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ORIGINAL RESEARCH

The Comparison Between Arclight Loupe and Handheld Slit Lamp in Anterior Segment Eye Disease Diagnosis

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Introduction: Early diagnosis of eye diseases improves outcomes and reduces blindness. However, diagnostic capacity in resource-poor settings is limited by a shortage of trained and equipped healthcare professionals. The Arclight device is a user-friendly, cost-effective diagnostic tool for both anterior and posterior segment eye diseases that requires minimal training. Studies have shown it to be effective for assessing the fundal reflex and performing fundoscopy; however, its accuracy and acceptability for anterior segment eye disease are still unknown.

Methods: This was a cross-sectional study carried out at Mulago National Super Specialised Hospital, where 21 ophthalmic clinical officers (OCOs) were recruited from surrounding districts. Each participant evaluated eleven patients with anterior segment pathologies and one normal case using the Arclight loupe and a handheld Slit Lamp. The diagnosis and the proportion of correctly identified conditions were recorded. Focus group discussions were held to assess the acceptability of using the devices. Discussions were transcribed verbatim and analysed using latent and manifest content analysis.

Results: Of the 21 participants, 13 (61.9%) were female, with a median age of 39 (IQR: 33–49), and had practiced for 6 to 10 years, representing 76.2%. The majority of conditions were correctly identified by both the Arclight (71.2%) and handheld slit lamp (72.3%). Pterygium was the most accurately diagnosed condition (100%) with the Arclight. Based on themes from Sekhon's framework and the Technology Acceptance Model, the Arclight device was found to be highly acceptable and easy for OCOs to use.

Conclusion: The performance of the OCOs in diagnosing anterior segment diseases with the Arclight is comparable to that of a handheld Slit lamp. It was also found to be an acceptable device for diagnostic purposes. In conclusion, the Arclight device is a suitable, low-cost alternative to the handheld Slit Lamp, especially in resource-limited settings.

Keywords: diagnostic accuracy, low-cost medical devices, portable ophthalmic devices, technology acceptance, blindness

Introduction

More than half a billion people with distance vision impairment caused by anterior segment pathologies[1–3] live in low- and middle-income countries (LMICs).[4] Vision impairments from cataracts and the sequelae of microbial keratitis and trauma are the fourth most common disability in Uganda, affecting 6.7% of the population.[3,5–7] This significantly reduces the ability of those affected to contribute to the country's productivity.[5] The situation is mainly due to the low number of ophthalmologists (fewer than two per million people), with the vast majority based in urban areas.[6] Although task shifting, through the expansion of a trained ophthalmic clinical officer (OCO) cadre, has been established, many

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healthcare workers cannot access functioning diagnostic devices, such as slit lamps, which limits the potential impact of this capacity strengthening strategy.[8]

The handheld slit lamp is suitable for both clinical and community outreach use and is a portable version of the gold standard (slit lamp) for diagnosing anterior segment eye diseases.[9,10] However, it is costly, easily broken, and requires regular maintenance with access to often hard-to-find and expensive consumables. It is also perceived as challenging to operate, requiring a relatively long training period to reach competence. These factors together limit its use in resource-limited settings, especially among primary and mid-level healthcare workers, who are typically the first to see patients with anterior segment eye diseases.[8,11] Additionally, Uganda has very few (<20) working slit lamps in public hospitals, which delays the diagnosis of preventable and curable anterior segment diseases.[11,12] The Lancet commission and Vision 2020 initiative recommend developing low-cost, portable devices for LMICs that are independent of scarce and expensive consumables without compromising core function.[1,13]

