Original Article

Association of Papilledema with Headache Visualizing Via Smartphone Fundoscopy

Syed Maroof Ali, Fawwaz Bin Shahab, Aamir Saghir and Salman Sharif

ABSTRACT

Objective: To determine association of papilledema with headache using 20D lens and a smartphone for fundoscopy.

Study Design: Prospective Cross-sectional Study

Place and Duration of Study: This study was conducted at the Ophthalmology OPD at Liaqat National Hospital, Karachi from, 25th May 2022 till 25th July 2022.

Materials and Methods: Patients, presenting to ophthalmology OPD at Liaqat National Hospital, patient complaining of blurring of vision and difficulty focusing on distant object were included in our study. We used a 20D lens for indirect ophthalmoscopy and smartphone camera for recording and taking pictures. Participant's pupils were dilated using 1% tropicamide drops and waited for 15-20 mins for pupil dilation. Video recording was done with flashlight switched on and recording was reviewed for fundus pictures and snap shots were taken from it.

Results: 384 patients were included in the study. There were 65.6% male and 34.4% female patients in our study with mean age 41.93±13.50 years while majority (62.8%) were from age group >35 years. we found 3.6% of patients with obesity, 12.2% with diabetes mellitus, 14.3% with hypertension and 45.1% with headache and 7.3% of patients were found with papilledema. Strong association was found with papilledema and headache with p-value of <0.001.

Conclusion: Strong association of papilledema with headache was found in patients who came with symptoms of blurry vision and We can reliably do fundus visualization with Smartphone based indirect ophthalmoscopy to view optic disc for presence of papilledema, can be cheap alternative to conventional ophthalmoscopy devices even in neurosurgical examinations, in covid-19 era where social distancing is a norm and proximity to the patients with direct ophthalmoscopy can be discomforting in these circumstances.

Key Words: Indirect Ophthalmoscopy with Smartphone, Smartphone ophthalmoscopy, visualize papilledema with smartphones, smartphone fundoscopy, fundoscopy for neurosurgeons, headache with papilledema.

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INTRODUCTION

In Neurology and Neurosurgery, History and Examination plays a vital role in detecting and interpreting symptoms of the patients with multiple disorders. Fundoscopy is also a part of such examination but performing ophthalmoscopy is in decline in non-ophthalmic care givers due to technical difficulties, nevertheless it is still an important part of examination. The accreditation council for graduate medical education has emphasized the importance of fundoscopy and recommended to identify papilledema prior to independent practice.[1] Routine practice of fundoscopy is encouraged in hypertensive and stroke patients as it can helps in detection of papilledema and can help in diagnosing hypertensive encephalopathy thus obviating the need for urgent MRI.[2]

Fundoscopy via smartphone has become increasingly popular nowadays being inexpensive and its utility for rapid documentation. In the start the examination was done via lens held manually in optic path and images were captured with the help of smartphone. With increasing innovation, the development of smartphone adapters has made this examination much easier, now we can do both direct and indirect ophthalmoscopy using smartphones and its increasing applicability in lower resource settings. Another advantage of smartphone usage is its continuous online connectivity which can also help in telemedicine.[3] Ophthalmoscope used in current practice are derived from the design of early twentieth century and its applicability is limited due to its specialist skills, it's difficult for an untrained personnel and bare usage by practitioners. In low-income countries due to its high cost many centers

Department of Neurosurgery Department, Liaquat National Hospital, Karachi.

Correspondence: Syed Maroof Ali. MBBS, Neurosurgery Department, Liaquat National Hospital, Karachi.
Contact No: 0333-2242922
Email: maroofsbp@gmail.com

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failed to deliver its services where its strongly required.[4]

One such example of smartphone based fundoscopy is the use of D-EYE, it is a digital ophthalmoscope that attaches to the rear camera of the smart phone and acts as a direct ophthalmoscope, it can be used on both dilated and un-dilated pupil although the field of view will vary, in un-dilated pupil the field is around 5o to 8o and in dilated pupil it is around 20o, this device is used in conjunction with an HIPAA (Health insurance portability and accountability) compliant app and is approved by U.S. Food and Drug Administration.[5] Another example is that of indirect ophthalmoscope made by utilizing google cardboard, the smartphone is inserted in the google cardboard and another small acrylic lens is used in hand to do the indirect ophthalmoscopy, this is a very cheap alternative to conventional devices and it also allows for taking pictures and recording as well.[6] The use of smartphone based fundoscopy was applied on medical students as well and they find it relatively easy to learn compare to conventional devices, in the era of Covid-19 where maintaining social distancing and close proximity is avoided these devices can help overcome the obstacle of doing fundoscopy.[7]

