Adjusting the Slit-lamp Oculars: An Unnecessary Burden or a Must?

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Abstract: Adjusting the slit-lamp eyepiece rings is perceived by some to be insignificant for achieving adequate focus. Others assume that these rings should be set only to compensate for one's refractive error. Observations are presented concerning the eyepiece scale setting during routine examinations, slit-lamp mounted YAG and Argon laser procedures and during ophthalmic surgery. Diagrams illustrate the optical basis of these observations. Factors influencing optimal eyepiece ring setting, besides ametropia, include slit-lamp misalignment (variations in calibration) as well as unconscious accommodation. An inaccurate setting cannot be fully compensated by adjusting the slit-lamp joy-stick. When an incorrect setting is used, while using oblique illumination, it becomes impossible to focus on details placed at the center of the viewfinder . In addition, irrespective of joy-stick position, it is impossible to view an oblique slit transecting the cornea in perfect focus. An accurate setting, as a whole, results in sharper images throughout the slit-lamp examination. Differences between individual instruments make it necessary to reset the eyepieces for each eye and for each individual instrument. Methods are described for evaluating the need for readjustment, as well as a simple technique for calibration in the absence of a focusing rod. (**Surv Ophthalmol 40:**225–228, 1995)

Key words. calibration • instrumentation • slit-lamp

When I started my residency I used to set the slit-lamp oculars to zero, having been told erroneously that the ocular power "should be set to match your refractive error." At times I noticed that I was working for hours on a slit set to +2 or −3, with no particular discomfort or compromise of focus. It once happened that a slit-lamp was left in the clinic, set to −3, for a whole week, while none of the doctors seemed to be bothered by it. The first time I realized that there might be a problem was when I noticed that sometimes a particular lesion of interest could not be seen in focus at the center of the viewfinder. The only solution for sharpness was to place the lesion at the midperiphery of the viewing field. Only there could I both focus and illuminate it when using oblique illumination. The second time was when I noticed that the fluorescein rings during Goldmann applanation tonometry were slightly off focus, and could be sharpened by adjusting the relevant ocular diopter ring (usually the right ocular).

I found myself in big trouble when, during my first YAG capsulotomy, it was absolutely impossible to focus the laser target and still have the posterior capsule in focus. No matter how I tried, not even a single shot broke the capsule. The solution came in the form of a focusing rod, a metal rod placed in the applanator socket for the purpose of focusing the oculars. My personal setting was found to be in the range of −2 to −3 (with daily fluctua-

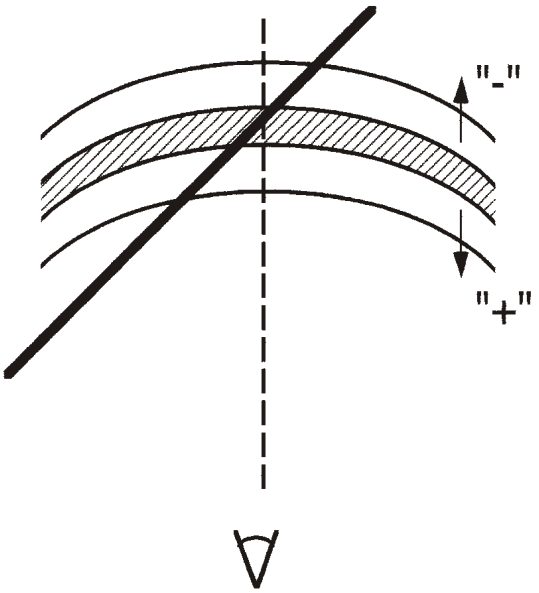

Fig. 1. The dashed line is the center of the viewfinder. The curved plane represents the zone of focus in a particular setting of the ocular diopter rings. Over-minusing will move this zone further away from the observer, while over-plusing will bring the zone closer. The antero-posterior "thickness" of the zone depends on the depth-of-field of the instrument. The diagonal bold line is the slit-lamp illumination.

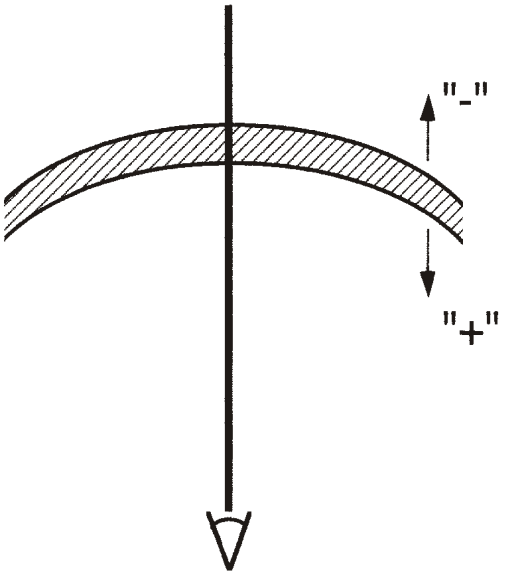

Fig. 2. During coaxial illumination the slit beam always intersects the plane of focus at the center of the viewfinder.

tions). This so-called "refractive error" setting is a resultant that combines any uncorrected refractive error and any accommodation applied by the examiner. Due to the box-myopia (instrument-myopia) reflex, young people accommodate to a certain extent when offered a target known to be closer then infinity. Some even accommodate in absolute darkness (empty field accommodation). One young colleague who argued that he could manage perfectly well with a zero or even a +2 setting was consequently found to be hyperopic.

