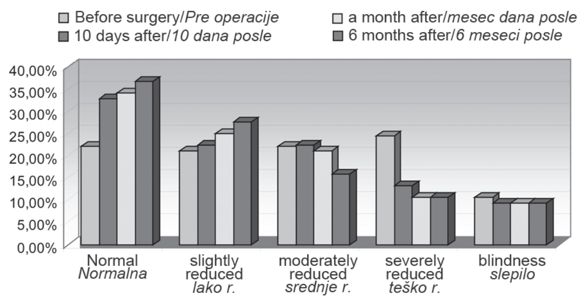
Preoperative VA, in relation to the number of eyes, was normal in 19 out of 86 eyes – 22.09%, slightly or moderately reduced in 37 eyes – 43.02%, while severe loss of visual acuity, including CF, HM and LP was found in total of 21 eyes – 24.41%. There were 9 or 10.47% totally blind eyes, with NLP.

In relation to the number of patients, 2 patients - 4.65% had normal visual acuity in both eyes. Monocular loss of visual acuity was perceived in 17 patients – 39.53%, and binocular in the remaining 24 patients – 55.80%. Severely reduced monocular visual acuity of both groups was found in more than half of the patients – 25, i.e. 58.13%.

Five out of 43 preoperatively analysed patients died during the first couple of days after surgery (11.62%). The average age of patients was 64.2 years; the symptoms lasted for more than 8 years in 3 patients, and the size of tumour above 70 mm was found in the same number of patients. Each and every one of them had a complete loss of visual function in one eye.

Thirty-eight patients were followed postoperatively.

Ten days after surgical treatment of 76 eyes with para- and suprasellar meningioma, normal visual acuity was recorded in 25 of them (32.89%), visual acuity was slightly or moderately reduced in 34 eyes (44.74%), it was severely reduced in 19 eyes (13.16%), whereas 7 eyes had no light perception (9.21%) **(Graph 1)**.




**Graph 1.** Eyes (%) and visual acuity in different time intervals

***Grafikon 1****. Vidna oštrina u odnosu na broj očiju u različitim vremenskim intervalima*

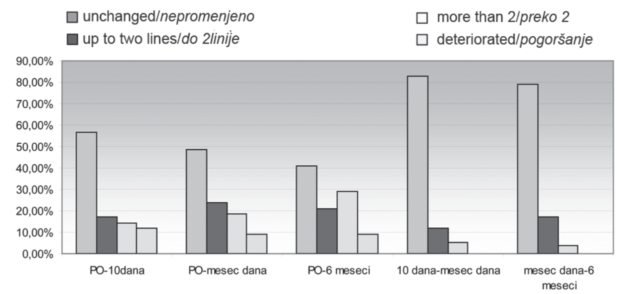
When compared with preoperative findings, visual acuity in the patients operated for meningioma remained the same in 43 out of 76 eyes (57%) 10 days after surgery, including 19 eyes which had had normal preoperative visual acuity (VA=1.0). Visual acuity was found to be improved in 24 eyes (31%). The gain of 2 lines of optotype was observed in 13 out of 76 eyes (17%), while more than 2 lines of improvement was found in 11 out of 76 eyes (14%). Deterioration was detected in 9 out of 76 eyes (12%) **(Graph 2)**.

In relation to the number of patients, 5 out of 38 patients (13%) had normal visual acuity in both eyes, 15 out of 38 (40%) had normal visual acuity in the better eye and 10 out of 38 patients (26%) had visual acuity from 0.5 to 0.9 in the better eye. Visual acuity less than 0.5 was found in 8 out of 38 patients (21%).

Using t-test, based on the hypothesis that visual acuity of the examined eyes does not change 10 days after surgery compared to preoperative values, it was determined that t=3.33019 for the p=0.00134. Since $p<0.01$, the hypothesis that there is no statistically significant difference of visual acuity before surgery and 10 days after can be rejected with probability of 99%, i.e. it can be concluded that visual acuity was significantly better 10 days after surgery.

One month after surgical treatment of 76 eyes for para- and suprasellar maningioma, normal visual acuity was found in 26 eyes (34.21%), slightly or moderately reduced in 35 eyes (46.05%), severely reduced in 8 eyes (10.53%) and with no light perception in 7 eyes (9.21%) **(Graph 1)**.

When comparing the preoperative findings with those one month after surgical treatment of 76 eyes with para- and suprasellar meningioma, it was concluded that the visual acuity remained the same in 37 eyes (49%). The number of eyes with improved visual acuity was significantly higher, i.e. 32 eyes (42%). The improvement of up to 2 lines of optotype was observed in 18 out of 76 eyes (24%), while the improvement of more than 2 lines was found in 14 out of 76 eyes (18%). Deterioration was perceived in 7 out of 76 eyes (9%); **(Graph 2)**.