In this study we will be only visualizing fundus to look for papilledema as there can be serious underlying cause for it. If the papilledema is present bilaterally it could be caused by IIH (idiopathic intracranial hypertension), obstructive hydrocephalus, cerebral venous sinus thrombosis or any underlying intracranial neoplasm, as papilledema is a sign of raised ICP urgent intervention is required to manage these conditions. Once damage is done it is not reversible and could lead to mortality and morbidity in patients.[8]

MATERIALS AND METHODS

This cross-sectional study was performed at Department of Ophthalmology, Liaquat National Hospital & Medical College, Karachi, Pakistan from 25th May 2022 till 25th July 2022 after getting the Ethical approval. Sample size was calculated using WHO calculator with 95% confidence and 5% margin of error resulting in sample size of 384 patients. Informed and written consent was taken from patients prior to their recruitment into the study through non-probability consecutive sampling technique. Only adults' patients from age 18 and above were included with symptoms of blurry vision and difficulty in focusing distant or near objects, any patient who has previous history of glaucoma, eye surgery and specification of lens were not included as it could hinder with examination.

We used an android smartphone and a 20D lens as shown in figure 1 for indirect ophthalmoscopy. Initially practiced on models and peers when comfortable then applied on patients as co-operation is necessary in this procedure. All the participants were neurosurgery residents, and they took turn on each other for examining the fundus of the eye. After getting comfortable with examining fundus on each other, we shifted towards examining the fundus of patients. We used 1% tropicamide drops for dilatation of the pupils and waited for 15-20 minutes for dilatation, patient should be on chair in front of you around 0.5 meter at the same level, tell the patient to look at the distant object. Start video recording in the smartphone with flashlight turned on. With another hand hold the 20 diopter (D) lens with your thumb and index finger and adjust it with your ring and little finger on patient's forehead and keep the eyelids opened. Hold the smartphone 10-40 cm away from the lens and gradually bring closer to the lens until you see the retina glow, adjust your camera until you see the fundus tilt a little to the lateral side as optic disc is present nasally, once done stop the recording and review and take snapshot of the fundus with good view.

Main concern of this project was to improve the quality of patient care and efficiency in health care system, the design used already established methods and did not have any physical or psychological burden on the participants. Informed and written consent were taken from all the patients before performing this procedure.

Statistical Analysis: Data analysis were performed by SPSS-v26. Mean and standard deviation was computed for quantitative variable while frequency and percentages were reported for qualitative variables. Association were checked by chi-square/fisher exact test. Odds were calculated by uni-variate and multivariate binary logistic regression. $P<0.05$ was considered as significant.

RESULTS

Total 384 patients with mean age 41.93±13.50 years were included in study. Detailed descriptive statistics of patient are presented in Table-1.

In our study, 7.3% of patients were found with papilledema. Table 2 shows comparison of patients' demographic and clinical features, showing significant difference among patients with papilledema from those without papilledema. No significant association was found with headache (p=0.000), gender (p=0.008), age (p=0.024), BMI (p=0.000) and diabetes mellitus as presented in Table-2.

Univariate binary logistic regression showed that male patients are less likely to have papilledema in comparison of female patients (OR=0.363, p=0.011). patients with age≤35 years are more likely to have papilledema in comparison to patients with age>35 years (OR=2.404, p=0.027) while diabetic patients are also found more likely to have papilledema in comparison to non-diabetic patients (OR=3.251, p=0.009). Detailed results of odds by Uni-Variate and multivariate binary logistic regression are presented in Table-3.

Table No.1: Descriptive statistics of study population (n=384)

	n (%)
Gender	
Male	252(65.6)
Female	132(34.4)
Age(years)	
Groups	
≤35 years	143(37.2)
>35 years	241(62.8)
BMI	
Underweight	11(2.9)
Normal	311(81)
Overweight	48(12.5)
Obese	14(3.6)
Diabetes Mellitus	
Yes	47(12.2)
No	337(87.8)
Hypertension	
Yes	55(14.3)
No	329(85.7)
Headache	
Yes	173(45.1)
No	211(54.9)
Papilledema	
Yes	28(7.3)
No	356(92.7)

