A clinical study in the fitting of the Soflens

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A CLINICAL STUDY IN THE FITTING OF THE SPLIT LENS

Presented to the Faculty of
Pacific University
College of Optometry
in partial fulfillment
of the requirements for the degree
Doctor of Optometry

By
Richard W. Baumann and Arnold Skolnik

April 21, 1972
The authors of this study wish to express their appreciation for the assistance received from the following people:

Don C. West, O.D. under whose direction this study was conducted.

John R. Gerke, PhD and Robert Buffington for the bacteriological evaluation.

Lynne Martin, the staff photographer.
Introduction:

The Bausch and Lomb Soflens is one of the first flexible hydrophilic lenses being fitted and the first flexible lens to be fit at Pacific University College of Optometry. Since flexible lenses had not been previously fitted at this college, the following study was designed in order to determine a clinically useful fitting technique so that the sof lenses could be incorporated into the general contact lens fitting program. The following report details a study involving the fitting of twelve patients with the sof lenses and careful and frequent clinical evaluation of both the optical performance of the sof lenses and the physiological compatibility with the eye. The discussion includes recommended screening and fitting evaluation procedures, and a report on both objective and subjective symptoms experienced at various times during the initial wearing schedule.
Procedure:
Subject Selection

The patients for this study were volunteers from the 3rd & 4th year optometry classes. Sixteen volunteers were screened and twelve accepted as potential soft lens wearers. Each prospective lens wearer was given a complete analytical examination. Also, peripheral keratometry using the Jessop's disc, slit lamp biomicroscopy, measurements of corneal, pupil, and fissure widths and heights, blink rate, and tear flow (Schirmer's test) were performed on each patient. The final group of patients chosen to wear the soft lens were under 26 years old and had adequate visual functions.

It was felt that peripheral keratometry was necessary in order to try to evaluate the reasons for the final lens positions on the corneas as well as aid in determining a lens of first approximation. Physical measurements of the corneal, pupil, and fissure dimensions were taken to provide information as to the possible difficulty of insertion and removal and whether the pupil size would be a significant limitation.

Each prospective lens wearer was screened according to the following criteria:

1. Refractive errors between -0.50D and -6.00D.
2. Convergence and Accommodation Ranges and Amplitudes.
3. With the rule astigmatism with K-reading being no flatter than 42.00D and having no more than 1.50 astigmatism.
4. Had not worn hard contact lenses for at least two months and preferably had never worn hard lenses.
5. Judgement by the clinicians in charge as to the reliability of the lens wearers. This estimation had to be made in order to determine whether the rigid schedule and demands would be followed by the patient.

The above criteria are slightly more restrictive than the initial screening criteria published by Baush & Lomb. This was done in hopes of obtaining a higher success ratio.

Lens Selection:

Having completed the screening, the prospective lens wearers were chosen on the basis of the patients who met the greatest number of screening criteria. The lens of first approximation was determined by the following procedures:

1. F-series lens (front surface curve of 43.75D) was chosen for patients with flattest central K-readings of 44.75D or less.
2. N-series lens (front surface curve of 46.75D) was chosen for patients with flattest central K-readings of 44.75D or greater.
3. Power was chosen to be equivalent to the spherical part of the refraction.

Baush & Lomb recommend choosing a power equal to the spherical equivalent, however, it was found that this power usually over minus the patient.

The lenses were placed on the patients' corneas and worn for one half hour. At the end of this time period, acuity and centering was determined. If the lens was not centered, the base curve series was changed, and the patient again allowed to wear the lens for one half hour. After the base curve series which produced the
best centering was determined, a spherical refraction was done while the patient was wearing the lens. If a change in powers would increase acuity, the power of the lens was changed. The lens power and base curve series determined by this method was the lens initially dispensed to the patient.