In response to the issues outlined above, the Arclight device has been designed and developed. It is a portable (weighs 18g), solar-powered, low-cost combination anterior segment loupe, ophthalmoscope, and otoscope.[14,15] The time to fully charge the device is 4–6 hours in the sun or 45–60 minutes via USB. Several studies have demonstrated the direct ophthalmoscope function to be equal to traditional direct ophthalmoscopes in performing the fundal "red" reflex and fundoscopy.[16–20] Additionally, it is easier to use, with a shorter learning curve for those with minimal eye care training.[16,18,21,22] These features make the Arclight potentially suitable for use by generalists and mid-level eye care workers in delivering primary eye care. In addition, the otoscope function has been evaluated in both high- and low-resource settings and has also been shown to be of equivalent function to traditional, more expensive devices.[17,23] As yet, however, evidence for the Arclight's use in the examination of anterior segment disease has not been explored. Therefore, this study aimed to evaluate the accuracy and acceptability of the Arclight anterior segment loupe compared to the handheld slit lamp in the diagnosis of common anterior segment eye diseases seen by OCOs in Uganda.

Methods

Study Design

This was a mixed-methods cross-sectional study employing both qualitative and quantitative techniques conducted in June 2022.

Study Site

The study was carried out at the ophthalmology outpatient clinics of Mulago National Super Specialised Hospital (MNSH). MNSH is the only public hospital providing specialized ophthalmic services in central Uganda and also serves as the teaching hospital for Makerere University.

Study Population

The study recruited Ophthalmic Clinical Officers (OCOs) from three districts in the central region of Uganda: Wakiso District, Mukono District, and Kampala District, which were purposively selected. Ophthalmic Clinical Officers (OCOs) undergo a one-year diploma specialized training in clinical ophthalmology, including diagnosis and non-surgical treatment of eye diseases.

Sample Size Estimation

A total of 21 OCOs were recruited. The sample size was calculated using a desired precision of 0.05, a mean diagnosis time with the Arclight device of 93.19 seconds,[16] and adjustments for the expected number of subjects during the study period, as well as a 10% non-response rate.[24] Participants were sampled consecutively from the list of the National Association of Ophthalmic Clinical Officers and Cataract Surgeons.

Three focus group discussions (FGDs) were planned to be conducted face-to-face, with each FGD consisting of six participants to ensure theme saturation. Participants were purposively sampled from the OCOs who took part in the quantitative phase of the study.

Study Procedures

Arclight Training Session

A one-day workshop on both the hand-held slit lamp and the Arclight device was conducted for the participants. The workshop emphasized examination techniques and diagnosis of common anterior segment eye diseases.

Selection of Patients

Two ophthalmologists with over 5 years of experience (AK and CN) recruited patients with the following diagnoses made on a table-mounted slit lamp: normal eye, chronic anterior uveitis, pterygium, corneal ulcer, corneal laceration, corneal scar, hypopyon, hyphema, trachomatous trichiasis, pupil abnormality, cataract, and papillary conjunctivitis.

Data Collection Stage

After obtaining written informed consent from both the OCOs and patients, research assistants (CN & AK) administered a questionnaire to collect data on the OCOs' age, gender, length of practice in ophthalmology, district of practice, and experience with the Arclight device.

Each OCO was randomly assigned to use either the Arclight or a handheld slit lamp first. Then, each participant examined all 12 patients and recorded the diagnosis. To reduce the chance of recall from short-term memory, the order of patients was changed before switching to the other device and conducting the second set of examinations. Patients were also disguised with a gown, a theatre cap, and masks, leaving only their eyes visible to the participants. To minimize patient fatigue, each patient's eye was examined a maximum of 11 participants using each device, and thus 2 groups of patients with the predetermined conditions were recruited; however, every OCO examined the same set of patients with the 2 devices. Within each group, each participant was examined by 2 devices.

Focus Group Discussions

FGDs were facilitated by a doctor trained in qualitative research data collection (AWS) and a trained note-taker (PAO). Each session lasted 80 minutes, with participants seated around a round table and the moderator among them. Before each FGD began, the moderator explained the study's objectives to the participants.

A questionnaire based on Sekhon's Model of Acceptability of Health Intervention[25] was used to collect data (S1), with all FGDs recorded and field notes taken by the PAO.25 FGDs were conducted until thematic saturation was reached. The recordings were transcribed by a skilled transcriber and reviewed by the investigators to ensure they conformed to the submissions from the FGDs.