SD; Standard Deviation

Table No.2: Association of Papilledema with demographics and co-morbid

	Papilledema n (%)		P-Value
	Yes	No	
Gender			
Male	12(42.9)	240(67.4)	0.008*
Female	16(57.1)	116(32.6)	
Age(years)			
≤35 years	16(57.1)	127(35.7)	0.024*
>35 years	12(42.9)	229(64.3)	
BMI			
Underweight	1(3.6)	10(2.8)	<0.001*
Normal	11(39.3)	300(84.3)	
Overweight	14(50)	34(9.6)	
Obese	2(7.1)	12(3.4)	
Diabetes Mellitus			
Yes	8(28.6)	39(11)	0.013*
No	20(71.4)	317(89)	
Hypertension			
Yes	4(14.3)	51(14.3)	1.000
No	24(85.7)	305(85.7)	
Headache			
Yes	3(10.7)	170(47.8)	<0.001*
No	25(89.3)	186(52.2)	

Chi-Square/Fisher exact test was applied.
P<0.05 considered as significant.
*Significant at 0.05.

Table No.3: Odds Ratio for Patients with Papilledema

	Un-Adjusted		Adjusted	
	P-Value	Odds Ratio(95% CI)	P-Value	Odds Ratio(95% CI)
Gender				
Male	0.011*	0.363(0.166-0.791)	0.004*	0.175(0.054-0.570)
Female®		1		1
Age(years)				
≤35 years	0.027*	2.404(1.103-5.241)	0.996	NA
>35 years®		1		1
BMI				
Underweight	0.694	0.600(0.047-7.630)		
Normal	0.066	0.220(0.044-1.104)		
Overweight	0.274	2.471(0.488-12.499)		
Obese®		1		
Diabetes Mellitus	0.009*	3.251(1.342-7.876)	0.123	2.604(0.773-8.778)
Yes		1		1
No®				
Hypertension				
Yes	0.995	0.997(0.332-2.992)		
No®		1		
Headache				
Yes	0.001	0.131(0.039-0.443)	0.996	<0.001(0.001-0.0009)
No®		1		1

®Reference group. Binary logistic regression was applied. P-value<0.05 considered as significant. *significant at 0.05 level.

DISCUSSION

Papilledema is defined as optic disc edema because of raised ICP. Papilledema can present with visual obscuration or blurring and be associated with headache in most cases. In. our study, prevalence of papilledema was found to be 7.3%, compared to an annual incidence of 2.5 individuals /100,000 in previous studies.[8]

Papilledema was found to be more common in females (57.1 v/s 42.9), was slightly more common in patients <35, compared with those >35 (57.1 v/s 42.9). There was no association noted between headache and papilledema in our study. As the cause of headache is mostly due to tension headache followed my migraine headache, papilledema will be less likely to be present in these patients.

A similar study was done by ophthalmology residents by applying 20 diopter lens and recording it via smartphone. Their results were comparable to indirect ophthalmoscopy, and they use this to train their residents on it.[9] Another study compares smartphone ophthalmoscopy with slit lamp bio microscopy to grade ventral cup-disc ratio in glaucoma patients. In this study a D-EYE adaptor was used to examine the optic disc in a patient without pupil dilation and their results were comparable to slit lamp examination. The limitation in their study was the examination were done by glaucoma specialist and more study would be required by to achieve its full potential in glaucoma examination.[10] One study utilizes the iPhone X for direct ophthalmoscopy using its telephoto lens for magnification. In this study pupils were dilated using 1% tropicamide and no adapter was involved in this study. The direct use of camera lens to take fundus images were employed but the field of view was limited to optic disc and its surrounding area nevertheless it was a good alternative for fundus imaging.[11]

Using the similar technique for indirect ophthalmoscopy using smartphones, retinopathy of prematurity was diagnosed in newborns, in their study they use a adaptor known as MII retcam, which is simply holding the smartphone and the 20D lens in one place so that the procedure can be done by only using one hand while the other can be used to stabilized the head and keep the open for examination. In addition to the pictures taken were sent teleophthalmology consultation as well, which makes a great tool for use in urban areas where such facilities are scarce.[12] In contrast to that one author has shared a 3D printable model of indirect ophthalmoscopy adaptor for smartphones, this adaptor attaches with the phone's back cover and a 20D lens is inserted on its other end. There is no extra equipment required and its pretty cheap to make via a 3D printer.[13] However in another article the author had made a smartphone adaptor using old sanitizer bottle and super glue while attaching the 20D lens on one side, a portable indirect ophthalmoscope was made which was very easy to operate and can give really good quality pictures.[14]

There are also some unconventional methods of doing indirect ophthalmoscopy using head mount lamp and a condenser lens 20D in one hand to visualize fundus by using this technique one can only visualize it but cannot record its findings, another method is the usage of nasal endoscope with contact method can give good view of fundus and the findings can be recorded as well.[15] All the above methods describe are good alternatives to conventional techniques of ophthalmoscopy, but they cannot replace the original devices. Our devices are not purposefully built for fundoscopy, and the original devices are too expensive to be utilized in every center of a developing country.