On each dispensing day, three to four individuals would be instructed on insertion, removal, cleaning, and asepticizing techniques. Two techniques of insertion were used. The first was the one recommended by the sofLens developer Baush & Lomb. The instructions were:

**Lens Placement:**
Wash hands thoroughly, making certain that all soap residue has been washed away. Work with the right lens first in order to avoid confusing the lenses. After removing the lens from the case, examine it to be sure that it is moist, clean, and clear. Be careful not to touch the inside surface of the lens. Then check to see that the lens has not been turned inside-out. This may be done simply by flexing the lens between the thumb and index finger. If, upon flexing, the edge is erect and pointing slightly inward, it is in its correct position. If the edge turns outward, folding back on the fingers, it is inside-out and must be reversed.

1. Place the lens on the outer edge of the index finger of your dominant hand.
2. With your head erect and gazing straight ahead, retract the lower lid with your middle finger.

3. Look up and fix your gaze on a point above you. Then roll the lens onto the white part of the eye.

4. Remove your index finger and slowly release the lid.

5. Close your eyes momentarily and lightly massage the lids to help center the lens.

The other technique used for insertion was the direct placement of the lens on the cornea. Having placed the lens on the cornea, the patient was then told to blink deeply several times to remove any air bubbles under the lens and to help center the lens. Both techniques were found to be satisfactory. The removal instructions were exactly those stated by Baush & Lomb.

Lens Removal:

1. Never probe about on the eye in search of a lens. Always be sure the lens is in the correct position on your eye before attempting to remove it. A simple check of your vision with each eye separately will tell if a lens is in the correct position. If vision is poor, yet you feel certain that the lens is still in your eye, you should obtain professional assistance for removal of the lens.

2. Having washed your hands and rinsed them thoroughly, begin the removal procedure by holding your head erect and turning your eyes upward. Retract the lower lid with the middle finger and place the index fingertip on the lower edge of the lens. Slide the lens down to the white part of the eye.

3. Compress the lens lightly between the thumb and index finger. Rolling the thumb and index finger together causes the lens to double up between the fingers, allowing air underneath. Remove the lens from the eye.

4. Clean the lens with normal saline solution and replace it on the cap of the carrying case.
The cleaning technique was also the same technique published by Baush & Lomb. The lens, after removal, was thoroughly wetted with normal saline and placed in the palm of the hand. The lens was then rubbed with the fingertip in the palm. The other surface was cleaned by holding the lens between the thumb and index finger while rubbing. If the lens became very dirty, it was suggested that the lens be immersed in hot water for a few seconds prior to cleaning. If this was done, the patient was instructed to soak the lens for an hour in the saline solution or to asepticize the lens before reinserting the lens.

Asepticizing was accomplished by putting the lens in the carrying case which was then placed in boiling water for not less than fifteen minutes. The asepticizing units were only used by members of the Pathology department of Pacific University. Their results on the sterilization study were as follows:

For a period of seven weeks, the Baush & Lomb asepticizer unit was tested for efficacy of asepticizing the soft lens. When following the recommended procedure, this consisted of mechanically rubbing the lens with saline, asepticizing and letting cool overnight and then sampling the saline within the carrying case. The sample was subjected to two procedures: (1) 1cc of saline was added to 10cc of thyoglycolate broth and (2) 0.2cc of saline was spread on tryptian soy agar plates. Both were incubated for 24 hours. These
procedures were done in duplicate to all samples. A total of thirty-three samples were taken from a total of five subjects. The sampling period for these subjects ranged from five days to seven weeks. No living bacteria were detected. It was concluded that the Baush & Lomb asepticizer unit was effective in preventing microbial growth in the saline in which the lenses were immersed overnight. It is important to note that at no time was any test carried out on the lens itself.

