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The effect of illumination on the time to, and pupil area of, maximum mydriasis

Abstract
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THE EFFECT OF ILLUMINATION ON THE TIME TO,
AND PUPIL AREA OF, MAXIMUM MYDRIASIS

By

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RODNEY L. WHITE
KATHLEEN R. SOLUM

A thesis submitted to the faculty of the
College of Optometry
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Advising Doctor:
Hannu Laukkanen
ABOUT THE RESEARCHERS...

RODNEY LEE WHITE

I was born in Cambridge, Nebraska on February 24, 1970. However I consider my home to be Nampa, Idaho, my place of residency since 1973. I was awarded a B.S. in biology/zoology and chemistry minor by the College of Idaho in 1992. In May of 1996 I will graduate from Pacific University College of Optometry with a truly overpriced education.

I currently have an associate position with Advanced Eyecare in Nampa, Idaho where I will continue to practice with the skills and knowledge base that I have accrued at Pacific University. I also plan be happily married to Rachel Rushforth.

RACHEL L. RUSHFORTH

I was born in England and moved to Victoria, British Columbia, Canada at the age of seven. I grew up in Victoria and I consider myself a Canadian. After graduating from St. Margaret's School, I attended the University of Victoria where I earned a Bachelor of Science in Biology. During the summer months while I was at University, I worked at the Pacific Forestry Centre where I was a microtechnician working with electron microscopes. I continued to work in the field of forest biology, doing research and microscopy, for two years after I completed my undergraduate degree. It was not until this time that I considered going back to school to further my education. When I began my Optometric career at Pacific University, it was with all the excitement of a new beginning. Now, I look forward to graduating, my upcoming marriage and all the future has to offer.

KATHLEEN R. SOLUM

I was born in Chester, Montana and grew up on a farm in north-central Montana. I completed my undergraduate education at Montana State University in Bozeman, Montana, earning a Bachelor of Science degree in Biology. Before continuing with my education at Pacific University, I decided to take a year off and relax a bit before more studying. I spent that year working for my parents on the farm and then traveling and living in Australia for six months. After returning home, it was time to continue with my education in the field of optometry. I now look forward to a challenging career in primary care optometry.
ACKNOWLEDGEMENTS

We would like to thank all of those individuals who took part in our thesis and volunteered to be dilated. We express much appreciation to Dr. Robert Yolton for all his help with the statistics and valuable advice. In addition, we thank Dr. Bradley Coffey for his help in obtaining information on the Cogan's Pupilometer. Most of all, we wish to thank Dr. Hannu Laukkanen for all his support, ideas and editing.
ABSTRACT

This study was designed to evaluate the mydriatic effects of patients being dilated under differing illumination conditions. Twenty subjects, ten females and ten males had their pupils dilated under darkened conditions and under normal illumination to determine if there would be a difference in the rate of mydriasis, or overall pupil size at the point of maximum dilation. Iris color and gender were separately evaluated factors in dilation results. Subjects were dilated using one drop each of tetracaine 1%, phenylephrine HCl 2.5%, and tropicamide 1%. Pupil diameter was periodically measured using a Cogan's pupilometer starting 6 minutes after drop instillation. Measurements with the pupilometer were taken at two minute intervals throughout the 30 minute test period. The final measurement 33 minutes after instillation of the dilating drops was taken with a biomicroscope reticule, both horizontal and vertical diameters were measured. No significant differences were seen between gender, iris color, or illumination type on the rate of maximum mydriasis. However, the relative pupil area was significantly greater following dilation under normal illumination conditions.

Keywords: mydriasis, illumination, phenylephrine, tropicamide, rate time, light, dark, pupil, dilation, dilation rate.

You have just finished placing the mydriatic agents into the eyes of your patient; do you now seat them in a dark or well lit room? Several studies have explored how drop size, patient age or iris color effects dilation rates and final pupil size; however, few studies have considered the effect of room illumination upon pharmaceutical induced mydriasis.

Despite patient inconvenience and increased examination time, dilated fundus exams are becoming more routine in today's optometric practice. To reach an acceptable mydriatic state for optimal retinal viewing requires 20-30 minutes
after the instillation of the mydriatic drops; yet, the procedure for a thorough
evaluation of the retina may only require a few minutes. In today's fast paced
world, time spent waiting for the patient to dilate is a valuable commodity to both
the patient and the optometrist. Therefore, any factor which could provide a faster
or more complete mydriasis should be investigated; especially, an option as simple
as placing the patient in either a light or dark environment while the drug takes
effect.

