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Abstract
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PHOTOGRAPHY OF CORNEAL CONTACT LENS

OPTIC SECTIONS AND FLUORESCEIN PATTERNS

BY

TOM AMBLER

IRVIN BOWMAN

Submitted in partial fulfillment of the requirements
for the Doctor of Optometry degree
in the College of Optometry
Pacific University
December, 1965

INTRODUCTION

The purpose of this project was to produce a set of instructional slides for use in classroom lectures on contact lenses. Emphasis has been on the use of the Slit Lamp Biomicroscope to determine the contact lens-cornea relationship. Frequent reference is made in the literature to the use of the Slit Lamp Biomicroscope in evaluating the fit of contact lenses. Many schematic drawings are being used as a means of illustration but the use of actual photographs taken through the Slit Lamp Biomicroscope has been very limited. (1) (2) (3) Shown also are variations in optic section and fluorescein patterns among habitual contact lens wearers.

PROCEDURE

Two patients who were not contact lens wearers were photographed wearing three different contact lenses. The first had a base curve paralleling the 90th meridian, the second was steeper and the third was flatter than the 90th meridian of the patient's cornea. Since the optic section cannot be produced along the 180th meridian without elaborate modification of the biomicroscope, it was considered necessary to fit the lenses in the above manner. If the patient's head were tilted 90 degrees, it was possible with some contorsion on the part of the patient to get an optic section in the 180th meridian. However, with the head in this posture the lens lagged to a new orientation on the cornea which would be either temporal or nasal depending on the angle of tilt.

The radii of the lens base curves were purposely chosen to exaggerate the steepness and flattness of the fit in order to show as clearly as possible the contact lens-cornea relationship. Data and commentary pertaining to each slide has been recorded on an information card.

The following information specifies the equipment and techniques used in photographing the optic sections and fluorescein patterns.

Biomicroscope - Gambs Photo Slit Lamp "1000" complete with Leica M1 camera.

Film - Kodak Ektachrome EH-135 (daylight) speed ASA 160, 20 or 36 exposure roll.

Development - Special development to ASA 600, processed by Charles Conklin and Sons, 4929 N.E. Fremont St., Portland, Oregon.

Filters - Kodak Series VI Wratten filter K-1, 40 mm. diameter, placed in front of biomicroscope aperture. Used for both optic sections and fluorescein patterns.

- Cobalt blue slit lamp filter which is standard equipment with the Gambs Photo Slit Lamp. This filter was used only for the fluorescein patterns and was brought into operation by the small handle on the slit lamp housing.

Fixation target - The fixation target supplied with the instrument was masked with a pinhole aperture to

facilitate precise fixation. This target was used for optic sections only. During fluorescein pattern photography the patient was asked to look into the blue light.

Remote control shutter release (pneumatic) - A pneumatic remote control unit was placed on the shutter mechanism to prevent camera movement while operating the shutter. This shutter release unit is identified as an Air-release for Still and Cine Camera, available from Sammy's House of Bargains, 735 S.W. Alder St., Portland 5, Oregon.

Slit lamp bulb - The standard instrument bulb was used for 72 exposures only. The efficiency of the bulb declines rapidly with use.

Illumination - The only illumination used was that provided by the instrument. During focusing, the lamp switch on the console was set to No. 2 position. During the actual exposure, the foot switch was pressed, which provided for maximum slit lamp illumination.

Slit lamp magnifying changer (4) - The slit lamp source can be used on either high or low magnification and is independent of the biomicroscope magnification. High magnification was used for the optic sections and low magnification was used for fluorescein patterns.

Biomicroscope magnification - Most of the photographs of optic sections and fluorescein patterns were taken using high magnification. Low magnification was also used for both with good results.

Focusing - The simple act of lowering the camera control lever on the left eyepiece to direct the image to the camera produced unwanted movement. Therefore this lever was permanently secured in the down (picture-taking) position, allowing focusing to be accomplished using the vision of the right eye. Continuous focusing was required until the time the shutter release was operated.

The best fluorescein pattern photographs were achieved by focusing on the peripheral region of the contact lens.

Preparing the Patient for Photography

A clean lens was placed on the cornea of the non-contact lens wearer 30 minutes prior to photography in order to reduce the effect of excessive tearing. The lenses of the habitual wearers were clean beforehand. Fluorescein was instilled after the patient had been familiarized with the instrument and photos were taken approximately one minute later. Preliminary focusing for the optic sections was completed during time set aside for patient familiarization. Patient comfort was essential in order to avoid movement during the exposure.

Photographic Sequence

1. Load camera with film.
2. Replace lamp bulb if over 72 exposures have been taken.
3. Secure camera operating lever in "down" position.
4. Lamp switch on No. 2 and foot switch convenient to right foot.

