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## Original Research Article

## Slit lamp photography for objective assessment of topical eye disorders

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## ABSTRACT

**Introduction:** Evidence based scientific studies has weightage, when they are presented with quantitative data analysis. Documentation and parametric analysis has become an integral part of present day research. Any publications or write-ups without explanation through standard parameters are not appreciated by the research society.

**Materials and Methods:** In Ophthalmology assessment of various parameters through photography is a debatable issue. Affordability for higher end diagnostic / OPD instruments may not be feasible for all. In such a scenario, here is an attempt made to standardize the slit lamp photography with a smart phone and its scientific analysis for evaluating clinical conditions like sub-conjunctival hemorrhage, etc.

**Conclusion:** This technique can become a tool for assessment and response of the therapies as well as an important tool to seek help from higher centers. Various add-on benefits in research, limitation and scope for further evaluation also being discussed.

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## 1. Introduction

Slitlamp bio-microscope is used as stethoscope in ophthalmic practices. Examination of an eye case is not completed unless being examined through slit lamp. This is a major step in examination of anterior chamber of eye. Various magnifying lens (depending on the specification of the slit lamp viz., 2 step, 3 step, 5 step slit lamps) are used in order to seek the details of clinical condition. Various models and like Haag-streit, Zeiss model, handheld, etc slit lamps with various models and makes various magnifications like 1x & 1.6x are used based on the need of the consultant.

For documentation purpose photography is an important tool in clinical practices. In Medical profession, technical expertise in higher-end professional camera / photo-editing is a bit lacking issue. Photography of bodily parts, surgical

procedures is easily possible. In Ophthalmic practices, picking up of images is a challenging task because of many reasons like red glow reflex, transparent nature of cornea, translucent nature of conjunctiva and underlying vasculature, photosensitivity, etc. Various Apps using camera of mobile phone can be used for photography like Camera FV5, Slit lamp Pro-ophthalmic CAM, etc.<sup>1</sup> But, these doesn't make much changes in output.

## 2. Slit Lamp Cameras

Slit lamp bio-microscope has the facility of photography. After prism compartment, a beam splitter is fixed before Eye piece / viewing portion of slit lamp. Then it is connected with the camera and computer for picking up of images through software. This equipment is available only in big / tertiary care units. Because of its non-affordability in general ophthalmic set up, they are not so frequently used. This in-turn fails in documenting various interesting clinical

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cases and clinical progress. Also seeking for opinion of experts in complications / difficult situations it won't be possible when the case is reported in remote places.

Smart phones are replacing many gadgets and working as a pocket computer. Even in the field of Ophthalmology, smart phones are replacing OPD equipment like eye testing charts, contrast sensitivity, etc. Now-a-days, high end smart phones with excellent photography configuration are at affordable cost. Hence, these can be used with higher efficiencies than the routine conventional slit lamp cameras. Mobile phone camera can be attached to the slit lamp with help of an adapter (telescope adaptor) and then photographs can be taken easily. Here is an attempt made to demonstrate the slit lamp photography and fix up the standard protocol for in-depth study of obtained images.

### 3. Direct External Photography

This works well in adnexal mass, lacerations, ptosis, strabismus, large ocular injuries where the point of assess is beyond slit lamp illumination. If a slit lamp is not available then direct smartphone photography would help for the rough evaluation. It would not be very helpful in ocular surface disorders, anterior and posterior segment issues. Add on effect of slit lamp is that its various views helps in documentation and evaluation of pathogenesis in different ocular structures.

Near focus point fixation of most of smart phone is 7 – 10 cm. also an issue. This is achieved by slit lamp adapter method and thus helps in obtaining clear images without using additional zoom, etc.

External photography techniques also can be used along with slit lamp, without using any kind of adapters. But it requires extremely stable / steady hands grip of smart phone against eye piece of slit lamp.