Data Analysis

Quantitative

Descriptive statistics were summarized as frequencies, percentages, medians, and interquartile ranges. Data was visualized using bar graphs. The performance of the devices was presented as the percentage of diagnoses correctly identified and compared using McNemar's test.

Qualitative

All audio recordings were transcribed verbatim in English and verified by two research assistants. All qualitative data were analyzed using a thematic approach in NVIVO software. De-identified data, organized in transcripts, were read multiple times by JM to identify relevant text segments and group them into codes. We also combined similar paragraphs into meaning units, which were then synthesized to create codes. These codes were further analyzed to identify themes using constructs from Sekhon's Theoretical Framework of Acceptability.[25] This framework includes seven constructs, which are adapted as shown in Table 1.

Table 1 Table Showing the Adaptation of Sekhon's Framework to Our Study

Sekhon's Theoretical Framework Constructs	Definition
Affective attitude	Denotes how a participant feels (either positively or negatively) about the Arclight device.
Self-efficacy	Denotes a participant's confidence in their ability to use the Arclight to examine eyes
Burden	Denotes the amount of effort an individual thinks is necessary for the successful outcomes of the intervention if they participate.
Opportunity cost	Denotes the potential loss or gain from other alternatives that result from making a choice
Perceived effectiveness	Denotes the extent to which an intervention is expected to achieve its intended purpose
Intervention coherence	Denotes the extent to which participants understand the Arclight device and its functioning.
Ethicality	Denotes the extent to which the Arclight device aligns with an individual's values.

We developed a narrative of our qualitative data based on the identified themes and included quotes from the FGDs to illustrate the participants' views. Participants did not provide feedback on our findings. We present our results following the Consolidated Criteria for Reporting Qualitative Studies (COREQ) checklist.[26]

Results

Study Participant Characteristics

In this cross-sectional study, 21 OCOs (13 females) were recruited, with a median age of 39 years. All OCOs had practiced for more than 5 years and had experience using a handheld slit lamp. Only 6 participants had previous exposure to Arclight. The details of the participant characteristics are displayed in Table 2.

Diagnostic Accuracy of the Arclight Loupe versus the Handheld Slit Lamp

Most conditions were accurately identified by the OCOs: Arclight (71.2%) and handheld slit lamp (72.3%). The percentages of correct diagnoses are displayed in Table 3 and Figure 1.

The median time taken to make the diagnosis was comparable between the devices: handheld slit lamp 26 seconds and Arclight 25 seconds. An almost perfect agreement between devices was observed for diagnosing Endophthalmitis/

Table 2 Characteristics of the Study Participants

Characteristic	Frequency.	Percent	Median IQR
Sex of the participant			
Female	13	61.90	
Male	8	38.10	
Age of the participants			
Median (IQR)			39 (33—49)
Duration in ophthalmology practice			
<=5 years	0	0	
6-10 years	16	76.2	
11-15	2	9.5	
16 and above	3	14.3	
Introduced to the Arclight device before the study.			
No	11	47.6	
Yes	10	52.4	
How long ago had you been introduced to the Arclight device in years, n=10			
Median (IQR)			3.5 (1—4)
Received prior training on how to use the Arclight device (n=10)			
No	4	40.0	
Yes	6	60.0	

Table 3 Proportion of Participants Who Correctly or Wrongly Diagnosed Eye Conditions Using Arclight Device versus Handheld Slit Lamp