Since most doctors seem to manage perfectly well with the 0 setting, one may wonder what is the significance of these observations. My personal experience leads me to believe that there may be important ocular signs that are constantly missed by some examiners. Thus, only after setting the slit to −3 did I spot fine corneal punctates and erosions before staining with fluorescein. The very first patient I observed with the new setting had peculiar fine corneal stromal striations on high magnification. I later realized that this was nothing but a normal healthy cornea. Anterior chamber reaction of questionable cells and flare suddenly flared up to +2, and corneal thickness became much easier to appreciate.

Optical Considerations

The rationale for fine-tuning the ocular diopter rings is related to the intersection of the oblique slit illumination with the plane of focus of the instrument (Fig. 1). The distance of the plane of focus from the observer is altered by the ocular diopter ring setting, by the observer's uncorrected refractive error, and by the amount of accommodation applied. The slit illumination, on the other hand, is in focus at the plane of the focusing rod (as long as the slit-lamp is properly calibrated). When the illumination beam is set to coaxial (straight ahead), the diopter setting is of less importance, because the illumination slit always intersects the plane of focus in the center of the viewing field (Fig. 2). However, with oblique illumination, the plane of focus intersects the slit illumination in the center of the viewing field only when the ocular diopter power is set correctly (Fig. 3).

Not all slit-lamps were created equal. The assumption by many clinicians that the scale on the eyepiece is accurate is simply not true. Even when the observer is not accommodating and is truly emmetropic, the optimal ocular setting may not be zero. Therefore, every observer should set the eyepieces individually, for each eye and for each slit-lamp.

Observing a Focused Slit as Opposed to Focusing the Slit-lamp

Focusing the slit-lamp is universally accomplished using the joy-stick. However, there is a second, different kind of focusing, which may not be appreciated by many examiners: this has to do with the slit illumination itself being in focus. To demonstrate this point at the slit-lamp, take a piece of

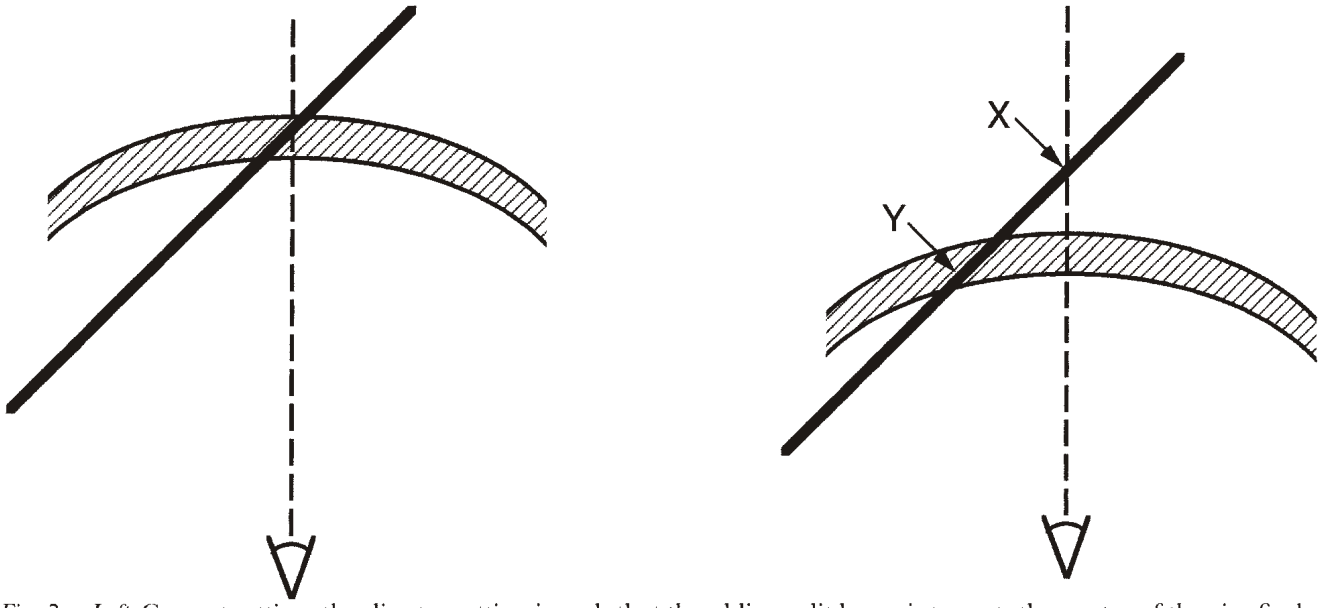

Fig. 3. Left: Correct setting: the diopter setting is such that the oblique slit beam intersects the center of the viewfinder at the plane of focus. This also assures a focused illumination beam. *Right:* Incorrect setting—This example is of an emmetrope accommodating 3 Ds but without compensating the slit-lamp oculars. Point x is illuminated and central but out of focus, whereas point y is illuminated and focused but lies in the periphery of the viewfinder.

