

TEACHING OPHTHALMOSCOPY WITH DIRECT VERSUS ARCLIGHT OPHTHALMOSCOPE IN NON-OPHTHALMOLOGY RESIDENTS

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ABSTRACT:

Objective: To compare patient comfort and resident ease of use with Direct and Arclight ophthalmoscope.

Methods: This comparative cross-sectional study was conducted during two-day workshop sessions of 180 minutes each held in 2018 at the Ophthalmology Department of Lahore General Hospital, Lahore. The residents from non-ophthalmology departments participated in this hands-on workshop. Participants were given a brief lecture and demonstration of the direct ophthalmoscopy technique. Patients with the variable vertical cup to disc ratio (VCDR) were selected. Residents were asked to perform dilated fundus examination using both ophthalmoscopes and record their findings in a predesigned booklet

Results: The scores of 74 participating residents using both devices were analyzed. A positive Pearson correlation value was found (0.712) along with a significant p-value of <0.001. The mean ease of use score for Direct ophthalmoscope was 6.0 ± 1.345 compared to 6.23 ± 1.193 with Arclight but still, the participants found that Arclight was slightly easier to use and handle. Mean Comfort Score (glare) with Arclight was 3.27 ± 0.703 compared to 3.0 ± 0.617 with the direct ophthalmoscope. The length of the examination was inversely related to its score which was perceived by the subjects as uncomfortably long with Direct ophthalmoscope score 2.77 ± 0.685 compared to 3.18 ± 0.664 with Arclight.

Conclusion: In addition to being cost-effective and compact Arclight is slightly easier to use with a shorter learning curve for beginners. It is better tolerated by patients hence providing more comfort during examination in terms of glare.

Keywords: Direct Ophthalmoscope, Arclight, Postgraduate residents.

How to cite this article: Moin M, Irfan A, Chaudhry A, Amjad A, Manzoor A, Siddiq L. Teaching ophthalmoscopy with direct versus arclight ophthalmoscope in non-ophthalmology residents. *Pak Postgrad Med J* 2019;30(2): 69-74.

INTRODUCTION:

Ophthalmoscopy is an essential part of medical examination even for non eye-care practitioners. It is performed to view the retina grossly for even common conditions like diabetic retinopathy, optic nerve disorders and retinal vascular diseases. Conventionally two devices are used to view the fundus: Direct Ophthalmoscope and Indirect Ophthalmoscope.

The direct ophthalmoscope is a more popular choice among non-ophthalmology specialists due to ease of use rather than indirect ophthalmoscope. Conventional direct ophthalmoscope, however, costs a lot (about USD 750-1000) and may not be a suitable option for them. A recent alternative for direct ophthalmoscope is ARC light ; a light weight and cost effective device with a simple yet efficient design. It only weighs about 18 grams. It can be bought in bulk at a very reasonable price (USD 7.50 per piece). This device consists of two parts, first part is the small direct ophthalmoscope consisting of a magnifying loupe and a light source, second part is a detachable otoscope. The LED light sources are powered by an inbuilt rechargeable battery which can be either be charged by a USB port or by an in built solar panel that are useful in mobile clinics. A lens slider with three adjustable lens can be used to correct the refractive error of the patient or examiner. Arclight also includes a near visual acuity chart, a color vision test, and a reference scale to measure pupil size.

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Received: June 11, 2020

Revised: October 30, 2020

Accepted: November 01, 2020

With emerging knowledge in every speciality of field of medicine, there is an essential need to correlate the findings for concluding a diagnosis and better management. The art of ophthalmoscopy may not only be learned by ophthalmologists but by medical professionals of every field. There is a need to encourage Medical students to perform this skill more often¹. Undergraduates face multiple barriers while learning this skill despite of its importance.^{2,3} An overall improvement in ophthalmoscopy skills was seen in medical students who had practiced ophthalmoscopy on more than 10 occasions apart from their formal teaching sessions, in a study conducted in Canada.⁴ Likewise, post graduate residents of all specialities must be able to conveniently perform ophthalmoscopy, however, the majority lack confidence in correctly using an ophthalmoscope to identify the basic pathologies.⁵ ARC light can prove to be a handy and user friendly tool for them.

