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Original Article/นิพนธ์ต้นฉบับ

Visual Field Defect Patterns and Junctional Scotoma in Sellar and Parasellar Region Tumors. Experience in a Neuro-Ophthalmology Clinic of a Tertiary Hospital

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Abstract

Objective: To demonstrate the visual field defect patterns of patients with sellar and parasellar region tumors in a tertiary neuro-ophthalmology clinic.

Methods: The data of all patients in the neuro-ophthalmology clinic at Naresuan University Hospital who presented with visual loss and were diagnosed with sellar/parasellar region tumors over 4 consecutive years were retrospectively reviewed. Visual fields (VF) were tested by the Humphrey Visual Field Analyzer 24-2 or 30-2 and were categorized into 5 groups: junctional scotoma (basic), junctional scotoma of Traquair, bitemporal defect, diffused loss in only one eye, and others.

Results: Among 39 patients, the diagnosis consisted of tuberculum sellae meningioma (25.64%), pituitary macroadenoma (20.51%), sphenoid wing meningioma (15.38%), craniopharyngioma (10.26%), cavernous sinus meningioma (7.69%), planum sphenoidale meningioma (5.13%), pituitary cyst (5.13%), sellar meningioma (5.13%), Rathke cleft cyst (2.56%), and clinoid meningioma (2.56%). Junctional scotoma was found as a sign of tumors in 41.03% of patients (junctional scotoma (basic) in 33.33% and junctional scotoma of Traquair in 7.69%), followed by bitemporal defect (35.90%). By using the multivariable logistic regression models, initial best-corrected visual acuity of a worse eye at 1.00 logMAR or poorer (AOR, 12.45; 95% CI, 1.03-150.34, $p = 0.047$), and tuberculum sellae meningioma (AOR, 36.76; 95% CI, 2.06-656.83, $p = 0.014$) were independent factors associated with junctional scotoma.

Conclusions: The junctional scotomas, both the basic one and the junctional scotoma of Traquair, are valuable tools for sellar/parasellar region tumor detection, especially the tuberculum sellae meningioma. It is crucial that general ophthalmologists be able to distinguish this type of visual field defect and request the appropriate further investigations.

Keywords: sellar region tumor, junctional scotoma, junctional scotoma of Traquair, visual field defect

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Introduction

Blurred vision is the most common presentation in every ophthalmology department around the world. There are many abnormalities, from the brain to the eyes, that could lead to blurred vision, including visual field defects (VFDs).

The sellar/parasellar region tumor is one of the most common intracranial neoplasms that cause VFDs[1-4]. Pituitary adenoma is the most common sellar region tumor; however, there are many other types of tumors that can mimic it[4-6].

In the literature, patterns of visual field defects produced by lesions in this area are variable depending on the inclusion criteria and type of perimetry used in each study. Kim TG et al. evaluated 534 patients diagnosed with a pituitary adenoma at a tertiary hospital and demonstrated that normal visual field (57%) was the most common visual field feature, followed by bitemporal hemianopsia (17.8%)[7]. Moreover, only 3 % (16/534) visited the ophthalmology department first with decreased vision[7]. Ogra S et al. evaluated 103 patients presenting to a neurosurgical unit and reported that 39% presented with visual loss, 59.3 % had VFD, in which bitemporal defect was the most common. (24.2%)[8].

We carried out this study to demonstrate the visual field defect patterns of patients with sellar and parasellar region tumors who presented with visual loss in a tertiary neuro-ophthalmology clinic and also to evaluate the prevalence and related factors of the junctional scotoma in this group of patients.

Subjects and Methods

Eligible Patients

The medical records of consecutive patients in the neuro-ophthalmology clinic, Naresuan University Hospital, who presented with visual loss and were diagnosed with sellar/parasellar region tumors between January 1, 2017 and December 31, 2020 were retrospectively reviewed.

This study was approved by the Human Research Ethics Committee of the Faculty of Medicine Naresuan University according to the Declaration of Helsinki, The Belmont Report, CIOMS Guideline, and International Conference in harmony with Good Clinical Practice.

Patient Factors

Medical records were reviewed in aspects of age, sex, presenting symptoms, duration of symptoms, initial best-corrected visual acuity (BCVA), presence of relative afferent pupillary defect (RAPD), optic disc appearance, visual field, neuroimaging studies, and tissue pathology. The diagnosis of the tumor was based on a pathology report. Tumor patients without blurred vision symptoms or confirmed pathology reports were excluded from the study.