### 4. Technical Specifications

Any slit lamp with all basic components is enough. Smart phone of any model and make is fine for photography. Higher the resolution and mega-pixel capacity of camera gives images with utmost clarity and contrast.

General basic slit-lamp comes with 10x magnification offered by eye piece at viewing site. This magnification we need to use for deducting from the obtained pixel size. Hence, before conducting trials one should note the level of magnification offered by slit lamp.

Mobile phone with camera complex (1/2/3/4 camera lenses) / individual camera situated in upper 1/3<sup>rd</sup> center of back panel is ideal. This helps in matching the camera aperture with the slit lamp eye piece. Camera situated at other sites like upper right corner, upper right vertical line aligned, upper right horizontal line aligned or upper right corner in square aligned won't affect the quality of photography. But, it would be difficult to withhold the side

corner camera phones in adaptor as well as matching camera aperture with eye piece of slit lamp. This also hampers the quantity of viewing angle.

## 5. Materials and Methods

A basic slit lamp with routinely used smart phone used for current trial along with a commonly used smart phone. Based on anatomical landmarks various views of examinations are planned for detail evaluation.

### 5.1. Slit lamp specification

1. 2 step Haag-streit Slit Lamp Bio-microscope with 1x & 1.6x magnification
2. Made – Appaswamy, Model – AIA 2S / 2 S L
3. Slit image – width, height and diameter – 0 to 14mm
4. Illumination – 12 V-30 W Halogen lamp / 3.4 V-700mAh LED

### 5.2. Camera specifications

1. Model – Poco x 2
2. Megapixel – 64MP
3. Picture size – 1 to 2 MB
4. Aspect ratio – 3:4
5. Resolution – 1101 x 1468 dpi
6. Zoom – Default zoom (1x)
7. All default settings without doing any adjustments in colours, contrast and brightness used for current study. Switch off Beauty mode, HDR mode, portrait mode and flash.
8. Use Auto-focus, with sufficient illumination, semi-dark room preferably, touch to focus for sharper objects.

### 5.3. Fixing of adapter

Adapter has 2 parts one portion to hold smart phone squarely and another portion fixes the eye piece of slit lamp. Make sure that, power and volume buttons are not accidentally pressed by sides of adapter.

Usually 2 types of adapters are available with hexagonal and circular models. Hexagonal is ideal for all kind of smartphone camera positions. Here camera sits in angular manner and this occludes both the eye pieces. Hence, for checking out image clarity / focus we need check in smart phone screen and adjust with joystick of slit lamp. Circular model adapter is ideal for center and single camera smart phones. Here, only one eye piece is occupied and other portion can be used for adjusting focus with joystick of slit lamp.

### 5.4. Procedure of photography

Patient is made to sit comfortably on chair unit as per SOP of slit lamp examination (chin placed neatly in chin

rest slot and forehead touching the upper forehead band). Obtained informed written consent for photography All the images are taken in semi-dark room in OPD set-up. Smart phone is attached with the eye piece of slit lamp of above specification with the help of a telescope mobile adaptor. Before photography slit lamp is focused with moderate diffused illumination and least magnification set the slit lamp on area of interest and Images are clicked (JPEG Format) in all 8 quadrants of intra-palpebral aperture & fornices with 9<sup>th</sup> image of full eye. Increase in slit lamp magnification reduces depth and area of focus which can be regained/ adjusted with movement of slit lamp joystick. Use pinch zoom to zoom desired area of interest.

These quadrants are made based on the width of aperture of slit lamp focus. 1. Nasal and 2. Temporal quadrants are the portions of eye visible through intra-palpebral aperture from margin of limbus to the respective canthus. Horizontal and Vertical line is drawn from the most prominent part of the limbus visible in the image captured (i.e. in intra-palpebral aperture). This was set as standard, because height and width of intra-palpebral aperture varies from individual to individual. Normal anatomical position differs as per race / gender / individuals. This defines the limits of the quadrants and helps in assessment of hemorrhage 3. Superior 4. Inferior 5. Superio-nasal 6. Superio-temporal 7. Inferio-nasal 8. Inferio-temporal quadrants are considered for assessment of hemorrhage. Series of photographs will be taken only in involved quadrant Measurement of individual quadrant will be assessed and summation will be done for calculation.