The wearing schedule was started on the dispensing day, usually a Monday. A slight modification of the Baush & Lomb wearing schedule was made to allow the patient to be seen earlier in the evening for their progress evaluation. The wearing schedule was as follows:

<table>
<thead>
<tr>
<th>Mon.</th>
<th>on by 9am</th>
<th>off 12n check</th>
<th>off 4pm check</th>
<th>off 8pm check and fluorescein check</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>on 1pm</td>
<td></td>
<td>on 5pm</td>
<td>9 hrs.</td>
</tr>
<tr>
<td>Tue.</td>
<td>on by 9am</td>
<td>off 12n</td>
<td>off 4pm</td>
<td>off 8pm</td>
</tr>
<tr>
<td></td>
<td>on 1pm</td>
<td></td>
<td>on 5pm</td>
<td>9 hrs.</td>
</tr>
<tr>
<td>Wed.</td>
<td>on by 8am</td>
<td>off 12n</td>
<td>off 5pm</td>
<td>off 9pm check and fluorescein check</td>
</tr>
<tr>
<td></td>
<td>on 1pm</td>
<td></td>
<td>on 6pm</td>
<td>11 hrs.</td>
</tr>
<tr>
<td>Thu.</td>
<td>on by 8am</td>
<td>off 12n</td>
<td>off 5pm</td>
<td>off 9pm</td>
</tr>
<tr>
<td></td>
<td>on 1pm</td>
<td></td>
<td>on 6pm</td>
<td>11 hrs.</td>
</tr>
<tr>
<td>Fri.</td>
<td>on by 8am</td>
<td>off 3pm</td>
<td>off 5pm</td>
<td>off 9pm check and fluorescein check</td>
</tr>
<tr>
<td></td>
<td>on 4pm</td>
<td></td>
<td></td>
<td>12 hrs.</td>
</tr>
<tr>
<td>Sat.</td>
<td>6-1-6-1-max of 4</td>
<td></td>
<td></td>
<td>no check</td>
</tr>
<tr>
<td>Sun.</td>
<td>8-1-8</td>
<td></td>
<td></td>
<td>no check</td>
</tr>
</tbody>
</table>

...
Mon. on by 8am off 4pm on 5pm
off 9pm check 12 hrs.
and fluorescein check

Tue. on by 8am off 4pm on 5pm
off 9pm 12 hrs.

Wed. on by 8am
off 8pm check 12 hrs.
and fluorescein check

Thu. on by 8am
off 8pm 12 hrs.

Fri. on by 8am
off 9pm check 13 hrs.
and fluorescein check

The progress evaluation was the standard hard lens evaluation used at Pacific University School of Optometry. The wearing time and subjective symptoms were first recorded followed by objective findings, acuities, sphero-cylinder refraction, keratometry and slit lamp evaluation. Only at the end of each day's wearing time was fluorescein used for identification of any tissue damage. Corneal photography was also used in the progress evaluation to keep a permanent record of any anomalies and for general records of the patients. The photography technique was developed primarily for this study using the Nikon slit lamp and will be covered later in the appendix.

Results:

The patients fitted with the sofLens fell into three groups:

1. those who could not wear the lens due to poor acuity,
2. those who could not wear the lens due to corneal damage and

3. those who could successfully wear the lens.

The sof lens is made with a rather small OZD (5.6-7 pm) compared to the over-all size of the lens (approx. 13 mm). Therefore, if the lens does not center properly, the OZD will not cover the entire pupil, and aberrations induced by the secondary curves will be apparent. These aberrations take the form of extreme flare, reduced acuity, or monocular diplopia. Since the OZD is small, decentration of the lens by as little as 2 mm will cause the distortions described. Almost all the patients who could not wear the lens because of reduced acuity were patients on whom the lens did not center well. These patients were looking through the peripheral portions of the lens and quickly gave up wearing the lens. Although attempts were made to center the lens by changing both base curve series and power, this proved unsuccessful. If the lens was centered by physically centering the lens with the fingers or by having the patient blink several times in rapid succession, the acuity would be restored to normal levels. Some of these patients complained of fluctuating acuity. It was found that this was due to the lens being moved on and off center during blinking or versinal movements of the eyes. All three of the patients who experienced centering problems had similar corneal topography. Peripheral keratometry showed that there was little
or not inferior corneal flattening by the third dot (Jesop's disc) and one patient showed slight inferior corneal steepening by the third dot. All patients showed one-two diopters superior corneal flattening by the third dot. Two of the patients also showed slightly more (approx. .50D) corneal flattening on the temporal side than the nasal side. On all these patients, the lenses positioned approximately 2mm superior and slightly temporally. Thus, it would seem that the lens positions over the flatter part of the cornea when this type of topography exists. Although the steeper base curve series did position slightly better than the flatter base curve series, the distortions induced by the periphery of the lens and thus, the reduced acuity (20/30 - 20/25) prevented the patients from becoming successful softlens wearers.