CONCLUSION

Strong association of papilledema with headache was found in patients who came with symptoms of blurry vision and Smartphone based fundoscopy can be used as an alternative to direct as well indirect ophthalmoscopy in neurosurgery setup to visualize fundus for papilledema, as they are significantly cheap these can be easily employed in out reached areas as well. In Covid-19 pandemic where social distancing is required and direct ophthalmoscopy is avoided because of its need for close proximity to the patient, in these situations' smartphone based fundoscopy can help avoid these obstacles in examination of papilledema. One more thing that can be applied is the use of Artificial Intelligence in interpreting the fundus photograph and can give instant results of normal or an abnormal fundus.

Author's Contribution:

Concept & Design of Study:	Syed Maroof Ali
Drafting:	Fawwaz Bin Shahab, Aamir Saghir
Data Analysis:	Aamir Saghir, Salman Sharif
Revisiting Critically:	Syed Maroof Ali, Fawwaz Bin Shahab
Final Approval of version:	Syed Maroof Ali

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REFERENCES

1. Rodenbeck SJ, Mackay DD. Examining the ocular fundus in neurology, Curr Opin Neurol 2019; 32(1):105-110.
2. Zafar S, Cardenas YM, Leishangthem L, Yaddanapudi S. Opinion and Special Articles: Amateur fundus photography with various new devices: Our experience as neurology residents. Neurol 2018;90(19):897-901.

3. Wintergerst MWM, Jansen LG, Holz FG, Finger RP. A Novel Device for Smartphone-Based Fundus Imaging and Documentation in Clinical Practice: Comparative Image Analysis Study. JMIR Mhealth Uhealth 2020;8(7):e17480.
4. Giardini ME, Livingstone IA, Jordan S, Bolster NM, Peto T, Burton M, et. al. A smartphone based ophthalmoscope Annu Int Conf IEEE Eng Med Biol Soc 2014;2014:2177-80.
5. Wu AR, Fouzdar-Jain S, Suh DW. Comparison Study of Funduscopic Examination Using a Smartphone-Based Digital Ophthalmoscope and the Direct Ophthalmoscope. J Pediatr Ophthalmol Strabismus 2018;55(3):201-206.
6. Eghrari AO, Wang A, Brady CJ.Google Cardboard Indirect Ophthalmoscopy Retina 2017;37(8):1617-1619.
7. Dunn HP, Kang CJ, Marks S, Witherow JL, Dunn SM, Healey PR, et al. Perceived usefulness and ease of use of fundoscopy by medical students: a randomised crossover trial of six technologies (eFOCUS 1). BMC Med Educ 2021;21(1):41.
8. Crum OM, Kilgore KP, Sharma R, Lee MS, Spiegel MR, McClelland CM, et al. Etiology of Papilledema in Patients in the Eye Clinic Setting. JAMA Netw Open 2020;3(6):e206625.
9. Nazari Khanamiri H, Nakatsuka A, El-Annan J. Smartphone Fundus Photography. J Vis Exp. 2017; (125):55958.
10. Russo A, Morescalchi F, Costagliola C, Delcassi L, Semeraro F. Comparison of smartphone ophthalmoscopy with slit-lamp biomicroscopy for grading diabetic retinopathy Am J Ophthalmol 2015;159(2):360-4.e1.
11. Gunasekera CD, Thomas P. High-Resolution Direct Ophthalmoscopy With an Unmodified iPhone X. JAMA Ophthalmol 2019;137(2):212-213.
12. Lekha T, Ramesh S, Sharma A, Abinaya G. MII RetCam assisted smartphone based fundus imaging for retinopathy of prematurity. Ind J Ophthalmol 2019;67(6):834-839.
13. Hu A, Damji KF. New open source 3-dimensional printed smartphone fundus imaging adaptor Can J Ophthalmol 2019;54(3):399-400.
14. Chandrakanth P, Ravichandran R, Nischal NG, Subhashini M. Trash to treasure Retcam. Ind J Ophthalmol 2019;67(4):541-544.
15. Shanmugam MP, Mishra DK, Rajesh R, Madhukumar R. Unconventional techniques of fundus imaging: A review. Ind J Ophthalmol 2015;63(7):582-5.