

Picture quality comparison between panoptic ophthalmoscope and non-mydriatic fundus camera

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ABSTRACT

Background: Non-mydriatic fundus photography has been shown to be a potential alternative to direct ophthalmoscopy in the emergency department. Panoptic ophthalmoscope is a newer handheld alternative to non-mydriatic fundus camera. Its advantages include greater portability and lower price. Panoptic Ophthalmoscope compatibly utilizes mobile phone's camera to capture high definition fundus photographs, however lower in quality in comparison with a fundus camera. This study compares the picture quality between panoptic ophthalmoscope (POO) and non-mydriatic fundus camera (NMFC).

Patients and methods: This comparative cross-sectional study was conducted in Lahore General Hospital, Lahore. Three twenty three (323) fundus pictures were taken from two different cameras. One hundred sixty pictures (160) were taken with NMFC and one hundred sixty three (163) with POO. Quality of each picture was assessed by two consultant ophthalmologists independently. The data was computed and analyzed by SPSS version 21. Chi square test was applied to the data. Confidence interval of 0.95 with α of 0.05 was taken.

Results: There was statistically significant difference in picture quality of disc, macula, superior and inferior vascular arcades ($p < 0.001$). Total 122 out of 160 pictures taken by NMFC and 48 out of 163 pictures taken by POO were considered ideal by first ophthalmologist whereas 96 of 160 pictures taken by NMFC and none taken by POO were considered ideal by second ophthalmologist.

Conclusion: Quality of images taken with NMFC is significantly better as compared to POO.

Keywords:

Non mydriatic fundus camera (NMFC); Panoptic Ophthalmoscope (POO); Fundus Photography; Image quality

INTRODUCTION

In 1926, Carl Zeiss Company introduced the first commercially available fundus camera, which offered a 10° retinal field.⁴ The traditional direct ophthalmoscopy is a common method⁵ but difficult in uncooperative patients especially in children. Students and practicing physicians have consistently reported a general lack of confidence in performing a fundus exam using a Direct Ophthalmoscope.^{6,7,8} Nowadays, even smartphones are being used by medical professionals as handy tool for performing funduscopy.¹⁰⁻¹² Another instrument other than direct ophthalmoscope is panoptic ophthalmoscope. The panoptic ophthalmoscope is a handheld instrument. In contrary to direct ophthalmoscope, the panoptic

ophthalmoscope provides an increased field of view of 25.⁴ This modified ophthalmoscope design provide more comfortable patient-examiner distance as compared to previous direct ophthalmoscope.^{2,13}

Alternative to direct ophthalmoscopy, another technique is non-mydriatic fundus photography.^{14,15} Image quality is critical for maximizing the diagnostic capability of fundus photographs.¹⁶ Fundus photography using a non-mydriatic camera is the most common method for retinopathy screening.¹⁷ diabetic Such digital retinal screening by specially trained and certified non-physician graders (NPGs) is found to have a sensitivity of 61%–90%, and a specificity of 85%–97%, which is comparable to that of an ophthalmologist.^{18,19} The current study will compare the image quality of two techniques for fundus examination, panoptic ophthalmoscope and non-mydriatic fundus camera and provide evidence based insight on which device is more efficient and reliable for diagnosis of retinal diseases using fundus imaging.

Conflict of Interest: The authors declared no conflict of interest exist.

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Table 1. Comparison of picture quality between NMFC and POO