Several pharmaceuticals, in varying concentrations, are available for the
use of dilating patients. However, the clinical drug of choice continues to be
phenylephrine HCL 2.5% and tropicamide 1% (Alldredge, 1996). For this reason,
we chose to use this drug combination to evaluate the effect of illumination on the
dilation process.

Drug characteristics of Phenylephrine HCL

Phenylephrine is a direct-acting alpha adrenergic agent which provides
mydriasis without cycloplegic effects. It may also be used as an ocular
decongestant or to break or prevent posterior synechia in uveitis (Rengstorff and
Doughty, 1982). Phenylephrine 2.5% is the recommended concentration for
routine fundus examinations. At this concentration, maximum mydriasis should
occur within 15-60 minutes post-drop. Recovery to pre-drop pupil size will most
likely occur in 3 hours (Bartlett et al, 1994).

Clinically, topical use of 2.5% phenylephrine in conjunction with punctal
occlusion induces few serious side effects, but there may be mild ocular reactions.
These mild ocular reactions include transient stinging upon instillation, irritation,
headache, brow ache, blurred vision, transient epithelial keratitis, allergic reactions,
and reactive hyperemia (Bartlett et al, 1994). Repeated doses of phenylephrine
may cause rebound miosis or reduce the mydriatic affect needed for ophthalmic
surgery. Therefore, excessive or repeated use with elderly patients should be
avoided (Bartlett et al, 1994).

Systemic complications are primarily cardiovascular in nature and include:
palpitations, tachycardia, arrhythmia's, hypertension, reflex bradycardia, coronary
occlusion, pulmonary embolism, subarachnoid hemorrhage, myocardial infarction,
stroke, and even death (Bartlett et al, 1994).

Caution is recommended when using phenylephrine with patients who have
cardiac disease, hypertension, atherosclerosis, diabetes or who are pregnant. It
should not be used if a patient is hypersensitive to any component of the formulation, or who has indication of possible angle closure. In addition, drugs that interact with phenylephrine, such as tricyclic anti-depressants, MAO inhibitors, reserpine, guanethidine, and methyldopa, are contraindicated (Bartlett et al, 1994).

**Drug characteristics of Tropicamide**

Tropicamide is an anticholinergic agent which is primarily used to dilate the pupil for fundus examinations and to prevent posterior synechia during uveitis or trauma. The cycloplegic effect of Tropicamide is also beneficial in determining refractive errors when a relaxed accommodative system is needed (Rengstorff and Doughty, 1982). Although it is classified as a cycloplegic agent, tropicamide is considered the drug of choice for mydriasis due to its quick onset and short duration of action (Bartlett and Jaanus, 1989; Bartlett et al, 1994). As a mydriatic agent Tropicamide provides maximum dilation within 20-40 minutes post drop. The pupil usually recovers to the pre-dilation state within 6 hours of instillation (Bartlett et al, 1994).

When Tropicamide is used in conjunction with punctal occlusion, systemic side effects are lessened. However, the patient should be educated about the potential for ocular and systemic effects. Ocular reactions may include increased intraocular pressure, transient stinging, hyperemia, blurred vision, photophobia, punctate keratitis, and possible allergic reactions (Bartlett et al, 1994). Systemic side effects include CNS disturbances, flushing and dryness of the mouth and skin, headaches, a rapid irregular pulse, irritability, bladder distention, hallucinations, drowsiness, decreased gastrointestinal motility, coma, medullary paralysis and in very rare instances, death (Bartlett et al, 1994).

Cycloplegic mydriatics should not be used with patients who are pregnant, or have posterior synechia, primary open angle glaucoma, have a potential for angle closure glaucoma, or are hypersensitive to the formulation (Bartlett et al, 1994).
The pharmacological mechanism of mydriasis

There are two separately innervated muscles involved in pupil mydriasis, the iris sphincter and the iris dilator. Tropicamide blocks cholinergic stimulation to the sphincter muscle of the iris and the ciliary body causing both pupil dilation and accommodative paralysis. In contrast, phenylephrine acts as an alpha receptor agonist, causing contraction of the iris dilator muscle, acting on the radial fibers. Other non-mydriatic affects that occur simultaneously with the use of phenylephrine include constriction of the arteriole smooth muscle (causing "blanching" of the conjunctiva) and the widening of the palpebral fissure by stimulation of Muller's muscle. The combined use of both a parasympatholytic (tropicamide) and a sympathomimetic (phenylephrine) provides maximal dilation that is resistant to intense light stimulation (Leonard and Henrick, 1980).