BCVA was tested using the Snellen chart or the Early Treatment of Diabetic Retinopathy Study (ETDRS) chart (in some cases). VA was converted to logMAR value for the statistical analysis. RAPD and optic disc were examined by a neuro-ophthalmologist (N.M.). Optic disc appearances were classified into 3 groups: (1) pallor, (2) normal, and (3) swelling. Because many patients complained of blurred vision only in one eye, BCVA and optic disc appearances were reported and analyzed only in the worse eye.

The visual field was measured using the Humphrey 750i Visual Field Analyzer (Carl Zeiss Meditec), 24-2 or 30-2 SITA-standard programs and was interpreted by a neuro-ophthalmologist. In this study, VFDs were classified into 5 groups: (1) junctional scotoma (basic), (2) junctional scotoma of Traquair, (3) bitemporal defect, (4) diffused loss in only one eye, and (5) others. There are 2 types of junctional scotomas. The first one is the junctional scotoma (basic), which consists of a

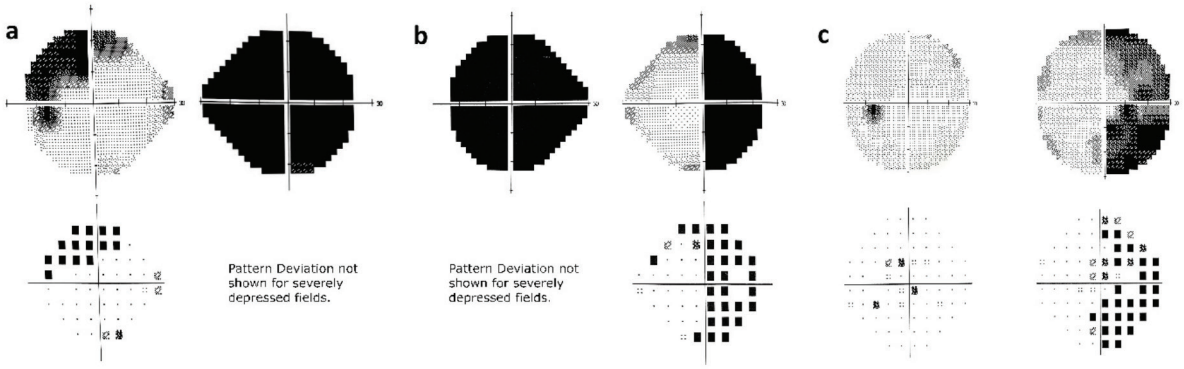

Figure 1 Characteristics of Junctional scotoma visual field defect. a: Junctional scotoma (basic) 1 (central or diffused scotoma in one eye with superotemporal defect in the fellow eye), b: Junctional scotoma (basic) 2 (diffused scotoma in one eye with temporal hemianopia in the fellow eye), c: Junctional scotoma of Traquair (monocular temporal hemianopia)

central defect in one eye and a superotemporal defect (Figure 1a) or a temporal half defect (Figure 1b) in the fellow eye. The second one is the junctional scotoma of Traquair which is the temporal hemianopia in the affected eye (Figure 1c).

Statistical Analysis

The statistical analysis was performed using SPSS version 17.0. Patients' demographic variables were analyzed as percentages. To evaluate the factors related to junctional scotoma, significant factors determined by chi-square or fisher's exact test were included in the univariate and multivariable logistic regression analysis. Results are reported as adjusted odds ratio (AOR) with 95% CI. Statistical significance was established at p-value < 0.05.

Results

Forty-eight medical records of sellar/parasellar tumor patients were reviewed; 9 of them were subsequently excluded due to presenting symptoms of diplopia without visual loss in 6 patients and incomplete data in 3 patients. So, a total of 39 sellar/parasellar tumor patients who presented with blurred vision were analyzed. The mean age was 52 years (SD, 12.06), consisting of 7 males and 32 females; most complaints were monocular visual loss (82.05%); and the median duration of symptoms was 150 days (IQR, 60–365). Two patients had visual loss accompanied by diplopia due to limitation of eye movements. The mean initial BCVA of worse eyes was 1.36 logMAR (SD, 0.68); RAPD was found in 74.36% of patients; and optic disc pallor, normal, and swelling in 66.67%, 28.20%, and 5.13%, respectively.