The second group consisted of three patients who had actual corneal damage from the lens. All three had the same type of corneal damage which appeared as dye retention around part of the periphery of the cornea. When viewed with the slit lamp biomicroscope, the damage appeared as if an arc shaped scratch had been made around part of the corneal periphery with a very sharp, fine needle. The depth of the damage was usually halfway through the epithelium and the eye was injected and the patient complained of discomfort. All three of these patients also had centering problems. Their corneal topography was similar to the "group one" topography, and all the lenses on
patients positioned superiorally and slightly temporally for some and slightly nasally for others. In all cases, part of the peripheral curve and edge of the lens was positioned one-three mm from the limbus and thus, was actually riding on the cornea. The lens was off center only enough so that 60-90 degrees of the cornea was covered by the actual lens edge. The remainder of the lens edge was positioned over or beyond the limbus. In all cases, the area of the cornea which was damaged was the area of the cornea under the edge of the lens and, in fact, the damaged area appeared as a near perfect outline of the edge of the lens. The damage almost appeared as if the edge of the lens had imprinted itself in the corneal epithelium, since the borders of the damage were extremely sharp and exactly followed the contour of the lens edge. No other dye retention appeared on these patients, just the arcuate staining under the lens edge. The damage was superficial and entirely disappeared within one-two days. After the epithelium healed, two of these patients resumed wearing the lenses, and once more experienced the same type of corneal damage. Following this second experience, these patients also discontinued wearing the sofLens.

The mechanism by which this damage occurred seemed to be a combination of both mechanical pressure on the cornea by the edge of the lens and an interference of the corneal metabolism under the edge of the lens due to sealing off of tear flow.
The damage appeared in all the patients after only 3-6 hours of wear on the first day of wear. Changing base curve series on the patients who continued wear after epithelial healing had no effect on the problem since the different base curve series lens centered in the same relative position as the previous lens. Keratometric readings were taken on all these patients while the sof lens was on the eye, and it was found that the front surface curve of the lens had flattened (from the manufacturer's value) almost the same amount as the difference between the back surface of the lens and the front surface curve of the cornea. The lens is, therefore, attempting to assume the curvature of the cornea and it is not unlikely that the natural resiliency of the lens produces a pressure on the cornea under the edge of the lens which results in the damage described.