		Fluorescein Pattern	Optic Section
5.	Slit lamp magnification	Low	High
6.	Biomicroscope magnification	High	High
7.	Slit width	Full	Minimum
8.	Wratten K-1 filter	In place	In place
9.	Cobalt Blue lamp filter	In	Out
10.	Lamp position	0 degrees	35-40 degrees to microscope
11.	Exposure setting	¼ second	½ second
12.	Fixation	Look at blue light	Look at fixation target

13. Patient Familiarization-

"Place your chin on this rest with your forehead against the upper bar. You must keep perfectly still during the sequence. I want you to look in this direction (see No. 11). When I say, 'Ready', hold your breath. The light will brighten and you will hear the shutter click. Fluorescein will now be instilled in your eye."

14. Place right hand on instrument focusing lever and the left hand on the shutter release bulb. Focus continually until the time of exposure.
15. Tell patient to make two hard blinks, then say "Ready". Push foot switch and squeeze remote control shutter release. Release foot switch.
16. Advance film for next exposure.
17. The same procedure was used for photographing the cornea only.

DISCUSSION

Good quality slides for evaluating the optic section and fluorescein pattern of a contact lens on the cornea were produced.

A simplified procedure for photographing fluorescein patterns and corneal pathology was evolved which may readily be used. Versatility of the Gambs Photo Slit Lamp "1000" made it possible to examine the fluorescein pattern, optic section and condition of the cornea, eliminating the necessity of moving the patient or the need of the Burton light.

The problems encountered in the production of these slides which were not altogether solved are discussed below.

The Gambs Photo Slit Lamp provides adequate light for eye examination when used in the conventional manner, and would serve well in photography were it not for the small nystagmoid movements of the eye. These movements reduce the definition which could be achieved if higher illumination were available.

The several techniques employed to provide greater illumination were the use of flash attachments, external room light and supplemental black light provided by the Burton light. None of these procedures produced any noticeable improvement in picture quality. A letter was written to the Gambs factory in France requesting information as to the possibility of procuring a lamp with higher light output. The reply, copy of which is attached, was negative at this time but endeavors being made to find a solution are as indicated. (4) (5) A partial answer to the problem was found by having the film specially processed. This effectively increased its speed, thereby allowing a shorter exposure time. To ensure excellent definition an exposure time not in excess of one-fiftieth of a second is the maximum.

Focusing, being very critical for direct illumination, was further complicated when focusing monocularly for the photography. Regions of the optic sections which were removed from the exact point of focus, principally in high magnification, tended to be somewhat flared-out and lacking in detail and proportion. An aperture stop on the camera which could be reduced in size, thus allowing greater depth of focus, would be most desirable. Because of lack of control of depth of focus the optic sections were photographed by "regions", i.e., central, intermediate and peripheral. This method proved effective for the central and peripheral regions but left something to be desired when relating the intermediate section to either the central or the peripheral regions.

The problems of focusing and insufficient illumination precluded the production of pictures with such definition that distinction could be made within a narrow dioptric range as to degree of flattness or steepness of contact lens fit as seen in optic section. However, the fluorescein pattern photographs and the pictures of corneal pathology taken with diffuse illumination were satisfactory.

CONCLUSIONS

The Gambs Photo Slit Lamp "1000" is a versatile instrument in evaluating the contact lens/cornea relationship and corneal pathology. Optic section photographs are suitable for instructional purposes, though not of such definition that fine distinction of lens fit can be made. Fluorescein pattern photographs and pictures of corneal pathology were satisfactory for instructional purposes and for the patient's permanent record.

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Ocular Products inc
1314 HOWELL STREET · SEATTLE, WASHINGTON 98101 ◉ MA 3-1651

July 22, 1965

Mr. Irvin Bowman
University Apartment G-3
Forest Grove, Oregon 97116

Dear Mr. Bowman;

Thank you for your letter regarding the photographic attachment of the Gambs Slit Lamp.

Your interest in attempting to photograph a slit with the Gambs Slit Lamp is rather a complicated subject. First of all, the slit lamp operates under the Tyndall theory, with the result that any extemporaneous light will destroy the resolution through the cornea. The amount of light required to produce good resolution of the section is quite minimal and is practically impossible to photograph. The result being, that only a long exposure would accomplish this on film and to date, I have really not seen one that I would call a good picture. We have, however, accomplished this with the black and white Polaroid film but remember that the film speed rating is at 3000, whereas your Kodachrome is at 150. We were able to see the various sections through the cornea with this type of film, however, if you are planning this for projection, the only way that you could accomplish this would be by rephotographing the Polaroid film for your projection purposes. I wish that I had a better solution to your problem, however, this has been attempted on many occasions by various other people and the results of the photographs have been anything but what you would actually see in the slit lamp. We are still working on this particular problem, as we have been able to do about anything else except this to our satisfaction. In the event that we come up with a solution in the next month or two, I'll be more than happy to submit whatever information we have been able to obtain. Should you require any further information, plea se do not hesitate to call on us.