Clinical Conditions	Arclight n (%), (95% CI)	Slit lamp n (%), (95% CI)	p-value**
Chronic Anterior Uveitis			
Correct diagnosis	5 (35.7%), (13.7—66.0)	4 (28.6%), (9.6—60.1)	0.132
Wrong diagnosis	9 (64.3%), (34.0—86.3)	10 (71.4%), (39.4—90.4)	
Pterygium			
Correct diagnosis	21 (100%)	20 (95.2%), (69.1—99.4)	0.317
Wrong diagnosis	0 (0)	1 (4.8%), (0.5—30.9)	
Corneal ulcer			
Correct diagnosis	15 (71.4%), (47.0—87.5)	15 (71.4%), (47.1—87.5)	1.000
Wrong diagnosis	6 (28.6%), (12.4—52.9)	6 (28.6%), (12.5—52.9)	
Corneal laceration			
Correct diagnosis	17 (80.9%), (56.4—93.3)	17 (80.9%), (56.4—93.3)	1.000
Wrong diagnosis	4 (19.1%), (6.7—43.5)	4 (19.1%), (6.7—43.5)	
Corneal scar			
Correct diagnosis	8 (38.1%), (19.1—61.7)	15 (71.4%), (47.1—87.5)	0.019
Wrong diagnosis	13 (61.9%), (38.3—80.9)	6 (28.6%), (12.5—52.9)	
Hypopyon/ endophthalmitis			
Correct diagnosis	5 (71.4%) (21.5—95.8)	5 (71.4%), (21.5—95.8)	1.000
Wrong diagnosis	2 (28.6%), (4.2—78.5)	2 (28.6%), (4.2—78.5)	
Trachomatous Trichiasis			
Correct diagnosis	14 (66.7%), (42.6—84.3)	13 (61.9%), (38.3—80.9)	0.317
Wrong diagnosis	7 (33.3%), (15.7—57.4)	8 (38.1%), (19.1—61.7)	
Pseudophakia			
Correct diagnosis	19 (90.5%), (65.9—97.9)	19 (90.5%), (65.9—97.9)	1.000
Wrong diagnosis	2 (9.5%), (2.1—34.0)	2 (9.5%), (2.1—34.0)	
Cataract			
Correct diagnosis	19 (90.5%), (65.9—97.9)	21 (100%)	0.157
Wrong diagnosis	2 (9.5%), (2.1—34.0)	0 (0)	

Note: **P value based on McNemar's test.
Abbreviation: CI, Confidence Interval.

hypopyon (Cohen's Kappa: 1.00 (1.000—1.000)) and Trachomatous trichiasis (Cohen's Kappa: 0.8966 (0.700—1.000)), while substantial agreement was noted for diagnosing corneal ulcer (Cohen's Kappa: 0.7667 (0.461—1.000)) (Table 4). More OCOs misdiagnosed corneal scars using Arclight compared to the slit lamp (13 [61.9%], 95% CI [38.3—80.9] vs 6 [28.6%], 95% CI [12.5—52.9], p-value 0.019). No agreement was observed between devices in diagnosing cataract (Cohen's Kappa: 0.000 [−Infinity—1.000]) or Pterygium (Cohen's Kappa: 0.000 [−Infinity—1.000]).

Acceptability of Using the Arclight Device in the Diagnosis of Common Anterior Segment Eye Disease

We used Sekhon's Theoretical Framework of Acceptability to assess findings from the FGDs on the acceptability of using Arclight. In summary, the use of the Arclight device in diagnosing common anterior segment eye diseases was acceptable to the OCOs.

Affective Attitude

User Friendliness

Participants used the Arclight device with ease and made the diagnosis in a shorter time. The quotes illustrate this:

