

## Evaluation of Posterior Segment Diseases Using Optos and Telemedicine Application in Eskisehir Region

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### ABSTRACT

**Aim:** Detection of posterior diseases in Eskisehir by telemedicine method.

**Methods:** 3965 participants were examined using a nonmydriatic fundus camera (OPTOS Tx-200) and an autorefractometer device in centers determined by Tepebasi and Odunpazari Municipalities of Eskisehir City. Collected data were evaluated by Ophthalmology Department of Osmangazi University, Eskisehir using Telemedicine Application (a data transferring system inter agencies and institutions).

**Results:** The mean age of cases was  $65.9 \pm 10.1$  (43-112) years. Pathologies were found in 1507 eyes; 374 hypertensive retinopathy, 354 age-related macular degeneration, 159 diabetic retinopathy, 59 posterior vitreous detachment, 57 glaucomatous optic disc changes, 25 retinal vein occlusion, 31 asteroid hyalosis and 443 other retinal pathologies. The mean best-corrected visual acuity (BCVA) in logMAR was  $0.34 \pm 0.63$  for the right eyes, and  $0.35 \pm 0.69$  for the left eyes in 3965 eyes. While the mean BCVA in logMAR was  $0.39 \pm 0.61$  for the right eyes and  $0.39 \pm 0.62$  for the left eyes in 1502 pathological eyes., BCVA was calculated as 0,  $27 \pm 0$ , 64 for right eyes and  $0.28 \pm 0.65$  for the left eyes in the healthy group ( $p < 0.001$ ). 217 patients who had pathology were referred to our clinics and 91 of them were followed up.

**Conclusion:** OPTOS (a non-mydriatic fundus camera) may facilitate the screening and examination of patients especially over 40 years old by means of a non-contact, drop-free imaging. and without having the need to recourse to a hospital by Telemedicine application. Therefore utilization of Optos and telemedicine may make early diagnosis and treatment of retinal diseases possible.

**Keywords:** age related macular degeneration, diabetic retinopathy, Optos, autorefractometer, telemedicine

### INTRODUCTION

Retinal diseases may result in serious and persistent outcomes when diagnosed late. Age-related macular degeneration (AMD), diabetic retinopathy (DR) and retinal vein occlusion (RVO) are the three most prevalent retinal diseases leading to permanent vision loss. A study conducted by the WHO (World Health Organization) in 2002, reported that vision loss due to these three diseases form the second most common etiology (13.5%).<sup>1</sup>

OPTOS Tx-200(nonmydriatic camera) is an imaging device that allows to obtain images by scanning ultra-wide retinal field up to 200 degrees (reaches to Ora Serrata) and is compatible with scanning softwares. Telemedicine is an application that allows to store and evaluate collected data and has 3 main

processes: store and forward collected data, remote control, and follow-up and interactive services.<sup>2</sup> Telemedicine facilitates diagnosis and management of patients who do not have immediate access to health centers.<sup>3</sup> There are more than 450 telemedicine applications used worldwide, which are commonly used in the diagnosis and management of elderly, individuals in the rural areas and war veterans.<sup>4</sup>

Permanent vision loss in retinal diseases may only be prevented by early diagnosis. Our study aims to utilize Optos Tx-200 imaging device in the early and off-site diagnosis of preventable retinal diseases in individuals over 40 years of age.

### METHODS

This is a cross-sectional prevalence study conducted from April 2012 to April 2013 with

approval of Ethics Committee of ESOGU Medicine Faculty, Eskisehir.

47,000 individuals over 40 years of age in Eskisehir and surroundings municipalities, were identified as the target group for this study. Approximately 3965 volunteers were examined. Nonmydriatic camera (Optos Tx-200) and Nidek autorefractometer screenings of volunteers' eyes were performed in facilities supported by Tepebasi and Odunpazari Municipalities.

Posterior segment retinal disease screening was announced via press by Osmangazi University, Eskisehir. Right and left eyes of each volunteer were measured three times using autorefractometer. The spherical equivalent (SE) was calculated by adding the spherical value and half of the cylindrical value. The best corrected visual acuity (BCVA) levels of volunteers were measured at 6 meters on Snellen chart and converted to log MAR. Then 2 non-midriatic fundus photographs were obtained for each eye using Optos Tx-200. All examinations and measurements were performed by 2 ophthalmologists (E.T and H.G).