Six of the twelve patients fit with the sof lens became successful lens wearers. Table 1 gives some indication of the type of patient successfully fit and the type of lenses used. As can be seen, a fairly good range of corneal curvatures and refractive errors were fit. However, most of the patients in this group had rather flat front surfaces corneal curvatures (41-42D). These patients were not chosen because of the flat K readings, but all the patients were volunteers and there was a large percentage of patients with flat K readings in all three groups. Again, the corneal topography of these patients
<table>
<thead>
<tr>
<th>SUBJECT NUMBER</th>
<th>SPHERICAL REFRACTIVE ERROR WITHOUT LENS</th>
<th>SUBJECTIVE CYLINDER</th>
<th>CORNEAL CORRECTING CYLINDER</th>
<th>INITIAL CENTRAL K READING</th>
<th>SOPLENS POWER &amp; SERIES</th>
<th>ACUITY THROUGH SOPLENS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>-2.00 OD/ -1.00 OS</td>
<td>-0.25x10 OD/ zero OS</td>
<td>-0.75x180 OD/ zero OS</td>
<td>44.75/45.25 OD/ 87@87</td>
<td>-1.75N OD/ -0.75N OS</td>
<td>20/15 OD/ 20/15 OS</td>
</tr>
<tr>
<td>2</td>
<td>-3.25 OD/ -3.25 OS</td>
<td>-0.75x120 OD/ -1.00x85 OS</td>
<td>-0.12x90 OD/ -0.62x90 OS</td>
<td>44.50/44.37@90 OD/ 44.50/43.87@90 OS</td>
<td>-3.50F OD/ -3.50F OS</td>
<td>20/15 OD/ 20/15 OS</td>
</tr>
<tr>
<td>3</td>
<td>-3.00 OD/ -2.00 OS</td>
<td>zero OD/ -0.75x105 OS</td>
<td>-0.37x180 OD/ -0.25x180 OS</td>
<td>41.62/41.87@90 OD/ 41.25/41.50@90 OS</td>
<td>-3.00N OD/ -2.50N OS</td>
<td>20/20 OD/ 20/20 OS</td>
</tr>
<tr>
<td>4</td>
<td>-1.50 OD/ -0.50 OS</td>
<td>zero OD/ -0.25x180 OS</td>
<td>-0.25x180 OD/ -0.50x180 OS</td>
<td>43.50/43.75@90 OD/ 43.50/44.00@90 OS</td>
<td>-1.50N OD/ -0.50N OS</td>
<td>20/15 OD/ 20/20 OS</td>
</tr>
<tr>
<td>5</td>
<td>-3.75 OD/ -3.75 OS</td>
<td>-0.25x175 OD/ -0.25x5 OS</td>
<td>-0.37x180 OD/ -0.62x180 OS</td>
<td>41.50/41.87@90 OD/ 41.37/42.00@90 OS</td>
<td>-3.75N OD/ -3.50N OS</td>
<td>20/20 OD/ 20/20 OS</td>
</tr>
<tr>
<td>6</td>
<td>-1.00 OD/ -1.50 OS</td>
<td>-0.50x175 OD/ -1.00x5 OS</td>
<td>-0.75x180 OD/ -1.00x180 OS</td>
<td>41.12/41.87@90 OD/ 41.00/42.00@90 OS</td>
<td>-1.25N OD/ -1.00N OS</td>
<td>20/15 OD/ 20/15 OS</td>
</tr>
</tbody>
</table>
were similar. They all had 1-1.5D inferior flattening by the third dot and similar corneal flattening in the temporal, nasal, and superior areas of the cornea. As with all the patients, these patients were fit with the lens of first approximation, and subsequent changes were made to improve centering and acuity. Four of the six patients required changes in base curve series in order to bring the acuities to 20/20. As with all the successful wearers, the acuity in both eyes was at least 20/20 at the time of the close out examination.

The adaptive symptoms experienced by these patients were similar to those experienced by conventional hard lens wearers, except greatly reduced in magnitude and duration. All but two of these patients had worn hard lenses at one time (none within six months prior to being fit with the sof lens) and comfort seemed to be one of the big advantages of the sof lens. Even the two patients who had never worn hard lenses remarked that 30 minutes after the initial dispensing, the lenses felt comfortable and that they were hardly aware of any wearing sensation. Table #2 gives some indication of the type of subjective reports that were received after each interval of wear for the first three days. After three days of wear, almost all subjective complaints disappeared, and universal satisfaction was reported by all the patients.