paper and move it forward and backward along the path of a narrow illumination slit, looking directly at the paper (not through the oculars). You will notice that only at a precise set distance from the observer will the slit appear to be in focus. When a slit-lamp is properly aligned and calibrated, the point in space in which the light beam is perfectly focused is in the center of the view-finder regardless of the angle of oblique illumination. This is also the precise location of the focusing rod. As mentioned before, rotating the ocular diopter power rings moves the location of the viewer's plane of focus antero-posteriorly in a continuous fashion. A razor sharp focus of the slit exists only in one fixed plane, the focusing rod plane. In all other diopter settings, without additional accommodation, an illuminated slit intersecting the cornea cannot be viewed as sharp (not even at the viewfinder periphery) , no matter how much one fiddles with the joy-stick. An out-of-focus slit cannot be made narrow (even at the minimal setting) and lacks crisp sharp borders. One way to appreciate the concept of a focused slit is to view a very narrow slit transecting the cornea using the following three ocular settings: −8, 0, +8. At these extreme settings differences become very obvious. Now try to detect differences in the following settings: −2, 0, +2 . After practicing these examples, try changing your habitual setting one diopter up and down. You may be surprised to discover that additional clarity can be gained by changing your setting by even 0.5 diopter (D). Remember that different slit-lamps, especially if produced by different makers, may be pre-set slightly differently. In summary, when casually using a slit-lamp, the two clues to an erroneous setting are a blurred slit and a preferred viewing zone outside the center of the viewfinder.

Coaxial Illumination

When using coaxial (or 5° near coaxial) illumination, such as during biomicroscopy (90 D, three-mirror etc.), the ocular diopter adjustment is of little importance as long as both oculars are set to the same value. On the operating microscope, regardless of the ocular setting, it is possible to focus and illuminate adequately. However, as a courtesy to one's assistant the surgeon should consider adjusting his or her refractive (plus accommodative) error. Younger surgeons may find that after initially matching their setting to that of the supervising assistant, they later increase the amount of accommodation and thus blur the vision of the assistant during difficult portions of the surgery, at just the time of greatest need for supervision.

Calibrating the Oculars

When a focusing bar is lacking, a simple way to check whether the slit-lamp ocular rings are set correctly, is to focus a near chart, placed in a perpendicular, steady position within the chin rest. The idea is to shine a very wide oblique beam from a 45° angle, and focus a small printed letter placed at the exact center of the viewing field as seen through the slit-lamp. Then reduce the slit-lamp

width to a narrow slit. If the narrow slit is not illuminating the letter, an incorrect ocular setting is being used. Department chairmen and ophthalmologists over the age of 45 are exempted from this test on grounds of presbyopia.

Adjusting the rings can be accomplished either by using a focusing rod, or through the following procedure: place a small print letter in the exact center of the viewfinder and set the joystick position so that a narrow illumination beam falls on the blurred letter. Finally, adjust the ocular rings until the letter is in focus. Discrepancies between the two methods are most probably related to extra accommodation applied while focusing the small print as opposed to the rod. Some ophthalmologists may find that the focusing rod underestimates the accommodation they apply while examining patients.

One may argue that instead of encouraging extra accommodation (over-minusing) by a more myopic setting, all the examiner needs to do is fully relax his or her accommodation. This, apparently, just doesn't work, and is analogous to prescribing the full objective correction to adult hypermetropes. For reasons related to slit-lamp alignment, it would not surprise me that even pseudophakes may improve sharpness by adjusting the slit setting based on the focusing rod rather then their prescription.

YAG and Argon Laser Slit-lamp Settings

YAG and Argon lasers utilize laser beams that produce the desired spot size at a precise set distance from the observer. Therefore, the observer has to set the ocular diopter rings so that his or her plane of focus is in accordance with the laser beam. Otherwise, either the retina image or the spot will not be in focus. With slit-lamp mounted lasers, focusing rods are of the utmost importance, otherwise sub-maximal laser effect will result (or excessively high energy would have to be used). My preliminary observation is that some surgeons need to over-minus the laser slit compared to both the setting used in the clinic and to the rod calibrated setting found prior to the laser session. This is possibly related to the book myopia effect, whereby concentrating on a difficult visual task induces additional accommodation.

Conclusions

Precise calibration of the diopter rings on the slit-lamp oculars compensates for any uncorrected refractive error as well as any unconscious accommodation by the examiner. This would likely result in sharper images at the center of the viewfinder. A precise setting is of utmost importance when using slit-lamp mounted lasers, since submaximal effect may result from discrepancies between the plane of focus of the slit as opposed to the laser. It is uncertain whether longterm use of too minus a setting of the ocular (over-minusing) would result in increased eye fatigue for the examiner.

Acknowledgment: I am grateful to Prof. Saul Merin and the section editor, ML Rubin, for their valuable comments while reviewing the manuscript.

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