Collected data was then evaluated by two expert ophthalmologists (H.B and H.G) in Eskisehir Osmangazi University (ESOGU) Department of Ophthalmology, through a simultaneous internet connection program (Telemedicine) carried out by Tepebasi and Odunpazari Municipalities and data processing center of ESOGU. Patients who had pathologies were referred to our ophthalmology department within one week for management and follow-up. All the necessary

examinations including (Optical coherence tomography (OCT) imaging, fundus fluorescein angiography (FFA), Indocyanine green angiography (ICA), fundus auto fluorescence (FAF), electroretinography (ERG), visual field tests, corneal topography, and Heidelberg retinal tomography) were performed.

Statistical analyses were performed using IBM SPSS Statistics version 22.0. Paired sample-t test was used to compare descriptive statistical methods and quantitative data. *P* values < 0.05 were required for statistical significance.

**RESULTS**

A total of 7713 eyes from 3965 cases were evaluated and included in the study conducted in April 2012-April 2013. 217 eyes (107 right eyes, 109 left eyes) were excluded due to lack of refraction and OPTOS measurements.

Of all the cases included, there was a total of 3857 right eyes and 3856 left eyes in the study. The mean age of cases was 65.9 ±10.1 (43-112) years; whereas 1475 (37%) patients were <65 years, 1823 (48.5%) were 65-75 years and 567(14.5%) were >75 years. Females were 51% (2022) of all cases and 49% (1943) were male. The mean BCVA in log MAR was 0.34±0.63 for right eyes and 0.35±0.69 for left eyes. The mean SE in diopters was -0.11±1.46 for the right eyes and +0.18±1.41 for the left eyes. We also observed that, 292 right eyes and 296 left eyes of 510 patients had undergone cataract surgery. A summary of the retinal findings are shown in **Table 1**.

**Table1.** Fundus findings

	Right eye		Left eye	
	Number of patients	Percentage of distribution (%)	Number of patients	Percentage of distribution (%)
Age related macular degeneration	170	4.28	184	4.64
Diabetic retinopathy	79	1.99	80	2.01
Hypertensive retinopathy	191	4.81	183	4.61
Posterior vitreous detachment	32	0.8	27	0.68
Glaucomatous optic disc	30	0.75	27	0.68
Retinal vein occlusion	12	0.28	13	0.31
Other pathologies	244	6.03	240	5.94
Normal	3100	78.1	3111	78.4
Couldn't be evaluated	107	2.69	109	2.73
Total	3965	100	3965	100

AMD (exudative and dry form) was diagnosed in 227 (5.72%) patients: 127 patients had AMD in both eyes and 100 had unilateral findings. Prevalence of AMD was found to be 3.5% (45) in <65 aged population, 7.02% (135) in 65-75 aged population and 8.28% (47) in

>75, therefore we observed an increase in the prevalence with older age. (p<0.05). Of all AMD cases, 103 (45.3%) were female and 124 (54.7%) were male. The mean BCVA in log MAR was 0.48±0.61 for the right eyes and 0.49±0.63 for the left eyes. A total of 141 out of

227 patients had dry form AMD. Patients with advanced AMD (n=11) were not called for a follow up. Patients with exudative type AMD (n=75) were called into our clinics for advanced testing and treatment.

DR was found in 143 (3.61%) of 3965 cases. 77 (54%) of 143 patients were female and 66 (46%) were male. DR prevalence amongst the 833 cases with diabetes mellitus (DM) diagnosis (21% of total cases) was found to be 17% in <65 years old patients, 17% in 65-75 and 18% in >75 years old patients. The mean BCVA of DR patients was 0.39±0.60 logMAR for the right eyes and 0.38±0.63 log MAR for the left eyes. Of all patients, one hundred forty three (143) diagnosed with DR through our study, had not been diagnosed with DM previously. Based on the fundus images, 47 patients were further evaluated for suspicion of DM related proliferative retinopathy and diabetic macular edema (DME) and treatment was planned according to the test results.