Physiological and anatomical influences on drug absorption

One of the most important aspects of pharmacokinetics is the absorption phase. Without adequate absorption, drug distribution and metabolism are altered and the intended effect does not occur. Absorption depends on the molecular properties of the drug, the penetrating factor of the tissue, the patient's age, iris pigmentation and tear flow (Mordi et al., 1986).

The major topical drug absorbing tissue of the eye is the avascular cornea. The corneal epithelium acts as a reservoir for lipophilic drugs and the stroma stores hydrophilic drugs. Any disruption of the corneal epithelium can affect drug absorption. The use of topical anesthetic, or any abrasion to the cornea can cause an increase in corneal penetration of mydriatic drugs. Phenylephrine has characteristics that may lead to corneal epithelium disruption (Eidelhauser et al., 1980). This change in corneal integrity may lead to an increase in both effect and duration of the phenylephrine and/or tropicamide induced mydriasis (Bartlett and Jaanus, 1989; Bartlett et al., 1994; Paggiarino et al., 1993).

Other ocular tissues and structures have limited affects on drug absorption. The sclera and conjunctiva account for less than one fifth of all drug absorption into the iris and ciliary body because they are so highly vascularized (Ahmed and Patton, 1985; Doane et al., 1978). Pigment granules within the iris absorb drugs with lipophilic properties and slowly release that drug over a period of time.
Previous studies have indicated that dark irides take longer to dilate than light colored irides but this has been insignificant in altering the dilation rate. (Dillon et al, 1977; Leonard and Henrick, 1980) Furthermore, the ciliary body is involved with drug detoxification and elimination and is the major drug metabolizing tissue of the anterior segment.

Tears play a major role in the process of drug absorption. Only 30 microliters can be held by the palpebral conjunctiva and fornix at one time which includes the 8-10 microliters of normal tear volume. Therefore, too large a volume or instillation of too many drops will simply roll off the cheek or pass through the puncta resulting in no increase in the desired pharmacological effects of the drug (Chrai et al, 1974; Bartlett and Jaanus, 1989). Similarly, ocular pharmaceutical agents may become diluted from reflex tearing if the drugs sting upon instillation which would further increase tear volume. However, increasing drop size has no affect in increasing drug absorption.

Increased absorption of a drug may occur with people who have a decreased tear flow rate such as elderly patients, patients with rheumatoid arthritis, keratoconjunctivitis sicca, or post-menopausal women (Bartlett and Jaanus, 1989).

**Concerns about dilation**

When compared to an undilated pupil, a dilated pupil facilitates locating and identifying posterior segment anomalies and abnormalities by providing an increased viewing area. However, there are drawbacks with pupil dilation. Increased examination time, patient inconvenience, and the fear of systemic and ocular side effects are commonly cited reasons why some practitioners do not routinely dilate and why some patients refuse dilation (Bartlett and Jaanus, 1989).

Most patient objections can be overcome with proper education. Most patients want the assurance that their optometrist is providing them with the best possible care. Benefits of dilation include an increased viewing area for accurate peripheral fundus assessment and clear stereo views to assist diagnosis. By simply explaining the benefits of dilation, the patient will feel more comfortable and assured that they are getting proper care. Also, patient comfort after the dilation can be enhanced by reducing the photophobic effects through use of mydriatic glasses or Rev-Eyes, a drug that reverses mydriasis by blocking the alpha-adrenergic receptors in the iris dilator (Conner et al, 1993). Patient risk associated


with potential side effects can be minimized if the administrating doctor is pharmacologically current, well educated, and prudent.