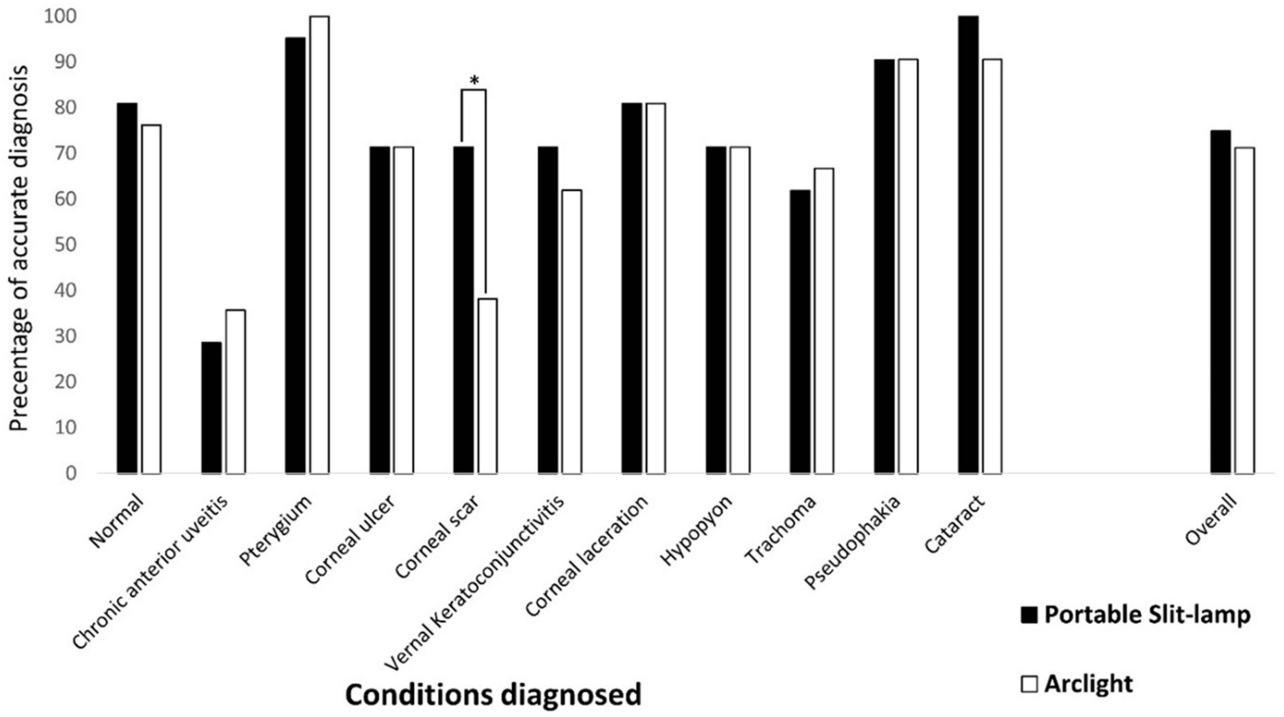

Figure 1 The percentage of OCOs who got the correct diagnoses using Arclight device versus hand-held slit lamp.
Note: *p-value <0.05.

> My experience with Arclight was that it was easy for me to come up with the diagnosis within a short time. You get the gadget (Arclight), you focus quickly on the patient's eye, and you have the right diagnosis. (FGD 1)

It Requires Minimal Training

Generally, almost all participants stated that they required minimal training to use the device efficiently in their clinical practice. The techniques to arrive at a correct diagnosis were easy to grasp in a short time. One participant reiterated

Table 4 Agreement Between the Arclight Device and Slit Lamp per Anterior Segment Eye Condition

	Percent Agreement Observed	**Expected Agreement**	**Cohen's Kappa**	**95%Confidence Interval**
Chronic anterior uveitis	78.57	56.12	0.5116	0.037–0.987
Pterygium	95.24	95.24	0.0000	(-infinity −1.000)
Corneal ulcer	90.48	59.18	0.7667	(0.461–1.000)
Corneal laceration	80.95	69.2	0.382	(−0.111–0.875)
Corneal Scar	57.14	44.9	0.222	(−0.0904–0.538)
Endophthalmitis/hypopyon	100.00	59.18	1.00	(1.000–1.000)
Vernal keratoconjunctivitis	90.48	55.10	0.7879	(0.515–1.000)
Trachomatous trichiasis	95.24	53.97	0.8966	(0.700–1.000)
Pseudophakia	90.48	82.77	0.4474	(−0.196–1.000)
Cataract	90.48	90.48	0.00	(-infinity −1.000)

> In a short time, I learnt and acquired skills on how to use the Arclight very well on the anterior segment examination and fundoscopy. (FGD 3)

Portability

One participant shared, "I can even move with it in my small bag and do my community work."