### 5.5. Procedure of assessment

Obtained images are transferred to PC / Laptop. Images opened in Adobe Photoshop 7.0 or any other version / online editing websites like <https://www.photopea.com> (JPEG Format). Involved segments are isolated and Area of hemorrhage / interest is selected with suitable selection tool (elliptical / polygonal / magnetic lasso / rectangular marquee) / Photopea.com tools – Rectangular select / Ellipse Select / Lasso Select / Polygonal Select / Magnetic Lasso. Dimensions details of the selection shown are noted in pixels (LxW). Considering the 10X magnification offered by eye piece lens of slit lamp, the obtained value is divided by 10. This facilitates in obtaining original size of area of interest. Dimensions obtained in pixel are converted into millimeter using an online conversion website ([www.unitconverter.net](http://www.unitconverter.net)) and are recorded.

Since we are using Photoshop / photopea software, zoom in or zoom out effect does not affect the actual size of pixels. This method of photography and calculations can also be used in measuring all types of ocular surface disorders and adnexal area.

### 5.6. Lenses and magnification

When the concept of magnification is considered in microscopes, there are two types of lenses that come in picture i.e. objective and ocular lens. Usually 10x magnification implies (10 (magnification offered by objective lens) x 10 (magnification offered by ocular lens) = 100 time's total magnification achieved).<sup>2</sup>

In Slit lamp bio-microscope, there is 1 set of prism and 1 set of ocular lens in eye piece fixed with 10x magnification. So, in total there is only 10 times magnification achieved by slit lamp. Hence, the obtained measurements in pixels to be divided by fraction of 10. Thus, facilitating calculation of original size of the object of interest.

## 6. Discussion

Documentation is a critical issue in medical practice. This can be done in both the ways – viz. Physical / on paper documentation and Digital way of doing documentation. Physical way of documentation is the conventional method followed in small as well as large private and government establishments. This method has its own drawbacks as well as benefits. Real time actual documentation in physical form is missing which can be easily done in digital platforms. Various software and specialty related clinical documentation attached hardware are available for the convenience of storage, processing, retrieval of data.

In private clinics with lesser sample it would be difficult to have digital platform for documentation. In institutional practices, it would be easy to get facilities. Even the manpower divides the work and makes the job easy.

To handle sophisticated costly ophthalmic equipment's trained faculty is required. But, when the whole technology is replaced with a commonly handled device (small phone) then even a general duty staff can handle the technique of medical documentation. Even in medico-legal cases these documentation through photography becomes valuable source of information.

Good ophthalmic photography is possible with the help of smart phone and various adapters like DIY ret Cam, MII Ret Cam,<sup>3</sup> etc. Assessment of obtained images with the help of artificial intelligence grading of Diabetic Retinoscopy, Optic Nerve Head, is possible. Assessment of images with the help of minimum online websites would bring an objective tool for research and development in Ophthalmology.

During post-graduate studies / other research works / evidence based clinical establishment, photography evolves as an important tool. Photography also helps in recording and monitoring whole course of treatment responses throughout clinical studies.

For a research work and dissertation studies analysis through objective parameters make it more valid when compared to subjective parameters. Based on photography,