Most topically applied pharmaceuticals used for pupil dilations are relatively safe. Rengstorff and Doughty (1982) state that, "Cycloplegics and mydriatics have been extensively used throughout ophthalmic history and serious complications have been rare but most often contributed to dosage, use with other drugs, surgery, trauma, and illness." Bartlett and Jaanus (1989) also suggest that the avascularity of the cornea provides a direct route for drug penetration without absorption by systemic circulation thus minimizing systemic side effects. Applebaum and Jaanus (1983) presented a study demonstrating the safety of diagnostic pharmaceutical application (DPA) by using data collected by Southern California College of Optometry and 20 other private practices. Of the 12,493 DPA cases, only six patients elicited minor side effects with the use of tropicamide or phenylephrine. The best way to prevent harmful side effects is to avoid circumstances where known characteristics and/or conditions are expected to trigger unwanted reactions. The optometrist should know the properties, recommended uses, and precautions and contraindications of every drug he/she administers.

**Project goals**

The intent of this study was to investigate whether the time needed for maximum mydriasis could be decreased or whether the amount of mydriasis could be increased by altering room illumination during dilation. Based on our understanding of the pharmaceutical properties of tropicamide and phenylephrine, and the physiology involved in pupil mydriasis, we predict that pupil dilation will occur faster if patients are placed in a darkened room following instillation of the topical dilation drops rather than a well lit room. In a dark room the iris sphincter will relax with natural pupil dilation, and the parasympatholytic drug will not be opposed by light induced antagonistic muscle constriction. Likewise, the sympathomimetic drug will be acting as an agonist in the natural direction with pupil dilation during darkness. Therefore, pharmaceutical dilation in darkness should put the system in harmony to achieve faster and/or more complete mydriasis.
SUBJECTS AND METHODS

Subjects
Twenty subjects, 10 females and 10 males between the ages of 19 and 37 years, participated in this study. All subjects reported themselves to be in good health and free of significant systemic, neurologic or ocular diseases. Only subjects who had not experienced allergies or adverse reactions to anesthetics or dilating agents in the past were included in this study. All participants had vision correctable to 20/20, unremarkable slit lamp findings, and anterior chamber angles greater than three via Von Herrick technique. Prior to participation, informed consent was obtained from each subject.

Methods
The initial examination of the subjects included a complete biomicroscopy evaluation to assess general ocular health of each eye and Goldmann tonometry to measure intraocular pressures. One drop of tetracaine 1% was instilled into each lower fornix just prior to performing tonometry. Care was taken to minimize any systemic absorption by occluding the puncta and having the subject close his/her eyes for 15 seconds. Anterior chamber angles were determined by using Von Herrick and shadow methods. In addition, eye color was classified as either being light or dark.

Subjects were then randomly placed in either a dark or a well illuminated room. By using a photometer in the illuminated rooms, light levels were controlled at 22 foot candles. A baseline horizontal pupil diameter was measured using Cogan's pupillometer.

Cogan's pupillometer is a handheld card which has a series of paired pinholes. The separation between the paired pinholes increases by 0.5mm with each pair down the card. The vertical spacing is uniform between the paired pinholes. When the card is held at a common vertex distance from the eye, the subject can see through a pair of two tiny holes simultaneously. While viewing a distant light target, the subject subjectively moves the card up and down until the two holes appear to just touch without overlap or separation. From this "ideal" pinhole separation distance a pupil diameter can be determined (Cogan, 1941). When the procedure was performed in a light room, subjects viewed a white wall at
six meters under ambient room illumination as previously described, whereas, when the procedure was performed in a dark room, subjects viewed a black light positioned six meters in front of them.

After each subject was trained to properly use the Cogan's pupilometer, a baseline pupil diameter measurement was obtained, for each eye, in normal room illumination. One drop of 2.5% phenylephrine HCl was then instilled into the lower fornix of each eye and the timer was started. After 15 seconds, one drop of 1% tropicamide was instilled into each eye. In each instance, precautions were taken to minimize systemic absorption through the use of punctal occlusion. Subjects were encouraged to keep their eyes open and to look into the distance for the duration of the experiment. Six minutes after instillation of the first drop, subjects were asked to measure their horizontal pupil diameter with the Cogan's pupilometer. After the subjects identified the pinhole pair that yielded touch without overlap or separation, the examiner then noted the pupil size equivalent from the front of the card. Subjects were unaware of which pupil sizes corresponded to the pinhole pairs. Following this pupil size determination, measurements were taken every two minutes until 30 minutes had elapsed. At 30 minutes, normal room illumination (22 foot candles) was resumed for those subjects who were dilated under dark illumination conditions. After a further three minutes in the light (i.e., 33 minutes after the installation of the drops) a final horizontal and vertical pupil diameter was measured using the slit lamp reticule. Tonometry was then repeated to check for any significant IOP changes. The subjects then returned in one week to complete the protocol with the alternate illumination condition. A minimum of one week was required between dilations to prevent any possibility of an additive effect of the dilation pharmaceuticals.