Objective symptoms were also similar to those seen on hard lens wearers, but these symptoms were again greatly reduced in
<table>
<thead>
<tr>
<th>Days of Wear</th>
<th>Maximum Hours of Wear Per Day</th>
<th>Subjective Sensations</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
<td>Fluctuating acuity</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Flare</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Feeling of slight</td>
</tr>
<tr>
<td></td>
<td></td>
<td>irritation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Feeling of slight</td>
</tr>
<tr>
<td></td>
<td></td>
<td>hotness and dryness</td>
</tr>
<tr>
<td>3</td>
<td>6</td>
<td>Same as Above</td>
</tr>
<tr>
<td>9</td>
<td></td>
<td>Same as Above</td>
</tr>
<tr>
<td>5</td>
<td>12</td>
<td>Same as Above</td>
</tr>
<tr>
<td>7</td>
<td>14</td>
<td>Fluctuating acuity</td>
</tr>
<tr>
<td>9</td>
<td>14</td>
<td>Feeling of slight</td>
</tr>
<tr>
<td></td>
<td></td>
<td>irritation</td>
</tr>
</tbody>
</table>
both magnitude and duration. As seen in graph #A, the average change in K readings was very small, and there was no incidence of change in corneal K readings above 1.00D. Very slight corneal edema was observed during the first day of wear on four of the patients, but no corneal edema was visible by the second or third day of wear. Also, no keratometer mire distortion was observed on any of these patients and no spectacle blur reported by any of the patients. The major complaint reported by these patients was slight fluctuating acuity during the first several days of wear and a slight feeling of dryness. By the end of the two week wearing schedule, the final lenses centered very well and there was less than 1mm blink or excursion lag. These patients were very well satisfied with the overall performance of the softlens and felt it provided both sufficient comfort and acuity to enable long term, full time wear.

Recommendations:

A fifty percent successful full time wear ratio was obtained in this study. The fitting and screening techniques outlined earlier were used throughout the entire study. About halfway through the screening, however, patients were no longer eliminated on the basis of the initial criteria. If the corneal readings did not fall within the limits set, fit was still attempted. In many cases, the patient was successfully fit. It does not appear, therefore, that prospective patients should
be refused solely on the basis of the corneal K readings but that an attempt should be made to fit these patients. If either base curve series centers well, and good initial acuity is achieved, then wearing time build up can be started. If good centering and acuity cannot be achieved after one half hour wearing time of the first lens, and changing base curve series does little to improve the centering and acuity, it is unlikely that the person will become a successful wearer.

The following screening and fitting procedure is recommended:

1. A standard examination should be performed. This should include peripheral keratometry and the other standard procedures used for examining prospective hard lens wearers. If no contraindications such as extremely high corneal or subjective cylinder, refractive power outside the range of available lens powers, or negative slit-lamp examination is found, the following fitting procedure may begin.

2. Fit lens of first approximation as outlined earlier.

3. Have patient wear lens for one half hour to allow excess tearing to subside and lens to center.

4. Check for centering and subjective report of flare or blur.

5. If lens is not centered after one half hour, change to the other base curve series and again allow one half hour wearing time before proceeding. If, at the end of this time, the lens is still not centered and there is still subjective reports of flare and blur, it is unlikely that this patient can be successfully fit.

6. Once the lens has centered, spherically refract through the lens. If a change in spherical power will improve acuity, change lens power, but not base curve series.

7. Re-refract through new lens to be sure it is an optimum power.
8. Dispense lenses early in the morning and check for corneal damage, edema, and K readings change at the end of three, six, and nine hours wear.

9. Check for dye retention at last check of first day.

10. Continue increasing wearing time according to schedule if all checks are negative. Check patient two times a week until full time wear is obtained.

The insertion and removal technique outlined by Baush & Lomb seems, at first, awkward and hard for a patient to master. However, in our study the technique worked well and the patients quickly learned the proper method of insertion, removal, and lens care. Several of the patients found that boiling the lenses was an inconvenience. However, the initial wearing schedule was easily followed. The procedures outlined by Baush & Lomb for insertion and removal, cleaning and handling of the lenses, and wearing schedule were all satisfactory to the patients and allowed building to full time wear with little difficulty.

Conclusion:

The Baush & Lomb sof lens provides greater comfort than the conventional hard lenses and in 50% of our cases, equivalent acuity to the conventional hard lenses. There appears to be no reason why the sof lens could not be the lens of first choice on the patients that can wear this lens. The procedure discussed for determining whether a patient can probably wear
the lens is a rather simple procedure and involves little clinical time. The same type of examinations, patient education, and precautions should be taken with prospective soflens patients as with prospective hard lens patients.