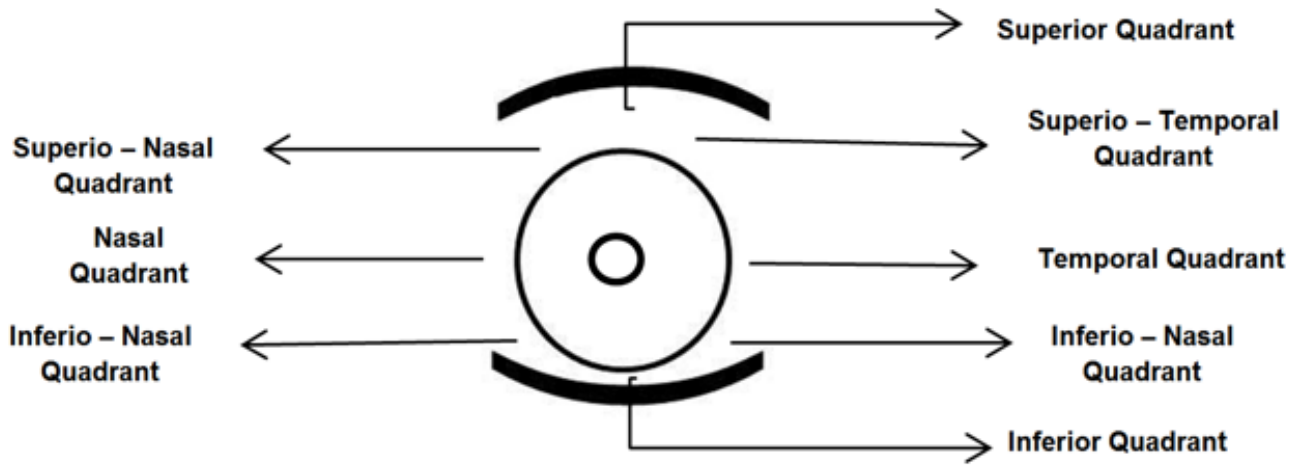


Fig. 1: Showing schematic re-presentation of 8 quadrants and full eye image

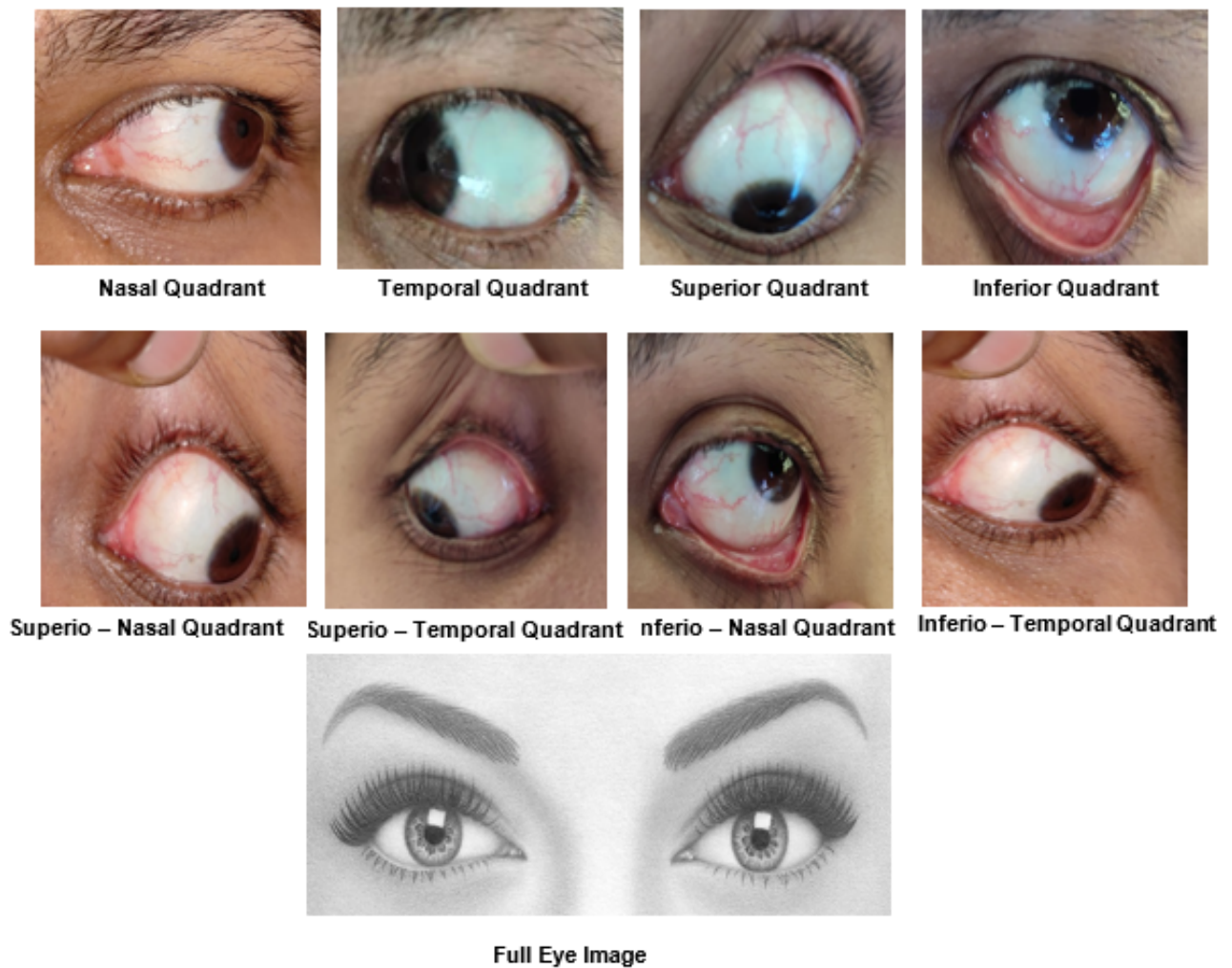


Fig. 2: Showing collage of 8 quadrants naked eye view of eyewith full eye image

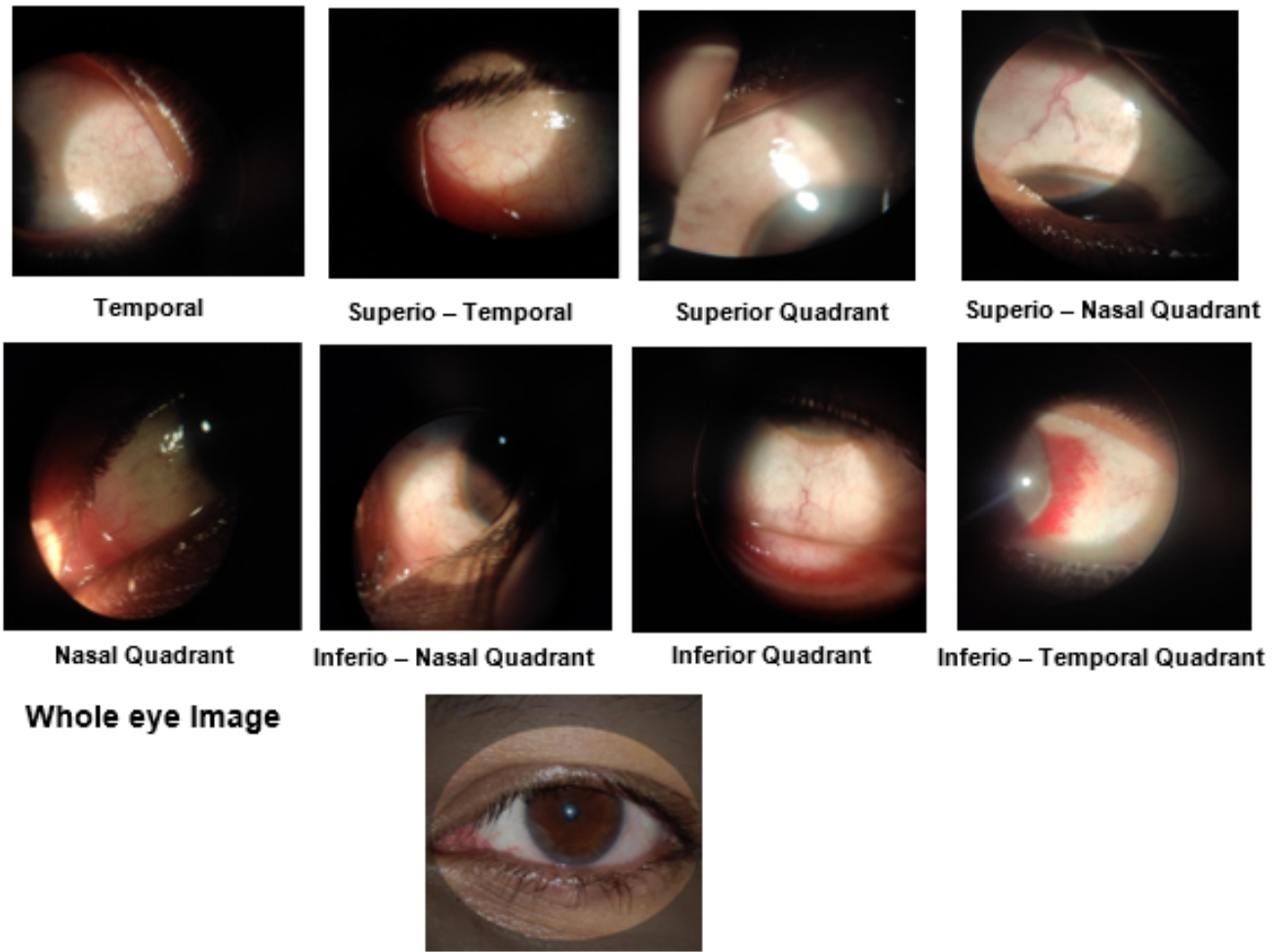


Fig. 3: Showing collage of 8 quadrants slit lamp view of eye with full eye image

A – Round Adapter

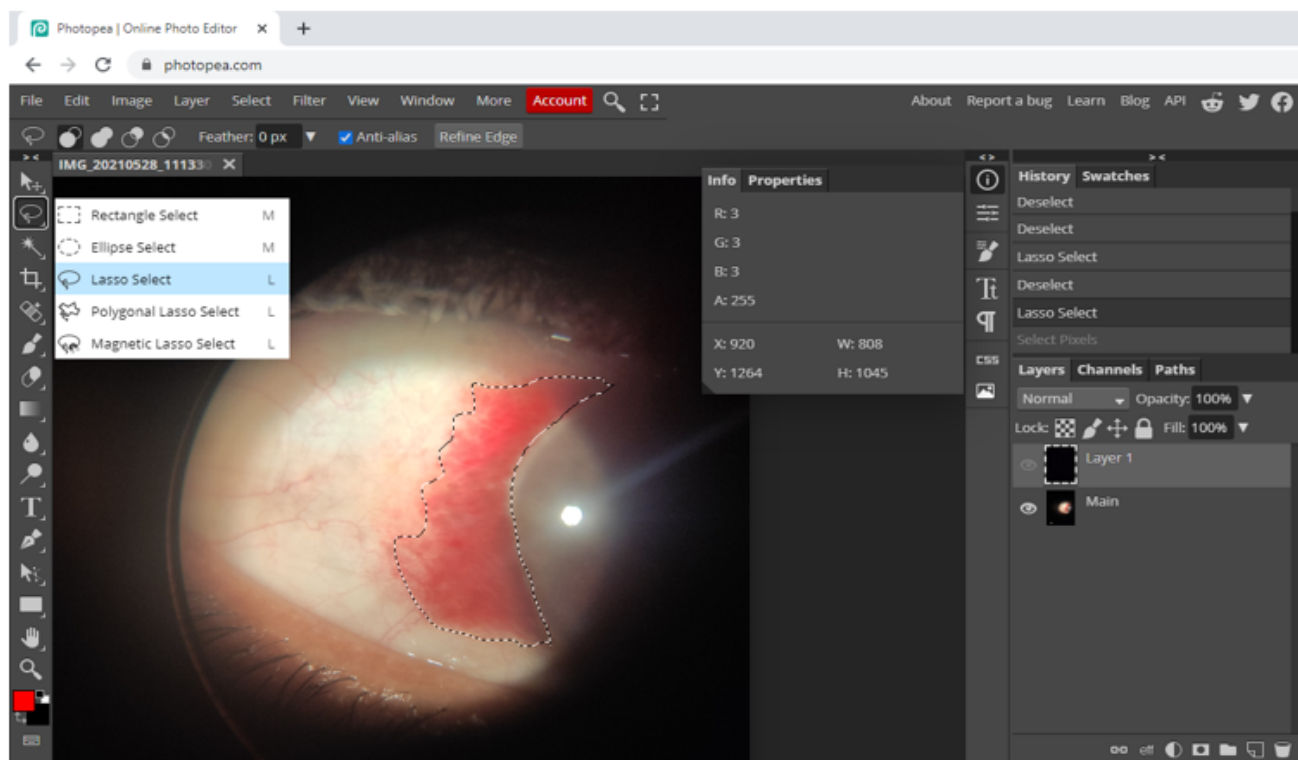
B – Hexagonal Adapter

C – Slit Lamp with Adapter



Fig. 4: Showing the telescope adaptor used in study as well as its attachment with eye piece of slit-lamp bio-microscope (available in all online shopping Platforms)





**Fig. 5:** Demonstration of Lasso selection tool in Photopea.com with selected topical eye disease i.e. Sub-conjunctival hemorrhage

various scientific tools can be developed like objective parameters in assessing the exact measurement of swellings, hemorrhages, growths, etc.