Based on neuro-imaging and pathology report, the diagnosis consisted of tuberculum sellae meningioma (10; 25.64%), pituitary macroadenoma (8; 20.51%), medial sphenoid wing meningioma (6; 15.38%), craniopharyngioma (4; 10.26%), cavernous sinus meningioma (3; 7.69%), planum sphenoidale meningioma (2; 5.13%), pituitary cyst (2; 5.13%), sellar meningioma (2; 5.13%), Rathke cleft cyst (1; 2.56%), and clinoid meningioma (1; 2.56%).

Among the tumor group, 13 patients had junctional scotoma (basic) and 3 patients had junctional scotoma of Traquair. The characteristics of VFDs are shown in

Table 1. Relations between each factor and junctional scotoma VFD in the tumor group were calculated by a chi-square test. The mentioned VFD were significantly related to the initial BCVA of a worse eye at 1.00 logMAR or poorer ($p = 0.039$) and tuberculum sellae meningioma ($p = 0.004$) (Table 2).

Table 1 Characteristics of visual field defect

Characteristic	Patients (n)	Percentage
Visual field defect		
Junctional scotoma (basic)	13	33.33
Central defect in one eye and a superotemporal defect in the fellow eye	6	15.38
Central defect in one eye and a temporal half defect in the fellow eye	7	17.95
Junctional scotoma of Traquair	3	7.69
Bitemporal defect	14	35.90
Diffuse loss in only one eye	7	17.95
Others (Homonymous hemianopia)	2	5.13

Table 2 Relation of junctional scotoma and other factors among tumor patients

Factor	Junctional scotoma patients (n=16, %)	Non-junctional scotoma# patients (n=23, %)	*p*-value
Sex			0.913
Male	3 (18.75)	4 (17.39)	
Female	13 (81.25)	19 (82.61)	
VA of a worse eye (logMAR)			0.039*
< 1.00	2 (12.50)	10 (43.48)	
≥ 1.00	14 (87.50)	13 (56.52)	
Diagnosis			
Tuberculum sellae meningioma	8 (50.00)	2 (8.70)	0.004*
Medial sphenoid wing meningioma	3 (18.75)	3 (13.04)	0.624
Planum sphenoidale meningioma	1 (6.25)	1 (4.35)	0.659
Sellar meningioma	1 (6.25)	1 (4.35)	0.659
Clinoid meningioma	-	1 (4.35)	0.590
Cavernous sinus meningioma	-	3 (13.04)	0.255
Pituitary macroadenoma	2 (12.50)	6 (26.09)	0.301
Craniopharyngioma	1 (6.25)	3 (13.04)	0.631
Pituitary cyst	-	2 (8.70)	0.503
Rathke cleft cyst	-	1 (4.35)	0.590
Disc pallor			0.384
Normal	9 (56.25)	18 (78.26)	
Pallor	6 (35.50)	4 (17.39)	
Swelling	1 (6.25)	1 (4.35)	
RAPD			0.117
Positive	14 (87.50)	15 (65.22)	
Negative	2 (12.50)	8 (34.78)	

RAPD: Relative afferent pupillary defect, VA: Visual acuity of a worse eye

bitemporal defect, diffused loss in only one eye, or other types of visual field defect, * $p < 0.05$ shows the statistical significance by chi-square or fisher's exact test

By using the multivariable logistic regression models, the initial BCVA of a worse eye at 1.00 logMAR or poorer (AOR, 12.45; 95% CI, 1.03-150.34, $p = 0.047$), and tuberculum sellae meningioma (AOR, 36.76; 95% CI, 2.06-656.83, $p = 0.014$) were independent factors associated with junctional scotoma (Table 3).

Table 3 Univariate and multivariable logistic regression analysis of factors associated with junctional scotoma

Factor	OR (95%CI)	AOR (95%CI)	*p*-value
VA of a worse eye (logMAR)			
< 1.00	Reference	Reference	
≥ 1.00	5.38 (0.99-29.34)	12.45 (1.03-150.34)	0.047*
Diagnosis			
Tuberculum sellae meningioma	10.50 (1.82-60.45)	36.76 (2.06-656.83)	0.014*
Medial sphenoid wing meningioma	1.54 (0.27-8.82)	2.41 (0.11-54.90)	0.581
Pituitary macroadenoma	0.04 (0.07-2.33)	1.04 (0.09-11.77)	0.975
Craniopharyngioma	0.04 (0.04-4.71)	1.60 (0.09-29.81)	0.893
Disc pallor			
Normal	Reference	Reference	
Pallor	3.00 (0.67-13.40)	3.17 (0.31-32.36)	0.329
swelling	2.00 (0.11-35.81)	4.69 (0.06-372.29)	0.489
RAPD			
Positive	3.73 (0.67-20.69)	1.17 (0.13-10.88)	0.893
Negative	Reference	Reference	