| Parameters | Doctor | Technique | Reviews | | | p-value |
|-----------------|------------------------|-----------|-------------------------|------------------------|--------------------|---------|
| | | | Don't see relevant area | Quality not sufficient | Quality sufficient | |
| Disc | First ophthalmologist | NMDL | 1 (3%) | 7 (24.1%) | 152 (58.2%) | <0.001 |
| | | PAO | 32 (97%) | 22 (75.9%) | 109 (41.8%) | |
| | Second ophthalmologist | NMDL | 3 (10%) | 13 (26%) | 144 (59.3%) | |
| | | PAO | 27 (90%) | 37 (74%) | 99 (40.7%) | |
| Macula | First ophthalmologist | NMDL | 3 (10.3%) | 10 (22.7%) | 147 (58.8%) | <0.001 |
| | | PAO | 26 (89.7%) | 34 (77.3%) | 103 (41.2%) | |
| | Second ophthalmologist | NMDL | 6 (9.2%) | 18 (18.4%) | 136 (85%) | |
| | | PAO | 59 (90.8%) | 80 (81.6%) | 24 (15%) | |
| Superior arcade | First ophthalmologist | NMDL | 2 (4%) | 6 (35.3%) | 152 (59.4%) | <0.001 |
| | | PAO | 48 (96%) | 11 (64.7%) | 104 (40.6%) | |
| | Second ophthalmologist | NMDL | 4 (7%) | 9 (11%) | 147 (79.9%) | |
| | | PAO | 53 (93%) | 73 (89%) | 37 (20.1%) | |
| Inferior arcade | First ophthalmologist | NMDL | 4 (6.8%) | 6 (33.3%) | 150 (61%) | <0.001 |
| | | PAO | 55 (93.2%) | 12 (66.7%) | 96 (39%) | |
| | Second ophthalmologist | NMDL | 6 (7.5%) | 6 (11.3%) | 148 (77.9%) | |
| | | PAO | 74 (92.5%) | 47 (88.7%) | 42 (22.1%) | |

PATIENTS AND METHODS

This comparative cross-sectional study included 323 pictures of patients visiting Lahore General Hospital, Lahore for fundus examination i.e. funduscopy. All patients who visited the diabetic clinic for screening of diabetic retinopathy between January 2018 to February 2019 were included. Patients with history of ocular trauma, previous retinal surgery and media opacity were excluded. Out of 323, 160 images were taken by non-mydratric fundus camera, while rest 163 images were taken by panoptic ophthalmoscope. Images were randomized and rated independently by two different consultant ophthalmologists (observers) with a background interest in retina, according to a five point scale for general assessment (Table 1). Regional quality assessment including 4 areas; disc, macula, superior arcade and inferior arcade was also performed. The data was computed and analyzed by using SPSS version 21. Chi-square test was used to compare the data. The agreement between both observers was determined by kappa test. The general quality of each ocular fundus photograph was graded on a five point scale: (1) Inadequate for any diagnostic purpose, (2) Unable to exclude all emergent findings, (3) Only able to exclude emergent findings, (4) Not ideal but still able to exclude subtle findings, (5) Ideal quality.

RESULTS

Table 1 summarizes comparison of disc, macula, superior and inferior vascular arcade's picture evaluation taken by non-mydratric fundus camera and panoptic ophthalmoscope, assessed by two observers independently. The results showed statistically

significant difference between both picture taking techniques, assessed by both observers ($p < 0.001$).

Table 2 reflects the comparison of general assessment of picture by two different ophthalmologists between non-mydratric fundus camera and panoptic ophthalmoscope. According to both ophthalmologists, 33.3% pictures taken by non-mydratric fundus camera were inadequate for diagnosis. In 55.6% (5) and 92.5% (37) pictures taken by panoptic ophthalmoscope, both ophthalmologists were unable to reach the level to exclude finding. First ophthalmologist rated 71.8% (122) pictures taken by non-mydratric fundus camera as ideal quality pictures, Second ophthalmologist rated 100% (96) pictures taken by non-mydratric fundus camera as ideal quality pictures. The results showed statistically significant difference between both camera pictures quality rated by both observers ($p < 0.001$).

DISCUSSION

Many doctors at Emergency Department (ED) are not well experienced to recognize optic disc or fundus abnormalities and thus request more experienced help.² There are number of studies suggesting difficulty for fundus examination while using ophthalmoscope. It is because of lack of learning opportunity or the instrument itself may be part of the problem. The new design for ophthalmoscope is Panoptic that utilizes 'axial point source' optics. It provides field of view of about 25° and a 26% magnification as compared to Coventional Ophthalmoscope. Panoptic ophthalmoscope proves to be advantageous because of ease of use and being mydrasis free.²¹ In this study, the picture quality of disc taken by non-mydratric fundus