**Graph 2.** Eyes (%) and visual acuity change in different time intervals

***Grafikon 2.*** *Promena vidne oštrine u različitim vremenskim intervalima u odnosu na broj očiju*

Regarding the number of patients, it did not change compared to findings 10 days after surgery - 5 out of 38 patients (13%) had normal visual acuity in both eyes, 16 out of 38 (43%) had normal visual acuity in one, i.e. better eye, and 10 out of 38 patients (26%) had visual acuity from 0.5 to 0.9 in the better eye. Visual acuity below 0.5 was found in 7 out of 38 patients (18%).

Using t-test, based on the hypothesis that visual acuity of the examined eyes does not change one month after surgery compared to preoperative values, it was determined that t=4,59531 for the p=0.00017. Since $p<0.01$, the hypothesis that there is no statistically significant difference of visual acuity before the surgery and one month after can be rejected with probability of 99%, i.e. it can be concluded that visual acuity was significantly better one month after surgery.

Six months after surgical treatment of 76 eyes with para- and suprasellar meningioma, normal visual acuity was found in 28 eyes (36.84%), slightly or moderately reduced in 33 eyes (43.42%), severely reduced in 8 eyes (10.53%) and no light perception in 7 eyes (9.21%); **(Graph 1)**.

When comparing preoperative visual acuity of patients with operated meningioma six months after surgery, visual acuity was found to be the same in 31 out of 76 eyes (41%); it was improved in 38 out of 76 eyes (50%). The improvement of up to 2 lines of optotype was observed in 16 out of 76 eyes (21%), while the improvement of more than 2 lines, being the most expressed, was found in 22 out of 76 eyes (29%). Deterioration was perceived in 7 out of 76 eyes (9%); **(Graph 2)**.

Regarding the number of patients, normal visual acuity remained the same in both eyes in 5 out of 38 patients (11%), 16 out of 38 (47%) had normal visual acuity in one, i.e. better eye, and 11 out of 38 patients (29%) had visual acuity from 0.5 to 0.9 in the better eye. Visual acuity below 0.5 in both eyes was found in 4 out of 38 patients (11%).

Using t-test, based on the hypothesis that visual acuity of the examined eyes does not change six months after surgery compared to preoperative values, it was determined that t=v5,78527 for the p=4,35 x10 -7. Since p<0.01, the hypothesis that there is no statistically significant difference of visual acuity before surgery and six months after can be rejected with probability of 99%, i.e. it can be concluded that visual acuity was significantly better six months after surgery.

To sum up, the improvement of visual acuity was observed in the half of examined eyes – 50%, the most evident changes being those regarding an increase in the number of eyes with normalised visual acuity – from 22% before surgery up to 37% after six months, and a decrease in the number of eyes with severely reduced visual acuity from 24% preoperatively up to 10.5% six months postoperatively. These changes were, similar to the cases with pituitary adenoma, most pronounced immediately after surgery. The increase in the number of eyes with slightly reduced visual acuity was also observed; (**Graph 1**). Visual acuity remained the same in 41% and the decrease was found in 9% of eyes.

In relation to the number of patients, 68% of them experienced an improvement of visual acuity (at least in one eye), only 13.16% achieved normal visual acuity in both eyes in 6 months, while 76.32% of patients obtained visual acuity of 0.5 and more in one eye, at least. No change in visual acuity was found in 21% and a decrease in 10% of patients.

## Discussion

Tumours of meningeal origin are most often diagnosed in middle-aged people. The average age of our patients was 53.3 years, that being within the range from 43 to 56 years, as published by other authors [1,3,5,6,17,18]. Most of them (56%) belonged to group from 41 to 60 years.

Female predominance has been confirmed by many authors [1-4,]. The female to male ratio in our patients was 74.4%:25.5%. Cushing and Eisenhardt observed a fast progression of neurological deficit in pregnant women with diagnosed meningioma [19], which was later confirmed [20-22]. This indicates that the growth of meningioma is stimulated by female sex hormones. Conclusions of contemporary authors are somewhat controversial [23,24], although immunohistochemical examinations have confirmed the existence of functional progesterone and oestrogen receptors in the cells of meningioma [25-28].

Clinical picture of supra- and parasellar meningioma is dominated by progressive loss of vision, monocular at first, and binocular asymmetric afterwards [3-8,17,18].

A decrease of visual acuity, as the most common subjective complaint, was found in 95.3% of our patients. Monocular decrease of visual acuity was noted in 39.5%, while binocular one was observed in 55.8% of patients. More than half of patients (58.1%) in both of these groups had severely reduced visual acuity in one eye.

Other authors have found that the per cent of loss of visual acuity ranges from 48% to more than 90% [3,4,28,29]. Such a large discrepancy can be explained by the influence of various locations of insertion and the directions of growth of meningioma in relation to the optic nerve and chiasm, taking into account individual variations of the length of optic nerve and location of chiasm. The highest decrease of visual function is found in meningioma of sellar tubercule and sphenoidal plane [1,5,8,12,16,17,23,30].