In the remainder of this paper, subjects dilated in a well lit room may be referred to as "light dilation" while those subjects dilated in a dark room may be referred to as "dark dilation".

**Statistical Analysis**

The time to maximum mydriasis was arbitrarily classified as the time after which subjects chose the same pinhole pair for five consecutive readings, thus indicating a pupil size fluctuation of no more than 0.5mm. Readings were recorded for both eyes and then a mean time was determined for each subject.
Paired t-tests were used to compare the time required in the dark to the time required in the light for maximum mydriasis to occur. Unpaired t-tests were used to analyze the effects of iris color. The mean times to maximum dilation with dark irides were compared to those with light irides in the illuminated room. Then the same computations were made with the results obtained in the darkened room. Unpaired t-tests were used in a similar fashion to compare times to maximum dilation of males to females under the same illumination conditions.

An average horizontal pupil measurement was calculated from both the eyes using the slit lamp reticule. Similarly, an average vertical pupil measurement was calculated. Paired t-tests were used to compare mean horizontal and mean vertical pupil diameters in a light room. The same comparison was made for data obtained from the dark room condition. The relative pupil area was determined by considering the pupil as an ellipse rather than a circle. Thus a relative pupil area was calculated using the formula, \( \frac{\pi vh}{4} \), where "\( v \)" is the maximum vertical pupil diameter and "\( h \)" is the maximum horizontal pupil diameter. A paired t-test was then used to compare dark dilation versus light dilation relative pupil area for each subject at 33 minutes post drug installation. In addition, a paired t-test was used to compare mean horizontal and mean vertical pupil measurements that were taken under the same lighting conditions.

The gender versus pupil size comparison was made using an unpaired t-test to compare the mean relative pupil area for males verses females who were dilated under the same lighting conditions. Similarly, an unpaired t-test was used to determine if iris color had any effect on the size of the dilated pupil area.

**RESULTS**

**Table 1: Time to maximum mydriasis (Values in parentheses are standard deviations)**

<table>
<thead>
<tr>
<th>Illumination level</th>
<th>Number of subjects</th>
<th>Males/Females</th>
<th>Mean time to mydriasis in minutes</th>
</tr>
</thead>
<tbody>
<tr>
<td>light</td>
<td>20</td>
<td>1/1</td>
<td>19.7 (4.3)</td>
</tr>
<tr>
<td>dark</td>
<td>20</td>
<td>1/1</td>
<td>18.1 (4.4)</td>
</tr>
</tbody>
</table>
### Time to maximum mydriasis

Table 1 presents the mean time to maximum mydriasis, as measured by the Cogan's pupilometer, for the 20 subjects who experienced light dilation and dark dilation. Although the subjects dilated faster in a dark room with a mean time of 18.1 minutes, compared to the mean of 19.7 minutes for dilation in a well lit room, the one-tailed paired t-test indicated that there was no significant difference (p>0.05) in the time to dilation between the light and dark dilations.

Unpaired t-tests comparing males versus females indicated no significant gender difference (p>0.05).

Unpaired t-tests showed no significant difference (p>0.05) between light and dark color irides. That is, in a light room, there was no difference in the time required for subjects with dark irides to dilate compared to those subjects with light irides. Similarly, when the dilation process was completed in a dark room, there was no significant difference in the time to maximum dilation.

### Table 2: Mean pupil measurements at 33 minutes after tropicamide 1% and phenylephrine HCl 2.5% were instilled (Values in parentheses are standard deviations)

<table>
<thead>
<tr>
<th>Illumination conditions</th>
<th>Mean horizontal pupil diameter in mm</th>
<th>Mean vertical pupil diameter in mm</th>
<th>Mean relative pupil area in mm²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light</td>
<td>8.12 (0.65)</td>
<td>8.07 (0.64)</td>
<td>51.73 (7.60)</td>
</tr>
<tr>
<td>Dark</td>
<td>7.94 (0.55)</td>
<td>7.91 (0.62)</td>
<td>49.55 (7.01)</td>
</tr>
</tbody>
</table>

### Relative area of pupil dilation

Table 2 presents the slit lamp pupil measurements obtained from the 20 subjects at 33 minutes post instillation of the mydriatic drops. When comparing the relative pupil area of subjects dilated in dark conditions verses light conditions using a paired t-test, there was a significant difference (p<0.05). Subjects dilated in a well lit room had a significantly increased relative pupil area compared to dark dilation.