Most of the OCOs said that Arclight was easy to carry from one place to another. They attributed this to its smaller size compared to the slit lamp, which they used for diagnosing anterior eye segment diseases.

> The Arclight is light (in terms of weight) compared to the Slight lamp, and you can move with it. Now we can even do home-to-home visits, looking at people's eyes. (FGD 1)

The Arclight Is an Affordable and Easy-to-Maintain Device

Cost also emerged as another factor that the OCOs preferred over the slit lamp. The participants felt that it was more realistic to purchase an Arclight for their practice.

> Of course, the cost attached will always affect my decision to use it because when you compare the two, 50,000 Uganda shillings (for the Arclight) is easily obtained than 35 million Uganda shillings, and they almost use the same time to arrive at the diagnosis, apart from a few cases. You will choose the Arclight. (FGD 1)

The Arclight's capacity to be recharged using solar power was viewed as a significant innovation that would enable participants to use it in hard-to-reach areas with limited access to electricity.

> since it is solar charged, I can use it anywhere, even in the villages, and I wouldn't bother about the availability of electricity in the area where I am. (FGD 3)

Self-Efficacy

Able to Use It to Diagnose Anterior Segment Conditions

The participants regarded the Arclight as a valuable device that would aid in diagnosing anterior segment diseases. As two participants observed:

> I found the Arclight device easy to manoeuvre and use to make diagnoses for anterior segment conditions. I did not have to make a lot of adjustments like when I use the slit lamp (FGD 3)

Arclight can be used in mass screening exercises

The participants believed they could use the Arclight device in their clinics and medical outreach efforts to evaluate a large number of patients quickly. Two participants mentioned this.

> I would prefer the Arclight device (to the portable slit lamp) because it is simpler to use, and you can handle many patients within the shortest time. The Arclight device would also be better (than the slit lamp) If I go for an outreach or camp (FGD 1)

It Can Be Used to Examine a Wide Range of Patients

The ability of participants to use the Arclight device with different patient groups emerged as a key issue during the focus group discussions (FGDs). The majority of the OCOs who had undergone training before using the Arclight felt that they could use the device with children who may not be cooperative or have limited ability to follow instructions.

> It can be used to examine both the cooperative and uncooperative patient. The portable slit lamp may not provide accurate results if the patient is uncooperative. The Arclight device is a good device to use to examine children who easily get tired, and they are moving up and about. (FGD 2)

However, some participants experienced challenges in adjusting to using the Arclight device for diagnosing common anterior segment eye diseases.

> My challenge was to adjust because we are used to these (instruments), which have a bigger working surface area. So, for me to focus on that small area in the beginning was hard for me. (FGD 2)

Burden

High Time Efficiency

For most participants, the average time to reach a diagnosis was shorter with the Arclight than with the slit lamp. The participants noted:

> The duration (to reach a diagnosis using the Arclight) was quite short. It is less than one minute, and you are already there. (FGD 1)

Perceived Effectiveness and Opportunity Cost

Our analysis found themes that overlapped in these constructs and hence are presented jointly:

High Preference for the Arclight

Participants in our study stated that they were able to use the Arclight to identify the common anterior segment conditions. In addition, some of the OCOs felt that the Arclight provided good magnification, enabling them to make a diagnosis in a very short time.

> I would prefer to use the Arclight to the slit lamp. (With the Arclight device), I was able to examine the depth and everything in the anterior segment. (FGD 3)

In comparison with other alternative devices used in eye care in Uganda, the participants in the FGDs felt that Arclight would provide them with the opportunity to diagnose their patients. This is despite their acknowledgment that the slit lamp remains the gold standard.