Besides almost immediate comfort, the soflens has one real advantage over the hard lens, and that is part time or erratic wear. This lens can be worn for 9 hours (3-1-3-1-3) the first day it is ever worn. This means that the lenses can be kept without building up any wearing time, and worn for a relatively long period of time to engage in such activities as skiing, other sports, or social engagements with almost immediate comfort and no spectacle blur upon removing the lenses. This part time wear feature makes the soflens a valuable visual aid for many types of patients.

In summary, the soflens was found to have a low success ratio compared to the hard lens, but performed well on the patients that could wear the lens. It must be remembered, however, that this study was limited to six weeks and thus, the long term wearing effects could not be investigated. The soflens is most likely only the first of a series of hydrophilic lens that will, in all probability, almost entirely replace the hard lens.
APPENDIX 1

A slit lamp biomicroscope photographic technique was developed using the Nikon Slit Lamp and camera. At the end of each day's wear, all the patients involved in the softlens study were examined under the Nikon Biomicroscope for any insult to the cornea and/or conjunctival regions. Any anomaly found was photographed using one of the standard slit lamp illuminations. The illuminations, magnifications, filters, and shutter speeds may be found in the table which follows labeled Nikon Slit Lamp Photography.

The pictures taken were of excellent quality. Those photographs which were taken are available at Pacific University School of Optometry. Some of the slides which display unusually clear detail are:

A. Slide #34 of roll #1 has very distinct stippling (optic block illumination).

B. Slides 2A Feb. '72, 3A Feb. '72, Roll 2 slide #5, Roll 3 slides #9 and #10 display decentration of the softlens when excursions are made by the eyes. This decentration mentioned earlier was believed to be one of the causes for flare and the inability to maintain constant clear vision both at near and far.

C. Roll 1 slide #31 as well as roll 3 slides #20 and #26 show excellent detail of vascularization both limbal and bulbar.

* Slides are available at the LRC, Pacific University School of Optometry.
# Nikon Slit Lamp Photography

**High Speed Ektachrome Tungsten 3200°K**

## Table 1

<table>
<thead>
<tr>
<th>Subject</th>
<th>Type of Illumination</th>
<th>Magnification</th>
<th>Light Intensity</th>
<th>Light Angle</th>
<th>Type of Filter</th>
<th>Shutter Speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cornea</td>
<td>diffuse</td>
<td>10 X</td>
<td>8</td>
<td>10°</td>
<td>full diffusing</td>
<td>1/15</td>
</tr>
<tr>
<td>Cornea</td>
<td>diffuse</td>
<td>16 - 25 X</td>
<td>8</td>
<td>10°</td>
<td>full diffusing</td>
<td>1/8</td>
</tr>
<tr>
<td>Cornea</td>
<td>optic section</td>
<td>16 - 25 X</td>
<td>8</td>
<td>60°</td>
<td>partial diffusing</td>
<td>1</td>
</tr>
<tr>
<td>Cornea</td>
<td>sclerotic scatter</td>
<td>16 X</td>
<td>8</td>
<td>—</td>
<td>partial diffusing</td>
<td>1/2</td>
</tr>
<tr>
<td>Sclera</td>
<td>diffuse</td>
<td>10 X</td>
<td>7</td>
<td>10°</td>
<td>full diffusing</td>
<td>1/15</td>
</tr>
<tr>
<td>Sclera</td>
<td>diffuse</td>
<td>16 - 25 X</td>
<td>7</td>
<td>10°</td>
<td>full diffusing</td>
<td>1/8</td>
</tr>
<tr>
<td>Fornix</td>
<td>diffuse</td>
<td>10 X</td>
<td>7</td>
<td>10°</td>
<td>full diffusing</td>
<td>1/15</td>
</tr>
<tr>
<td>Crystalline lens</td>
<td>optic section</td>
<td>16 X</td>
<td>8</td>
<td>60°</td>
<td>none</td>
<td>1</td>
</tr>
<tr>
<td>Fluorescein patterns</td>
<td>diffuse</td>
<td>16 X</td>
<td>8</td>
<td>10°</td>
<td>cobalt blue</td>
<td>1</td>
</tr>
</tbody>
</table>