When looking only at the mean horizontal diameter of the pupil, dilation during light conditions yielded a significantly (p<0.05) larger horizontal diameter then dark dilation. However, the vertical pupil diameter differences fell just short of
significance (p>0.05). This surprising finding indicates that most of the increased relative area obtained from light dilation is derived from the horizontal measure. Within the same lighting conditions, there was not a significant difference between the horizontal and vertical pupil diameter measurements (p>0.05).

There was no significant pupil size relationship between males and females or between light and dark iride colors within the same set of illumination conditions using unpaired t-tests (p>0.05).

Subjective response

During the dark dilation procedure, when the lights were turned on 30 minutes after drop installation, many subjects complained of discomfort due to the bright lights. The same subjects in the light dilation procedure did not report this discomfort.

DISCUSSION:

The goals of this project were to determine whether the speed or size of maximum dilation would be different if the patient was dilated in a darkened room versus a well lit room. In other words, do illumination conditions 30 minutes after drop installation, affect pupil dilation? Also, we were interested whether gender differences or iris color would influence dilation results.

Contrary to our original prediction, this study showed that placing a patient in a dark room does not result in a significantly faster dilation than dilating the patient in a well lit room. Allowing the patient to dilate in a dark room did improve overall comfort. However, this initial comfort is short lived because the patient will soon be subjected to the bright lights of an indirect ophthalmoscope. Perhaps waiting for this procedure in a well lit room will lessen the discomfort of the bright lights to come.

Based on slit lamp measurements, 33 minutes after dilation, there is a significant difference (p<0.05) in the pupil area when patients dilate in a dark room compared to in a light room. Unexpectedly, the relative pupil area obtained from light dilation produced a greater mean pupil area (2.18 mm²) than that from dark dilation. Although we do not know exact reasons why, one possible explanation may be that in the light, the iris is constricted and thus more area of iris and ciliary body is exposed and available for absorption of mydriatic agents. Surprisingly, it
was the horizontal pupil diameter that was statistically larger, whereas the vertical pupil measurement was not. This may be explained by the natural pooling of the mydriatic in the palpebral fissure in the horizontal meridian. With the eyes open, fluid will tend to accumulate in the horizontal meridian along the lower lid margin and the blinking action may push fluid towards the fissure. In a well lit room we believe the lids may tend to assume a more squint type posture than in the dark, thus narrowing the palpebral fissure, decreasing the vertical width of the drug reservoir in contact with the front surface of the eye. Increased drug concentration along the fissure could conceivably increase the drug availability to the cornea and might explain the greater horizontal mydriasis obtained from a light dilation.

Gender or iris color was not a factor in either the rate to maximum mydriasis, or in differences of relative pupil area. Our finding that gender has no impact on dilation results was expected since there are no anatomical differences between healthy male and female eyes that would increase or decrease drug absorption. Our finding that iris color has no significant effect is consistent with past research which has shown iris color (categorized as light or dark) has no significant effect in the amount or rate of dilation (Dillon et al, 1977; Leonard and Henrick, 1980).

The ambient illumination during patient dilation is usually determined by the doctor rather than the patient. For patient comfort one may recommend low illumination during dilation. However, our results demonstrate that dilation with low light levels are not significantly faster and may yield a pupil area that is slightly smaller, although this difference is probably not clinically significant. The "bottom line" is that although patient comfort may be slightly enhanced with dark dilation, the patient is not going to be ready for the fundus examination any faster. One might argue that it is preferable to have the patient sit in the reception area and enjoy the company of friends or other patients. The additional benefits of undergoing dilation in a well lit room include not only the increased final dilation area, but also as the dilation progresses, the eyes seem to gradually adapt to the increased light reaching the retina. After all, it seems paradoxical during the dilation to place the patient in a dark room for comfort, when moments later, very bright lights will be aimed directly through their fully dilated pupils. In the future, after instillation of the mydriatic drops, we will seat our patients in a well lit room while the drops take effect.
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