This device has been tested in many teaching centres as well as in deserts of Sahara where they were used to screen many individuals in mobile clinics. They are powered by solar energy and are cost effective which made them ideal tools for these mobile clinics. Fred Hollows Foundation has been using a modified form of this device to screen trachoma patients for the prevention of blindness in Ethiopia since many months.⁶ Due to its cost effectiveness it has a potential to transform the healthcare and screening system in under-developed countries⁷, as majority of preventable cases reside in poorer countries where there is lack of basic diagnostic tools.⁸ Locally, in Pakistan, this device has been used to screen patients for diabetic retinopathy, almost as efficiently as a conventional ophthalmoscope.⁹

We used this device in a hands-on workshop to teach direct ophthalmoscopy to the post-graduate residents of specialities other than ophthalmology. We compared the standard direct ophthalmoscope with the ARC light during this session.

METHODS:

This comparative cross-sectional study was conducted during two-days hands-on workshop sessions of 180 minutes each held in 2018 at the Ophthalmology Department of Lahore General Hospital, Lahore. Post Graduate residents from different departments of Lahore general hospital were invited. Residents with a refractive error exceeding the corrective lenses of Arlight (-6 to +4) were excluded. Informed consent was signed from both the volunteers and the examiners. Participants were given a brief review of funduscopy techniques and response booklets were given to them for noting down their findings. The residents were first given an introductory “refresher” didactic session on direct ophthalmoscopy in which they were taught basic fundus examination

techniques including optic disc and VCDR assessment. After that, the residents had a short practice session to familiarize themselves with both devices. All subjects had one eye dilated at random using tropicamide 1% eyedrops.

Table 1. Examination scale for the examiner.

Ease of Use (For Examiner)	(1) Unable to use the device
	(2) Unable to see the red reflex
	(3) Could see red reflex properly
	(4) Could see vessels but not disc
	(5) Could identify disc but unable to determine vertical CD-ratio(VCDR)
	(6) Able to determine VCDR with a high level of difficulty
	(7) Able to determine VCDR with a medium level of difficulty
	(8) Able to determine VCDR with a low level of Difficulty
Comfort Scale (for Subject)	(1) Uncomfortable glare
	(2) Significant glare
	(3) Mild glare
	(4) No glare
Length of Examination (for Subject)	(1) Uncomfortably long
	(2) Long examination time
	(3) Average examination time
	(4) Brief examination time

The subjects were nine healthy volunteers (18 eyes) with variable Vertical Cup to disc ratio (VCDR) who had their pupils pharmacologically dilated using tropicamide 1% eye drops, for participants to examine the fundus. After informed consent from patients and the participants, residents were asked to perform funduscopy on patients with ARC light as well as a conventional ophthalmoscope. The examinations were conducted in two circuits. The devices (Arlight or Heine ophthalmoscope) were randomly assigned to the residents. In the first circuit, the residents examined both eyes of each subject using their assigned devices. In the second circuit, they changed ophthalmoscopes and re-examine both eyes. They were instructed to note the following parameters on the booklets: 1) Ease of use (EOU) score for the examiner, 2) The level of glare experienced by the subject, and 3) Duration of the assessment (using a score of 1–4).

Four consultant ophthalmologists with interest in Vitreo-retina speciality, examined each subject with the conventional direct ophthalmoscope before the

residents to provide the “reference standard” for VCDR measurement. Data was recorded at the end of each examination by both the examiner (resident) and the subject (patient) on prepared booklets given to the participants. The examiner recorded the VCDR (range: 0.0 to 1.0) and ease of use score (Table 1). The patients recorded the level of glare experienced and an impression of the length of the examination (Table 1).

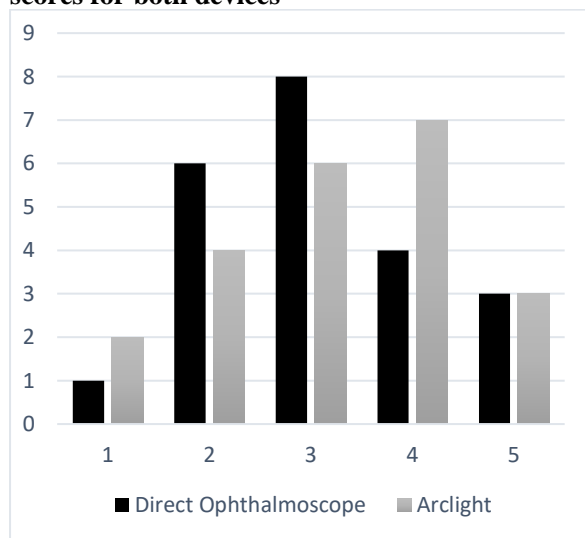
After a successful collection of data from 74 postgraduates, it was compiled and used to draw statistically significant descriptive and inferential results. A well tested and reliable examination scale¹⁰ was used to score our required parameters. (Table – 1)

The SPSS, version 25.0 (IBM, USA), was used for data entry and analysis. Findings from the study were assessed with the variables characterized as either categorical or continuous. Statistical analysis was performed by calculating the mean values and standard deviations of the scores obtained from participants for Ease of use, “glare,” and “length of examination”.