Of all the participants included, 184 (4.64%) patients and 374 eyes were diagnosed with hypertensive retinopathy (HTRP) including stages 1 through 3. Even though 170 (92%) of these patients had high blood pressure (HBP)

diagnosis, 14 patients were not previously diagnosed. On the other hand, the prevalence of HTRP in patients with previously known HBP diagnosis (n=1683) was 10%. The gender distribution amongst HTRP patients were, 81 (44%) were female and 103 (56%) were male. (p>0.05).

A total of twenty four (24) (0.61%) of cases included in the study were detected to have had RVO, whereas 23 patients had unilateral and 1 patient had bilateral findings (12 right and 13 left eyes). Female to male ratio was 13 to 11 amongst the 24 cases. Of all the 24 patients with RVO diagnosis, 13 (54%) also had hypertension (HBP) and 9 (37.5%) had DM. When looked at the distribution amongst age groups, 10 (0.67%) were <65 years and 14 (0.56%) were >65 years. After further evaluation in our clinic, 15 patients were treated with RVO related ME.

Rare retinal pathologies were observed in 443 eyes of 242 patients (229 right eyes, 214 left eyes). Glaucomatous optic disc changes (identified as cup/disc ratio>0.5 and/or asymmetrical cupping) were detected in 47 patients. Distribution of the rare pathologies are shown in **Table 2**.

**Table 2.** Distribution of Other Retinal Pathologies

Pathologies	Number of patients	Percentage of distribution (%)
Lattice and the other degenerations	89	37
Myopic Fundus	69	28
Choroid Nevus	21	9
Asteroid hyalosis	16	0.6
Optic disc pathology	47	19
Total	242	100

According to our results, 37 patients with AMD, 10 patients with DR and 33 patients with HTRP had their initial diagnosis of AMD, DM and HBP through our screening study.

**DISCUSSION**

We screened 3965 cases (43-112 years of age) in Eskisehir and surrounding municipalities via a non-mydratic fundus camera (Optos Tx-200). A variety of retinal diseases were detected in 18% of all cases and 5% received treatment. According to the literature review in Turkey, our study is the only and widest study of posterior segment screening. We performed a non-contact, population-wide screening without any risk of adverse effects related to eye drops or infection, in a limited time. This study also facilitated the examination of patients by performing the screening without need of accessing a medical facility.

AMD is the most common cause of vision loss over 65 years old population in developed countries. Prevalence of AMD was observed as 5.72% (227 patients) in our study; distribution amongst age groups were as follows; 3.05% in <65 years old population, 7.02% in 65-75 years and 8.28% in >65 years of age. In other prevalence studies, Klein et al. found the prevalence of AMD 14.4% in 55-64 ages, 19.4% in 65-74 ages and 28% in >78 ages.<sup>5</sup> Smith et al. reported the prevalence of AMD 0.21% in 55-64 ages, 0.85% in 60-74 ages, 4.59% in 75-84 ages and 13.05% in >85 ages<sup>6</sup> Even though the prevalence of AMD according to age seems variable in different studies, the common conclusion is that the prevalence of AMD increases with age in all studies, also compatible with our results and literature.<sup>5,6</sup> In our study, the prevalence of male gender

amongst 227 AMD patients was higher compared to females (124 (54.7%) male and 103 (45.3%) female). Some studies reported no significant difference on gender, whereas in some others prevalence was slightly higher in female gender. Causes of higher prevalence on male gender in our country may be due to more exposure to UV than females, nutrition, alcohol consumption, smoking and genetic factors.