Sincerely yours,

OCULAR PRODUCTS, INC.

Chas E Erickson

Chas. E. Erickson
President

CEE:scs

APPAREILS D'OPHTALMOLOGIE

GAMBS

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LYON, LE Ier septembre I965

Dear Sir,

I have been very pleased to know that you are using our Photo Slit lamp I000 for research purpose.

In an instrument like a slit lamp (which is optically similar to a fixed or movie view projector), when the design of the optical system and more particularely of the condenser lens, has been made right, the full power (watts) of the lamp in itself does not matter on the luminosity of the image. The only important thing is the brightness or specific intensity of the light source. (see H. Chretien "Calcul des combinaisons optiques" p.366), and more particularely in slit lamps, because the necessary depth of field makes the use of a wider objective lens inadmissible. As far as incandescent lamps are concerned, the far best was the tungsten ribbon type; but they are no more manufactured. Among the filament type, the Osram flat filament type which is used in our slit lamp is far the brightest of all the types we have tried. Brightness is as following :

1000 candles / cm² ≈ 1000 lumens per square cm

Switch on	I (5v).	Brightness ≠	I000 stilbs
"	2 (6v).	" ≠	I500 stilbs
"	3 (7,5v).	" ≠	3000 stilbs
photo Switch	(9v).	" ≠	5300 stilbs

But, if a flash light is incorporated in the same place like the filament of the conventional bulb, it will be able to deliver the same energy (integration brightness x time) in I/500 sec instead of I sec, and with additional side effects (more effective Tyndall effect because of shortness of waves) which are favourable.

../..

JOE B. GOLDBERG, O. D. F. A. A. O.
4700 COLLEY AVENUE
NORFOLK, VA. 23508

PHONE 622-6301

Mr. Irwin Bowman
University Apartment G-3
Forest Grove, Oregon 97116

July 20, 1965

Dear Mr. Bowman:

I have found it extremely difficult to photograph good quality optical sections of the eye using the biomicroscope. The Gambs 1000 slit-lamp model and its photographic system is fairly new to me. I am experimenting with it currently and early information leads me to believe that the illumination system is unsatisfactory to provide for a good clear optical section of the cornea such as you would like to have.

The only good corneal optical section using a narrow slit is one of the transparencies taken by the late Bernard Mazow. I believe Mazow used an electronic flash to furnish the illumination. Whereas the Gambs system is effective for observing and photographing ocular pathology, the illumination system is excellent for superficial corneal lesions to be seen when photographed but very difficult to photograph any degree or quality of penetration into the corneal epithelium.

It is quite possible that the Gambs system would be better if used with an electronic flash system instead of the incandescent illumination.

I have been slightly disappointed with the results of the Gambs 1000 model whereas my photography over the past three years using the Gambs No. 850 model and the photo attachment has been excellent.

If you have further difficulty, it is suggested that you contact Mr. Charles Ericksen, Ocular Products, Inc., 1314 Howell Street, Seattle, Washington.

I would like to see representative samples of what you have accomplished with the photography system of the Gambs 1000 and will send some slides to you of mine under separate cover.

If I can be of further assistance, kindly let me know.

Sincerely yours,

Joe B. Goldberg, O.D. F.A.A.O.
JBG/la

GAMBS
LYON

The location of flash in slit lamp is possible in three different ways :

I/ Optically, by forming images of filament and flash in the same place (semi-reflecting or movable mirror), or one on the other (intermediary condenser); this, however makes the optical system of the slit lamp complex, cunbersome and expansive.

Two other ways are possible, which make the flash unit available as a separable attachment, and does not interfere with the conventional uses of the slit lamp :

2/ Mechanical location of the flash in the right place, and the filament very close. We are trying this way; manufacturing of combinated bulb is however very delicate.

3/ Locate in the right place the flash; no filament, but feeding of the flash

- as a strobe light for examination
- as a flash for shooting of picture.

We are starting some trials in this way.

Doctor D. Donaldson has made fundus photography by this way, and reported it in Transactions of American Ophthalmological Society, vol 62, p. 429-458, 1964. Unfortunately, we have not this paper. Can you get a copy and send it us ? or possibly could you get us in touch with Doctor Donaldson ?

Thanking you in advance, we remain

Very truly yours.

GAMBS S.A
Le Président Directeur Général

Paul GAMBS