Photography is a 2D image of an object, which fails in exact depth perception and involvement of underlying tissues. But, recent advancement in photography / image development laboratories came up with highly sophisticated 3D model development tools like live photography in higher versions of iPhone helps in easy and live documentation. This might not be a feasible option for all due to higher values of such smart phones.

Since we are using slit lamp for photography, positioning of the patient, intensity of light source, distance of camera, distance of object to be captured, etc remains same in all the images which is a mandatory issue in medical photography used in researches.

Various techniques of slit lamp photography are in practice. Various commercial and trades came in practice with different models of tools for attachment with slit lamp. Few of them also applied for patents in the name of MI Ret Cam.<sup>3</sup> All of them are concentrating on imaging techniques. Here, we are working on assessment of obtained images objectively.

## 7. Scope for Further Research

Photography is 2D imaging technique which develops an important tool for surface documentation. Depth perception is missing in 2D photography. Change in colour, contrast and brightness settings masks the actual colours / pathology. These default settings differ from model to model of smart phone. Hence, before taking photography one should check the image with live presentation and do necessary settings if required. Thus, the settings fixed once to be kept unchanged throughout the course of the study / assessment.

For validation of current work 2 dissertations works are under progress.

3D live photography is not feasible for all. Hence, further research and development is required in assessment of depth perception and image processing.

After obtaining images the use of various software and artificial intelligence grading of diseases, diagnosis could be possible in future days.

## 8. Conclusion

Slit-lamp photography can be used as a standard scientific tool for exact assessment of topical eye diseases. This also helps in developing objective parameters for research in clinical studies.

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None.

## 10. Conflict of Interest

The authors declare no conflict of interest

## 11. Acknowledgement

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## References

1. Davis AJ, Anju K. How-to guide for smartphone slit-lamp imaging. *Kerala J Ophthalmol.* 2019;31(1):64–71.

2. Burran S, Rochers DD. Microscopy [Internet]. Dalton State College; 2021 [cited 2021 Jun 3]. Available from: <https://bio.libretexts.org/@go/page/24083>.
3. Lekha T, Ramesh S, Sharma A, Abinaya G. MII RetCam assisted smartphone based fundus imaging for retinopathy of prematurity. *Indian J Ophthalmol.* 2019;67(6):834–9.

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