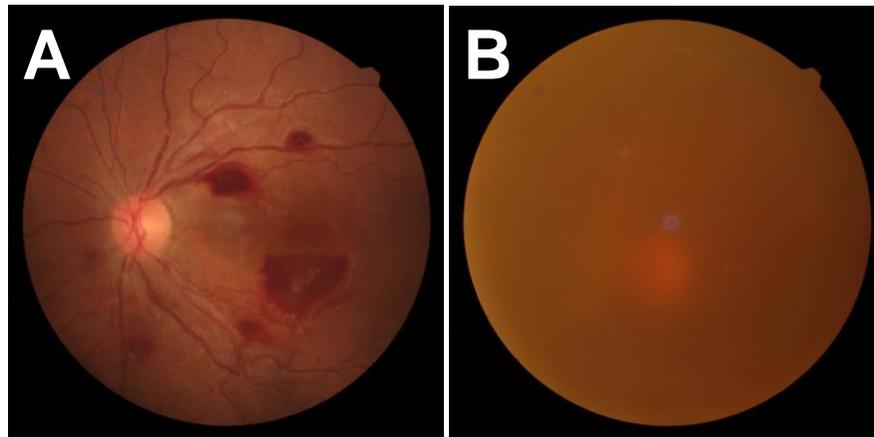


Figure 1. Example image of the five-point scale used for general quality assessment: A) Ideal Quality. B)The quality is inadequate for any diagnostic purpose.

Table 2. General assessment of pictures

| Doctor | Technique | General assessment of picture | | | | | p-value |
|------------------------|-----------|-------------------------------|---------------------------|-------------------------------|------------------------|---------------|---------|
| | | Inadequate for diagnosis | Unable to exclude finding | Only exclude emergent finding | Not Ideal but workable | Ideal quality | |
| First ophthalmologist | NMDL | 2 (33.3%) | 4 (44.4%) | 7 (21.9%) | 25 (23.6%) | 122 (71.8%) | <0.001 |
| | PAO | 4 (66.7%) | 5 (55.6%) | 25 (78.1%) | 81 (76.4%) | 48 (28.2%) | |
| Second ophthalmologist | NMDL | 3 (33.3%) | 3 (7.5%) | 7 (9.9%) | 51 (47.7%) | 96 (100%) | <0.001 |
| | PAO | 6 (66.7%) | 37 (92.5%) | 64 (90.1%) | 56 (52.3%) | 0 (0%) | |

camera was considered to be more sufficient qualitatively as compared to panoptic ophthalmoscope. In 58.2% and 41.8% pictures, disc quality was considered to be sufficient qualitatively by first and second ophthalmologists, respectively. Similarly, the macula's picture quality taken by non-mydratic fundus camera was considered more sufficient. In most of the pictures taken by panoptic ophthalmoscope, the relevant areas of macula were not seen. The superior and inferior vascular arcades' pictures quality were also considered to be more sufficient taken by non-mydratic fundus cameras. In both table I and II, comparison of general assessment of pictures by two different ophthalmologists between non-mydratic fundus camera and panoptic ophthalmoscope showed 33.3% pictures taken by non-mydratic fundus camera were inadequate for diagnosis. According to both observers, 55.6% (5) and 92.5% (37) pictures taken by panoptic ophthalmoscope were unable to reach the level to exclude findings. First ophthalmologist rated 71.8% (122) pictures taken by non-mydratic fundus camera as ideal quality pictures, second ophthalmologist rated 100% (96) pictures taken by non-mydratic fundus camera as ideal quality (table II). Our analysis on picture quality of both cameras indicates that the quality of pictures taken by non-mydratic fundus cameras,

provides more information as compared to panoptic ophthalmoscope. The agreement between both observers was not very healthy.

Maberley and associates stated that both fundus photographs taken by professionals and non-professionals were accurate for diagnosis.²⁰ Photographic findings were not affected by pupil size and environment. In fact, forceful pupil dilation and enabling operator to take various fundus photographs would increase the variability of picture quality.²¹ Massin and coauthors suggested that diagnosis of DR is more easy with the fundus photographs taken by the non-mydratic camera.²² The current study could be improved either by using multiple operators for taking photographs to avoid personal errors, or by using both techniques on the same eye of the patients for reliable comparison.

CONCLUSION

There was a significant difference in image quality of non-mydratic fundus camera and panoptic ophthalmoscope. The fundus images obtained from non-mydratic fundus camera rated more ideal as compared to those from panoptic ophthalmoscope, for establishing a reliable diagnosis.

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