*$p < 0.05$ shows the statistical significance

Discussion

Blurred vision is the most common problem that brings patients to an ophthalmology clinic. The sellar/parasellar region tumor is one of the most common intracranial neoplasms that cause visual field defects and blurred vision[1-4]. A pituitary adenoma is the most common of these tumors[6]. In our study, however, there were more parasellar meningioma cases than pituitary adenoma cases. Pamela et al. revealed that 48% of pituitary adenomas are hormonal secreting tumor[4]. So some patients with hormone-secreting pituitary adenomas may present with the hypersecretory syndrome at an Internal Medicine Department and get the diagnosis along with the treatment before their tumors grow big enough to cause visual problems.

Lee et al. claimed that patients with pituitary adenomas have visual field defects of only 9 to 32%[9]. In 2019, Kim et al. reported that 36.1% of pituitary adenoma patients had optic chiasmal compression without visual field defects[7]. Even though pituitary macroadenoma was reported to be the most common tumor in many publications and the compatible visual field defect was bitemporal hemianopia, the patients with obvious defects may not be referred to the neuro-ophthalmology clinic. These should explain the less number of pituitary macroadenoma and bitemporal hemianopia in this report.

Junctional scotoma VFD is often found in patients with sellar/parasellar region tumors[10-14]. The junctional scotoma is classified into two types: the basic one and

the junctional scotoma of Traquair. The junctional scotoma (basic) is caused by the lesion between the optic nerve and the chiasm that affects an ipsilateral optic nerve and contralateral inferonasal/nasal retinal fibers[1], and the junctional scotoma of Traquair is also a result of the lesion at the junction between the optic nerve and the chiasm, but the mass affects only the nasal retinal fibers of one eye[8].

Most cases in this study were referred to a neuro-ophthalmology clinic to work up the cause of optic neuropathy, especially those with unilateral visual loss and positive RAPD. In the setting of a neuro-ophthalmology clinic, the classic bitemporal VFD was found in only 36% of sellar/parasellar tumor patients. In this study, junctional scotomas (junctional scotoma (basic) and junctional scotoma of Traquair) were detected in almost fifty percent of patients. This implies the important role of these VFD patterns in detecting sellar/parasellar tumors.

A recent study in a tertiary neuro-ophthalmology clinic reported that 50% (18/36) of patients with VFD due to lesions involving the optic chiasm demonstrated junctional scotoma, followed by bitemporal hemianopia (39%; 14/36)[15]. This data is consistent with our study.

In the study, the visual field was measured using the Humphrey 750i Visual Field Analyzer (Carl Zeiss Meditec), 24-2, or 30-2 SITA-standard programs. The Humphrey Field Analyzer is an automated perimetry that has been widely used to assess the progression of functional loss[14-19]. Several previous studies about VFDs in sellar/parasellar region tumors used varying methods to determine the VFDs, which may be less reliable and impractical compared with the Humphrey Field Analyzer[3,18-20].

This study demonstrated various disc appearances in sellar/parasellar tumor patients, included optic disc pallor, normal, and swelling in 66.67% (26/39), 28.20% (11/39), and 5.13% (2/39) respectively. Optic disc pallor and retinal nerve fiber layer loss are generally associated with a poorer prognosis for visual improvement following treatment[21]. Sellar/parasellar tumors typically do not produce optic disc swelling. Optic disc swelling in the setting of chiasmal dysfunction indicates either papilledema due to third ventricular compression by a sellar/parasellar mass[22] or secondary to a high tumor volume[23] or an infiltrative/inflammatory process involving the anterior visual pathway[22]. In this study, there were 2 patients with optic disc swelling due to medial sphenoid wing meningioma extended to the optic nerve sheath (secondary optic nerve sheath meningioma).

We can conclude that junctional scotoma is a beneficial parameter that can lead us to the detection of sellar and parasellar region tumors, especially the tuberculum sellae meningioma. However, there are some limitations in this study. First, it is a retrospective study. Second, it was conducted in a single center, the tertiary hospital, which might affect the variability of the cases.

Finally, the junctional scotomas, both the basic one and the junctional scotoma of Traquair, are valuable tools for sellar/parasellar region tumor detection, especially the tuberculum sellae meningioma. It is crucial that general ophthalmologists be able to distinguish this type of visual field defect and request the appropriate further investigations.