A total of 143 (3.61%) patients were found to have DR in our study. According to this study, prevalence of DR in 833 DM patients was 17% in <65 years old population, 17% in 65-75 years of age and 18% in >75 years of age. In a population based study conducted in China, prevalence of DR has been reported as 1.3% in presumably healthy population and 23% in DM patients.<sup>7</sup> In another international multicenter DR prevalence study conducted between 1980-2008 with 22896 DM patients prevalence of DR has been found 34.6%.<sup>8</sup> Another study from Norway with 514 DM patients (4-87 years old population) reported the prevalence of DR as 26.8%.<sup>9</sup> In a study conducted in India, prevalence of DR in a population of 6218 DM patients has been reported 21.7%.<sup>10</sup> The prevalence of retinopathy in DM patients was 10.8-60% in clinical based studies and 14.5-70% in population based studies according to reports of International Diabetes Association.<sup>11</sup> Our study results are comparable with literature as we also found the prevalence of DR in patients with DM 4-6 times higher than the population prevalence. RVO was detected in 24 (0.6%) of our 3965 cases. Similarly, Klein et al. reported 0.6% (31 patients) in 4822 cases.<sup>12, 13</sup> (54%) of 24 RVO patients had comorbid HBP and 9 (37.5%) had comorbid DM in our study. In a study by Kanra A et al., the prevalence of HBP in RVO patients has been reported as 68% and the prevalence of DM as 20%. HBP prevalence was 42.4% in over 65 years old population according to our study. Further, prevalence of HTRP was found as 4.64% and it was 10% among HBP patients. Prevalence of HTRP was significantly higher in male gender than females ( $p < 0.05$ ). HBP prevalence has previously been reported 66.3% in >60 years old male population in USA according to<sup>13</sup>. In our country, prevalence of HBP was reported higher in female population with 31.8%.<sup>14</sup>

Optos Tx-200 has been used in limited populations to date, but it has been used for the first time in such a comprehensive screening program. Optos Tx-200 provides a great convenience to patients as a result of non-

mydriatic imaging with the ability of screening a large area up to 200 degrees compared to other imaging devices. There are some limitations of this useful device; Optos Tx-200 allows screening up to 150-200 degrees in one shot, but assessing of Ora Serrata may not be possible, if not taken shots of certain view points. In the evaluation of peripheral lesions, indirect ophthalmoscopy examination yields more accurate results than 3-mirror fundus examination. Evaluation of lower and upper quadrants of fundus via Optos Tx-200 is also limited. The 3-mirror fundus examination used by Optos Tx-200, reflects laser-scanned panoramic image of a spherical structure as a photograph; therefore this examination is limited in assessing the peripheral lesions and pathologies that can be evaluated by depth perception (neovascularization posterior vitreous detachment, etc.) due to magnification coefficients and different depth settings.

In a 2010 study with 49 participants, Optos Tx-200 has been shown to be useful in detecting not only retinal pathologies, but also choroidal pathologies and screening 200-degree area.<sup>15</sup> In a 2011 study that included 28 eyes, Optos Tx-200 has been reported as a practical and easy method for detection of ischemic areas caused by proliferative retinopathy and for planning and application of laser photocoagulation.<sup>16</sup> In another study conducted by Slotnick et al. (2012), where Optos Tx-200 and panoramic autofluorescence method was in 6 cases; diagnosis and treatment has been reported to be easy.<sup>17</sup>

Based on our review of literature, our study is the first one showing the applicability of telemedicine in ophthalmology. There are over 450 telemedicine applications available worldwide that facilitate access to medical care of rural population, elderly and veterans.<sup>18</sup> In a meta-analysis, studies on electronic communication and video conferences on diabetes management has been reviewed and telemedicine has been reported to be beneficial especially in terms of patient-specific treatment, cost-benefit analysis and easy application.<sup>19</sup> Also in our study, telemedicine has been shown to be beneficial in terms of convenience, economical benefits and patient satisfaction. However, telemedicine is a rather foreign health service for patients, healthcare providers, health policy makers and local administrations. We expect that new studies on telemedicine and service quality will provide social and economic improvements.

## CONCLUSION

Our study is one of the most comprehensive retinal diseases prevalence study performed in Turkey and approximately 4000 people were evaluated in situ. In addition, it's a great advantage to use a non-contact imaging method such as Optos. Our study is the first and pioneering performance that used telemedicine method. Telemedicine will be more preferred in the future due to benefits brought by healthcare systems, early diagnosis and treatment and health policies for geriatric patients.

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