RESULTS:

The scores from both devices were used and correlation was positive (Pearson Correlation value = 0.712) and significant (p-value <0.001). The mean Ease of use score (Eou) for Direct Ophthalmoscope was 6.0 (± 1.345) while the mean of Eou for Arclight was 6.23 (± 1.193) , detailed distribution is shown in Chart-1.

Chart -1 .Histogram for frequencies of Ease of Use scores for both devices



The mean value for comfort scale (CS) determined by the amount of glare felt by the patients/subjects for Direct Ophthalmoscope was 3.0± 0.617 while the mean comfort scale (CS) for Arclight was 3.27± 0.703, as demonstrated in Chart-2.

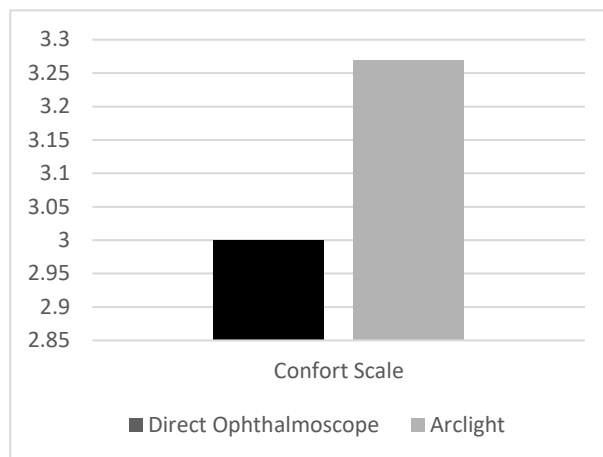


Chart – 2. Comparison of Average Comfort Scores

The patients from both groups (Group 1 and Group 2) were also instructed to note down their perceived time taken for each examination by a score of 1-4 for each device. The length of examination (LOE) score for Direct Ophthalmoscope was 2.77 (± 0.685) while that for Arclight was 3.18 (± 0.664).

Table – 2

Table – 2 .Mean values for perceived Length of

Device Used	Length of Examination Score (1 – 4)		P – Value (Chi Square)
	Mean	Standard Deviation	
Group 1 (Examined by Direct Ophthalmoscope)	2.77	0.685	0.043
Group 2 (Examined by Arclight)	3.18	0.664	

Examination Scores.

DISCUSSION

Arclight ophthalmoscope device aims to provide a reliable and economical alternative to the conventional direct ophthalmoscope. Our goal was to assess its convenience for patients and examiners while using it as a teaching tool for the residents. Our study demonstrated that Arclight is a cost effective and easier to use alternative for performing ophthalmoscopy. We also established that it is better tolerated by patients due to lesser glare and shorter duration of examination as compared to standard direct ophthalmoscope.

This study found no evidence of a difference between the Arclight ophthalmoscope and the conventional direct ophthalmoscope in terms of measuring VCDR by post graduate residents. However, the non-ophthalmology residents found the

Arclight much easier to use in comparison with standard ophthalmoscope, as evident from the mean ease of use score which was slightly higher for Arclight (6.23 ± 1.193) in comparison with standard direct ophthalmoscope (6.0 ± 1.345). In a study conducted by Lowe J et al¹⁰, during examination there was a very small difference between the reference standard VCDR measurement and the Arclight measurements, mean difference being -0.078 , indicating that even accuracy of both devices is almost same. Similarly, Niraj Mandal MBChB et al¹¹ established that the lens-free ophthalmoscope (such as Arclight) is a reasonable easier alternative to the standard Keeler pocket ophthalmoscope, in a randomized cross over study comprising of 400 eye examinations.