Acknowledgements

Authors' contributions: Kosaiyaganonth N initiated the project, designed the data collection tools, monitored the data collection for the whole trial, wrote the statistical analysis plan, cleaned and analyzed the data, as well as drafted and revised the manuscript. Mekhasingharak N initiated the project, designed the data collection tools, monitored the data collection for the whole trial, revised the manuscript, approved the final manuscript prior to journal submission, and supervised the study.

Conflicts of Interest: Kosaiyaganonth N, None; Mekhasingharak N, None.

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ลักษณะลานสายตาผิดปกติและลานสายตาผิดปกติแบบ Junctional scotoma ของผู้ป่วยเนื้องอกบริเวณแอ่งต่อมใต้สมองและใกล้เคียงในคลินิกประสาทจักษุของโรงพยาบาลขนาดตติยภูมิ

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บทคัดย่อ:

วัตถุประสงค์: เพื่อนำเสนอลักษณะลานสายตาที่ผิดปกติของผู้ป่วยเนื้องอกบริเวณแอ่งต่อมใต้สมองและใกล้เคียง ที่พบในคลินิกประสาทจักษุในโรงพยาบาลระดับตติยภูมิ

วิธีการวิจัย: ผู้วิจัยได้ทำการสืบค้นและรวบรวมข้อมูลจากประวัติการรักษาของผู้ป่วยที่มาพบจักษุแพทย์ด้วยอาการตามัวแล้วถูกส่งปรึกษาที่คลินิกประสาทจักษุ โรงพยาบาลมหาวิทยาลัยนเรศวร จนได้รับการวินิจฉัยเป็นโรคเนื้องอกบริเวณแอ่งต่อมใต้สมองหรือใกล้เคียง ตั้งแต่ มกราคม 2560 ถึงธันวาคม 2563 ลักษณะลานสายตาถูกทดสอบโดย Humphrey Visual Field Analyzer 24-2 หรือ 30-2 และถูกนำมาจัดกลุ่มเป็น 5 กลุ่ม ได้แก่ junctional scotoma (basic), junctional scotoma of Traquair, bitemporal defect, diffused loss in only one eye, และ others

ผลการวิจัย: มีผู้ป่วยเข้าเกณฑ์ทั้งหมด 39 คน ประกอบด้วย Tuberculum sellae meningioma ร้อยละ 25.64, Pituitary macroadenoma ร้อยละ 20.51, sphenoid wing meningioma ร้อยละ 15.38, craniopharyngioma ร้อยละ 10.26, cavernous sinus meningioma ร้อยละ 7.69, planum sphenoidale meningioma ร้อยละ 5.13, pituitary cyst ร้อยละ 5.13, sellar meningioma ร้อยละ 5.13, Rathke cleft cyst ร้อยละ 2.56, และ clinoid meningioma ร้อยละ 2.56 พบลานสายตาที่ผิดปกติชนิด Junctional scotoma ร้อยละ 41.03 (ประกอบด้วย Junctional scotoma (basic) ร้อยละ 33.33 และ Junctional scotoma of Traquair ร้อยละ 7.69) ตามด้วย Bitemporal defect ร้อยละ 35.90 จากการวิเคราะห์โดยวิธี multivariable logistic regression พบว่า Junctional scotoma มีความสัมพันธ์อย่างมีนัยสำคัญกับระดับการมองเห็นเริ่มต้น (ของตาข้างที่แย่กว่า) ที่ 1.00 logMAR หรือแย่กว่า (AOR, 12.45; 95% CI, 1.03-150.34, p = 0.047) และเนื้องอกชนิด Tuberculum sellae meningioma (AOR, 36.76; 95% CI, 2.06-656.83, p = 0.014)

สรุปผลการวิจัย: ลานสายตาผิดปกติชนิด Junctional scotoma ทั้งชนิด basic และ Junctional scotoma of Traquair พบได้บ่อยและมีความสำคัญต่อการตรวจพบเนื้องอกบริเวณแอ่งต่อมใต้สมองและใกล้เคียง โดยเฉพาะอย่างยิ่งเนื้องอกชนิด Tuberculum sellae meningioma ดังนั้นจึงเป็นสิ่งสำคัญที่จักษุแพทย์ควรสามารถแยกแยะลักษณะลานสายตาผิดปกติชนิดนี้และส่งตรวจเพิ่มเติมเพื่อหาสาเหตุได้อย่างเหมาะสม

คำสำคัญ: เนื้องอกบริเวณแอ่งต่อมใต้สมอง, ลานสายตาผิดปกติ

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