> For the case of our settings, the fact that we lack infrastructure and equipment, I guess the Arclight device is more flexible to use compared to other tools. But as the gold standard, the slit lamp stands out better because it comes with other accessories and magnifications. When it comes to eye care (in our settings), which runs largely on outreaches, I think Arclight makes a difference. (FGD 2)

However, participants also noted potential limitations with the effectiveness of Arclight:

Perceived Technical Limitations of the Arclight

Arclight Increases Exposure to Pathogenic Aerosols

To obtain accurate results, the participants had to stand close to the patients, which made them (OCOs) uncomfortable The OCOs felt that this increased their exposure to possible pathogens (especially aerosols from infected patients) for their patients. One participant reiterated:

> In cases where I suspect infections or in cases where I suspect flu because of the proximity of the patient to me, I might be discouraged from using the Arclight device for fear of acquiring an infection from the patient. (FGD 1)

It Cannot Make a Slit

For some conditions, the participants noted that the Arclight device might not be the most suitable device for providing sufficient depth for an extensive examination of the anterior segments of the eye. One participant noted:

> There are scenarios where I think I would not use the Arclight device to examine a patient. For example, if I want to locate a specific pathology at a certain layer of the cornea, I might not use the device. This is because the Arclight device does not provide the necessary slit to enable localization of the corneal layer where the pathology is located. So, I would prefer the Slit lamp. (FGD 1)

It Is Monocular

The participants regarded the fact that Arclight was monocular as a limitation of its use in clinical practice.

> The Arclight device is a monocular equipment as you use one eye to examine but with the slit lamp, you can use two eyes. There is an added advantage of depth perception (using the slit lamp) where you are going to see things very well using the two eyes. (FGD-1)

Intervention Coherence

Comprehensible Description of the Technique of Use

Participants in the FGDs demonstrated excellent comprehension of the process of using Arclight to perform anterior segment eye examinations. Two participants noted:

> You establish rapport with the patient. Explain the purpose of the examination, you switch on the light, of course you go structure by structure, beginning from outside, eye lashes, eyebrows, lids, eye lashes, then like that you go to the cornea, conjunctiva then you can go to look at the anterior chamber so basically that is what it entails from outside to inwards. (FGD 2)

Ethicality

Willingness to Use the Arclight in the Future

Participants stated that based on their experiences using the Arclight, they would implement it in clinical practice for the diagnosis of anterior segment eye conditions. They hoped to use this in conjunction with the slit lamps for their practice.

> I would use this device in practice always because it is easy to manage, use and carry. I do not have any reservations (FGD3)

> I have access to the slit lamp already. I have been provided with an Arclight and I would definitely be using it in my practice (FGD2)

Discussion

This mixed-methods study shows that Ugandan ophthalmic clinical officers can diagnose common anterior-segment diseases with the low-cost, solar-powered Arclight loupe as accurately and quickly as with a portable slit-lamp. Across 231 examinations, the overall proportion of correct diagnoses differed by only 1.1 percentage points (71.2% vs 72.3%), and median examination times were essentially the same with the majority reporting a short learning curve. The findings therefore position the Arclight as a credible alternative to handheld slit-lamps where these are scarce, expensive, or difficult to maintain.

Our results build on previous research demonstrating the Arclight's usefulness for posterior segment assessment and red reflex screening.[16,18–21,27] Those studies involved medical students and general health workers. In contrast, the current trial included experienced mid-level eye-care providers and compared performance against a more advanced and costly gold standard for anterior segment examination—a handheld slit lamp—rather than an equivalent "loupe" device. The high agreement levels for inflammatory disease, trauma, trichiasis, and pseudophakia indicate that the loupe's monocular, broad-beam optics are effective for most pathologies seen in primary eye care. The only significant clinical limitation observed was a case of corneal scarring, where examiners using the Arclight were less likely to identify it correctly. This reflects OCOs' concerns about the absence of a slit beam and binocular depth perception.

Acceptability data help explain why diagnostic performance was maintained after only a single day of training. Participants valued the loupe's light weight, pocket size, solar recharging, and negligible running costs—attributes that directly align with the Technology Acceptance Model's constructs of perceived usefulness and ease of use.[28] Cost is especially important: purchasing one portable slit lamp costs roughly the same as 600 Arclight devices, a difference that could significantly expand access to anterior-segment screening in district hospitals and outreach programs.[8] Additionally, users recognized the potential for quick, high-volume assessments during community eye-health camps and appreciated the practical benefit of examining children and uncooperative adults without needing chin rests or access to often hard-to-reach mains electricity.

