OCUTECH® Sight Enhancement Technology

Through the Looking Glass: Thoughts about treating tunnel vision with Image Minification
A narrow window of opportunity

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Perhaps the most challenging visual impairments to address in low vision care are disorders affecting peripheral vision such as RP, Choroideremia and late stage glaucoma. Peripheral vision is associated with motion detection and seeing in low illumination. As a result, and as we know, individuals with constricted visual fields will have difficulty traveling independently as well as having very reduced 'night vision.'

Tunnel vision functional issues

The functional challenges encountered with tunnel vision usually fall within three categories— safe mobility (coursing stairs, especially going down; avoiding bumping into people and objects); finding items beyond the restricted field of view in their living, work or school environments; and reduced low-light vision (which we won't address in this blog).

Image Minification for Field Enhancement

Reversed telescopes (usually a 2.2x power) have traditionally been offered as an option as an optical treatment for the narrow field of view. The rationale for these reversed telescopes is that they reduce the image size by 50%, in effect doubling the field of view diameter, allowing more visual information to be visible within the restricted visual field. For instance, an individual with a 10 degree diameter field of view, when looking through a 2.2x reversed telescope (or 0.5x in field expansion parlance) will have the equivalent of a 20 degree field of view— a doubling of the visual field diameter.

The 50% Image Minification from the Image Minifier (IM)

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Here's an example that make the case of the visual benefit more clearly (sorry for the pun!).

Despite the presumed functional benefit offered by the widening of the visual field, the acceptance of 'field expanders' is infrequent. However, some individuals do find them useful—so it would be of value for us to try to better understand who would be more likely benefit from these types of devices and why.

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Optical telescopes, designed for distance magnification, when reversed produce significant barrel distortion causing the periphery of the minified image to be rounded and tilted especially when looking downward. When these are used as a mobility tool, a distorted image can undermine the device's benefit for safe mobility such as for coursing stairs, curbs and other environmental transitions.
Reversed telescopes designed specifically for treatment of restricted fields—called either *Field Expanders* (FE) or *Image Minifiers* (IM)— provide a flatter (undistorted) field of view providing a much more natural visual perception for the user.

Barrel Distortion using 2.2x reversed telescope

Flat image using 0.5x Field Expander

Why not provide greater image minification than 50%? Once a patient has significant visual field constriction, there is usually also some concomitant reduction in visual acuity. So, an individual who may have best-corrected visual acuity (BCVA) of 20/40, will, with a 0.5x minification device, now have a visual acuity equivalent of 20/80. Greater amounts of image minification will cause the content within the reduced image to be even less discernable, and hence less likely to be helpful for the individual. As a result, currently available optical field-enhancing devices are only available with a 50% image size reduction factor.

There are, however, some convenient optical characteristics of FE and IM devices. They are not very vertex distance sensitive and they have very broad depths of field. They can be positioned in front of eyeglass lenses without significantly impacting their field of view (as compared to telescopes that need to be positioned through the carrier lens to maximize their field of view), and they don't need to be focused.

Who responds to field expansion?
Clinically, individuals with a visual field of 20 degrees diameter or greater are usually not complaining of significant mobility difficulties. Mobility becomes much more impacted when field diameters approach 10 degrees or less. This clinical observation may help us to better understand the range of visual fields (the 'narrow window' of the title if you will) where a 0.5x FE or IM can be of value.

When an individual with a 20-degree field (we'll always be talking diameter) evaluates a 0.5x FE, while they may now have the equivalent of 40 degrees, they weren't having enough difficulty to make the FE beneficial enough to bother with. If an individual only has a 3-degree field, the FE can make it 6, so while it's wider, it's still not wide enough (more than 10 degrees) to be functionally helpful—it's not *better enough* to matter. However, an individual with 10 degrees will now see 20, and that they may like. It may be the same for 7 degrees, as now it will be 14. At 5 degrees it will now be 10, the possible

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threshold for mobility issues, and as a result the patient's response might go either way. So, it appears that there is this 'narrow window of opportunity'—perhaps between 7 to 15 degrees-- where the optical doubling of the field of view might be helpful for individuals.

Want to know what 10 degrees is? Extend your arm to its full length and bend your hand at the wrist so your fingers face the ceiling. At arm's length the width of your hand is just about 10 degrees.

Prescribing Considerations

Let's assume that your patient appreciates the benefit of the visual field doubling. Let's now talk about prescribing. Where is the individual likely to be looking to insure their safest mobility? They'll be looking downward most likely. So, positioning the field expander in the top of the carrier lens in bioptic position may be ergonomically inconvenient. They'll have to tilt their head too far down to be able to see the floor. So, a straight-ahead (full diameter) position, or perhaps even a downward position should be considered, because that's where all the 'action' is likely to be. Positioning the FE in full diameter position means it will be in the way when not needed, so the flippable SightScope option may be compelling because it can be moved in and out of position as needed. A handheld device, that can be worn around the neck and picked up as needed, may also be a convenient option if the hands are otherwise available and not using a cane, walker, or carrying packages for instance.

Handheld Image Minifier (IM) with

Field Expander (FE) mounted in SightScope mounting allowing it to

Field Expander (FE) mounted to carrier lens in full-diameter position

Field expansion can also be helpful for locating objects on a table, desk, work area and for watching TV and movies. Of course, since the field of view is like a cone, widening as one looks further away, sitting as far away as the individual's acuity will permit will also maximize the field of view. Again, these visual activities are either in straight-ahead or downward positions, so a top-mounted bioptic position will be inconvenient. Individuals need to learn to keep their materials close at hand so they won't have to look too far afield to find them, however, the challenge as many individuals with tunnel vision will tell you, is that others tend to move their materials around, making them harder to find.

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