ASA 125 developed @ 320 ASA

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*angle with visual axis*
PICTURE TAKING USING THE NIKON ZOOM SLIT LAMP MICROSCOPE WITHOUT THE ELECTRONIC FLASH ATTACHMENT

A simple and practical technique has been devised to take high quality 35mm color slides through the Nikon slit lamp and camera (Nikon Nikkormat or Nikon F) using only the internal illumination of the slit lamp.

The technique was devised after the failure of two Nikon electronic flash attachments normally used in producing color slides with the slit lamp. It was found that clinically useful pictures can be taken without the added cost of the flash unit and without the necessity of adjusting an auxiliary piece of equipment.

Table #1 shows the various camera and slit lamp settings for photographing different parts of the eye using different types of slit lamp illumination. In the table, light intensity refers to the calibrated markings on the slit lamp voltage output dial. It was found that under diffuse illumination conditions, the angle between the light source and the microscope head should be as close to zero as possible without obstructing the field of view. This eliminates shadows and uneven light intensity across the field. A ten degree angle between the slit lamp light source and microscope head was found to be suitable for most of the diffuse illuminated pictures.

A special filter is available through Nikon (background illumination filter) which replaces the regular filter slide when taking pictures. This special filter consists of two partial diffusers. The wider of the two partial diffusers was found to work well for the
optic section and sclerotic scatter illuminations. If this filter
is not used, only that portion of the eye which is in the direct path
of the optical section beam will be illuminated, and the rest of the
picture will appear black. With this filter in place, a small amount
of light from the optical section beam is diffused over the entire
field of view providing a picture which has a well-illuminated optical
section with adjacent areas also visible.

In order to obtain high quality diffuse illuminated pictures
which contain no bright spots or shadows, the narrower of the two
partial diffusing filters was replaced with a full diffusing filter.
The full diffuser was obtained simply by having a local ophthalmic
laboratory frost a piece of glass to the same density as the frosted
area of the partial diffuser, and cut the frosted glass to fit the
circular aperture of the filter plate. The retaining ring which holds
the narrow, partial diffuser in the filter plate was removed, and
the full diffuser merely substituted for the partial diffuser. The
full diffusing filter provides a very large field of even illumination.
It may be necessary to alter slightly the angles between the slit
lamp light source, microscope head, and visual axis of the subject to
eliminate reflections from the anterior surface of the cornea.

Excellent color reproduction was obtained using Kodak high-speed
Ektachrome tungsten (3200° K) 35mm slide film, ASA 125 (developed at
ASA 320). All alignment and focusing of the camera and slit lamp
can be done at low levels of light intensity. The light intensity
need only be increased to the higher levels for an instant while the
picture is being taken, and then returned to the lower level. This
allows for maximum patient comfort. The same camera and slit lamp illumination settings used for the cornea work equally well for subjects wearing contact lenses.

Although the shutter speeds used may seem very slow, excellent quality color slides were obtained. By instructing the patient to remain as still as possible during picture taking, even the optic sections and fluorescein patterns were sharp and clear. This method of picture taking was tested in the office of a private practitioner, Alfred Furie, O.D., during a typical, busy day, and the results were excellent. With very little practice, the shutter speed and light intensity settings for the different magnifications and illuminations become almost automatic; pictures can be taken very rapidly with surprisingly good results.

Permanent records of corneal transparency, opacities, scars and vessel proliferation can be made in a matter of seconds and kept for future comparison. Crystalline lens transparency also can be documented and compared to the transparency at a future date. The fit of a contact lens and the conjunctival vessel patterns are equally easy to record on film.

Using this technique, it becomes practical to photograph an observed condition instead of merely describing what is seen. In contrast to the written description, the photograph will never lose its meaning with the passage of time.