Postoperatively, after 6 months of observation, 68% of our patients showed an improvement of visual acuity (at least in one eye), only 13.16% returned to normal visual acuity in both eyes, while 76.32% of patients had visual acuity of 0.5 and higher in at least one of the eyes. No change in visual acuity was observed in 22%, and a decrease in 10% of patients.

In recent years, research dealing with state of visual function after surgical removal of sellar, suprasellar and parasellar meningioma refers to a different degree of its postoperative recovery, ranging from 32% to 70% [1,3-6,8,14,30,31]. Galal et al. [6] found an improvement of visual acuity in 60% of patients with suprasellar meningioma, and no improvement in 40% of patients. Li-Hua et al. [14] discovered an improvement of visual acuity in 64.9%, no change in 29.1% and a decrease in 6% of patients, while Zevgaridis et al. [8] found an improvement in 65%, no change in 18% and a decrease of visual acuity in 10% of patients, that being closest to our results.

It is presumed that there is a significant influence of meningioma localisation on the postoperative outcome. Patients with meningioma of sphenoidal plane, sellar diaphragm, and the ones occupying optic foramen, have a significantly worse recovery in comparison to the patients with meningioma of sellar tubercule, which is explained with a greater possibility of damage of the upper and lower chiasmal vascular plexus during the removal of tumours of the above mentioned locations [32].

Most authors [5,6,8,13,33] have observed a quick improvement of visual acuity during first 10 to 14 days, followed by further slower improvement during the following months up to one year and in rare cases even later. Puchner et al. [33] have pointed out that more than half of the patients require a longer period for improvement or recovery of visual acuity. Our data show that improvement occurs in the first 10 days postoperatively in 44.73% of patients (17 out of 38) and that this recovery is statistically significant.

The mechanism of optic nerve fibres damage in compressive chiasmal lesions implies venous stasis caused by pressure and disturbance of fast and slow phase of axoplasmatic transport, followed by oedema and anoxia of the nerve fibres, and further degeneration and demyelination of fibres, with interrupted or weakened signal transmission down the nerve and damage of its function as a consequence [18,34]. The early fast phase, in which visual function- visual acuity and visual field significantly improve or return to normal during the first 10 to 14 days, is thought to be caused by the removal of the so-called physical blockade of transmission [34], or by fast resorption of oedema localised at the place of lesion after the removal of blockade of fibres that were not irreversibly damaged [35]. Restoration of normal axoplasmatic transport and the process of remyeliniation are biological mechanisms leading to slower recovery in the following 3-6 months or longer [18,34].

## Conclusion

An improvement of visual acuity has been observed in a half of the examined eyes, with most distinctive changes being the increase in the number of eyes with normalised visual acuity and the decrease in number of eyes with severely reduced postoperative visual acuity. These changes are most prominent immediately after surgery, during the first 10 days.

It can be concluded that in the follow-up period of 6 months, there is an improvement of visual acuity in relation to the number of eyes and to the number of patients obtaining normal visual acuity, or visual acuity from 0.5 to 0.9 in one eye at least, which enables the patients to perform their everyday sight-related activities, such as reading, writing, near work, watching television, etc.

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## *Sažetak*

***Uvod***
*Cilj rada bio je da se utvrdi stepen oporavka vidne oštrine postoperativno kao i praćenje stanja vidne oštrine posle hirurške dekompresije optohijazmalne regije.*
***Materijal i metode***
*Retrospektivno je analizirano 43 pacijenta sa meningeomom optohijazmalne regije kod kojih je na osnovu anamnestičkih podataka i neurooftalmološkog pregleda utvrđen poremećaj vidne funkcije, a isključeno postojanje drugih bolesti oka ili očnog živca. Pacijenti su podvrgnuti detaljnom oftalmološkom pregledu preoperativno i postoperativno (pri otpustu pacijenta − 10 dana posle opeacije, posle mesec dana i posle šest meseci).*
***Rezultati***
*Poboljšanje vidne oštrine postoji kod 50% ispitivanih očiju (68,42% pacijenata), sa najizraženijim promenama u smislu povećanja broja očiju sa normalizovanom vidnom oštrinom i smanjenjem broja očiju sa teško redukovanom vidnom oštrinom postoperativno. Ove promene su najizraženije neposredno postoperativno, tokom prvih deset dana.*
***Zaključak***
*Oporavak vidne oštrine i vidnog polja nakon dekompresije predela hijazme moguć je u slučajevima gde mehanički pritisak na nervna vlakna i ishemija vlakana zbog pritiska na krvne sudove samog nerva nije trajala dovoljno dugo da dovede do njihovog ireverzibilnog oštećenja.*

*Ključne reči: Vidna oštrina; Vidno polje; Meningeom; Optička hijazma + patologija; Ishod lečenja; Hirurška dekompresija*

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