Nevertheless, three technical limitations were identified. First, the absence of a slit beam limits the ability to locate stromal lesions and measure anterior-chamber depth, functions still best performed with a slit lamp when available. Second, monocular viewing reduces judgment of depth, which may partly explain the lower accuracy for corneal scarring. Third, clinicians need to stand very close to the patient, raising concerns about aerosol transmission of respiratory pathogens. These limitations suggest that the Arclight loupe is best used as a supplementary tool rather than a replacement: it can address a gap in diagnostic resources in health clinics and outreach settings, while slit lamps remain the preferred choice for examinations in district and tertiary hospitals, if available.

Several strengths of this study increase our confidence in the conclusions: the patient sample represents a realistic case mix, the device use order was randomized, patients were masked, and the order of cases was varied between rounds of examination. Additionally, triangulating quantitative accuracy with qualitative acceptability was employed. Limitations include the modest sample size of OCOs from districts near Kampala, the brief familiarization period with the Arclight compared to many years of slit-lamp experience, and the cross-sectional design, which cannot track changes in proficiency, device durability, or infection control practices over time. Future studies should (i) follow users longitudinally to observe learning curves and sustained acceptability; (ii) assess diagnostic accuracy for subtler conditions such as early keratoconus or Fuchs endothelial dystrophy; (iii) evaluate cost-effectiveness and effects on referral patterns; and (iv) test simple infection-control measures, such as disposable breath shields, to reduce perceived aerosol risk.

In summary, when used by trained OCOs, the Arclight loupe provides diagnostic accuracy and speed similar to a portable slit lamp, while offering clear benefits in cost, portability, and independence from mains power. Adopting this economical technology in eye-care task-shifting strategies could significantly increase the timely diagnosis of anterior-segment disease in low-resource settings, supporting blindness reduction efforts and advancing the goals of the Vision 2020[15] and Lancet Global Health Commission agendas[1].

Conclusion

Compared to the Slit lamp, OCOs found the Arclight device acceptable and time-saving, but technical limitations such as the inability to create a slit and its monocular design could be potential barriers to its use. In settings with limited access to slit lamps, the Arclight devices should be considered an alternative tool for diagnosing anterior eye segment diseases.

Abbreviations

OCO, Ophthalmic clinical officer; FGD, Focus group discussion; MNSH, Mulago National Super Specialised Hospital; LMIC, Low- and Middle-income countries.

Data Sharing Statement

The datasets used and analyzed in this study are available from the corresponding author upon reasonable request.

Ethical Approval

This research was a minimal risk study conducted in accordance with the Declaration of *Helsinki*. Ethical Approval was sought from the Mulago Hospital Research and Ethics Committee (MHREC 2021-58) and the Uganda National Council of Science and Technology (HS2007ES) before data collection. Administrative clearance was sought from the MNSH administration. The study team members are trained in the principles of Good Clinical Practice and the Protection of Human Subjects. Participants were informed about the aim of the study, the methods employed, the nature of their participation, and that anonymized responses and direct quotations would be published. Written informed consent was then obtained from all study participants. All information collected from participants during the research was kept strictly confidential with no name /personal identifiers of any person who took part in this study to be used in any report or publications resulting from the study. Participation in the study was voluntary.

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Author Contributions

All authors made a significant contribution to the work reported, whether that was in conception, study design, execution, data acquisition, analysis, interpretation, or all these areas; participated in drafting, revising, or critically reviewing the article; gave final approval of the version to be published; agreed on the journal to which the article was submitted; and accept responsibility for all aspects of the work.

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Disclosure

Dr. Andrew Blaikie is employed by the University of St Andrews, where Arclight has been commercialized under a subsidiary company within the University. He does not, however, have any direct financial gain from sales. The authors report no other conflicts of interest in this work.

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