As a training device, despite of being in the early stages of evaluation, preliminary studies from Scotland, Malawi, and Tanzania have shown that Arclight is more effective than traditional tools for teaching ophthalmoscopy in medical students and other health professionals.^{12,13} Another study from University of Dundee shows that this device is also almost as accurate as a traditional direct ophthalmoscope for screening for signs of diabetic retinopathy and glaucoma.¹⁴ Despite of being easier to use and affordable, the cheaper ophthalmoscopes like Arclight and Optyse may unfortunately face issues in poorer countries; like a large number of population with untreated refractive errors^{15,16}, thus limiting the performance of lens-free instruments as pointed out by Harle et al.¹⁷ Lowe J et al¹⁰ demonstrated that in 288 fundus examinations done by ARC light as well as standard ophthalmoscope, there were no significant differences in 'ease of use scores' between the first and second circuits. In some cases of ametropia, using lens-free devices can cause problems, but that can be solved relatively by allowing myopic subjects to keep wearing their glasses and urging hypermetropic subjects to try to focus on a close target.¹⁸

The comfort level of the subjects was determined asking the patients the level of glare they feel during the examination from a score of 1 (Uncomfortable glare) to 4 (No glare). Responses were noted on the booklet. The mean value for comfort scale (CS) determined by the amount of glare felt by the patients/subjects for Direct Ophthalmoscope was $3.0 (\pm 0.617)$ while the mean comfort scale (CS) for Arclight was $3.27 (\pm 0.703)$, as demonstrated in Chart-2. This proved that the subjects felt less glare and slightly more comfort during Arclight examination as opposed to Direct Ophthalmoscope. Similar results were appreciated in a study by Lowe J et al¹⁰ where participants reported significantly more "glare" from the Heine ophthalmoscope as compared to ARC light. On 150th anniversary of Helmholtz, it was demonstrated by Armour H¹⁹ as tribute to Helmholtz's initial designs that a simple lens free ophthalmoscope

(such as Arclight) can be used to reasonably appreciate main gross findings on retina with ease.

In our study the subjects were also instructed to note down their perceived time taken for each examination by a score of 1-4 for each device. The length of examination (LOE) score for Direct Ophthalmoscope was $2.77 (\pm 0.685)$ while that for Arclight was $3.18 (\pm 0.664)$ as shown in Table-1. This means that patients perceived the length of examination done by Arclight shorter than that of Direct Ophthalmoscope. Similarly in a study by Lowe J et al¹⁰ it was reported the subject perceived a shorter duration of assessment when examined with ARC light rather than Heine direct ophthalmoscope. The relatively briefer length of examination boosts the confidence of residents as learning curve becomes shorter, it also allows more patients to be assessed in the same amount of given time hence facilitating in saving the resources and generally improving the healthcare. Despite its limitations, a lens free ophthalmoscope like (OptyseTM or Arclight) is a very effective tool for performing direct fundoscopy. Although it does not meet the same performance criteria as regular direct ophthalmoscopes, but in a study by Harle D et al¹⁷, it achieved clinically acceptable results in a much shorter time in 81% of cases, as compared with 94% with conventional ophthalmoscopes. During teaching workshops, such as ours, assessments and ophthalmoscopy simulations can have some limitations.²⁰ Limitations of our study include small sample size and lack of randomization. Slight unequal dilation of pupils and allocated sides of eyes under examination may also be potential limitations.

CONCLUSION

During this teaching experience in form of two workshops, it was seen that mean Ease of use scores for Direct Ophthalmoscope and Arclight were almost same, however Arclight was slightly easier to use and handle. Patients perceived slightly less glare and more comfort during examination with Arclight as compared to standard direct ophthalmoscope. Duration of examination perceived by the subjects was uncomfortably long with Direct Ophthalmoscope in comparison to Arclight. This shows that in addition to being cost effective and a compact instrument, Arclight is slightly easier to use, better tolerated by patients, and has a shorter duration of examination as compared to standard direct ophthalmoscope.

DISCLOSURE

The authors have no financial benefit or conflicts of interest in this work.

ETHICAL APPROVAL

The study was approved by the Ethical Review Committee of Postgraduate Medical Institute, Ameer ud Din Medical College, Lahore, Pakistan.

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AUTHOR'S CONTRIBUTION:

MM: Study Design, Manuscript writing, Critical Analysis

AI: Data Collection, Manuscript Writing, Statistical Analysis.

AC, AM: Data Collection. Critical Analysis.

AA, LS: Data Collection, Manuscript writing