Fitting Peripheral Prisms for Hemianopia
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Background
In the last 14 years we have been developing and evaluating a new optical treatment for hemianopia using peripheral prisms mounted above and below the line of sight on one lens on the side of the field loss. The clear area between the prism segments permits continuous single undisrupted binocular vision while the extent of the prism across the lens provides measurable peripheral field expansion at all (horizontal) positions of gaze. This statement is true only if the high power prisms are fitted with the serrations towards the eye, as typically done with the press on Fresnel prism. A series of studies including Multi Center Community Based clinical trials have confirmed that many patients with hemianopia find the field expansion helpful for obstacle avoidance when walking. A recent randomized control trial has shown that the prisms is effective also in improving driving performance.

Initially the peripheral prisms were implemented in a “horizontal” design using temporary 40° press-on™ Fresnel prisms (providing about 20° lateral field expansion). A fitting procedure for the press-on prisms was developed and later refined in a multi-center community-based clinical trial. This multi-center trial demonstrated that community-based practitioners, with little or no prior experience of the peripheral prism system, could successfully fit the press-on prisms using the protocol we developed.

![Figure 1. Peripheral prisms fitted for a patient with left hemianopia. The prisms are fitted base-out on the left lens.](image)

![Figure 2a. Without peripheral prisms](image) The binocular visual field plot (Goldman V4e) of a patient with left hemianopia. The gray area represents regions of the visual field that are not seen. The dashed line represents the binocular visual field of a normally sighted person.

![Figure 2b. With peripheral prisms](image) The binocular visual field of the same patient with the peripheral prism system. Two areas of about 20° x 20° of visual field expansion are seen.
In the meantime, Chadwick Optical, Inc. developed a permanent 40° PMMA Fresnel prism insert embedded in the spectacle lens, which provides better optical quality and durability than the temporary press-on prisms. More recently a 57° high power prism, providing about 30° of field expansion, has been implemented in the permanent prism glasses. Other more recent developments include a new patented “oblique” design that enables expansion of the peri-central field despite the peripheral placement of the prisms. While the position of the oblique prisms is identical to that of the horizontal design and thus the single binocular vision is maintained centrally, the image shifted by the prism covers the central portion of the lost field. This is considered advantageous in general and particularly for the possible use in driving. With this design the area through the windshield of a car is expanded despite the field of the prism segments themselves are above and below the windshield.

**Figure 3.** Spectacles with permanent 40Δ Fresnel prism segments in the “horizontal” design developed by Chadwick Optical, Inc. Shown for a patient with right hemianopia.

![Figure 3](image)

**Figure 4a.** Spectacles with permanent 40Δ Fresnel prism segments in the “oblique” peripheral prism design. Shown for a patient with left hemianopia.

**Figure 4b.** Binocular visual field plot for patient with left hemianopia (same patient as in Figure 2) wearing peripheral prisms of the oblique design. The oblique design enables expansion of the central field despite the peripheral placement of the prisms on the spectacle lens (Figure 4a)

A controlled randomized clinical trial is now completed in which the original “horizontal” and the new “oblique” designs were compared in the high power prisms. This trial has enrolled 73 patients. A simplified fitting procedure developed for that study was found effective and easy and will be the basis of the fitting technique taught at the workshop. An independent third party study has just been published in OVS claiming even higher success rate than we have found. We have also just published a paper reporting the outcome of a controlled trial in which a real prism was compared to sham prism during on road driving evaluation. We have continued to analyzed and study the various effects of the prisms addressing secondary effects that have been ignored or
neglected in the past.\textsuperscript{8,10} With these analyses we have uncover many novel considerations that are important for implementing clinical decisions. For example we now understand that people with incomplete hemianopia will not benefit fully from the high power prism fitted in the typical design with the serration pointing away from eye. For these patients fitting with the prism serration towards the eye may be more beneficial.

We also realized that under specific luminance conditions such as with bright patches of sun light and in nights with car headlights or other bright sources of lights the patient may be impacted by spurious reflection in the prisms coming from unintended directions that may create false alarms for the patients.

![Image of spurious reflections]

\textbf{Figure 5.} Spurious reflections with 57° with eyeward prism serration (EPS). On the left a natural scene with bright light sources locally. On the right the view of that scene photographed through the prism. Note the coding of the same areas highlighted in both sides with the same framing. With the outward prism serration the level of spurious reflection is reduced but distortions are increased.\textsuperscript{10}

The difference in prism distortion level between the two fitting configurations is also very large with the extremely high power prisms use. The OPS design result in wider field expansion but much of it is due to the minification (distortion effects). With this configuration the effect of total internal reflection at the prism start playing a meaningful role with increased scanning into the hemiblind side. This limits the field expansion for patients who do scan into the blind side. On the other hand with EPS configuration the field continues to expand with scanning and there is slight magnification rather than minification. However, the overall field expansion is not substantially different, and as mentioned above the spurious reflections problem is heightened with the EPS design. Thus choosing between them requires careful analysis of the patient characteristics and should be considered only when substantial experience has been gained.
Figure 6. Variation with field expansion, distortion and lack of transmission due to total internal reflection as a function of angle of scanning to the blind side (left) with the OPS (top) and EPS (bottom) configurations, respectively.

As can be seen from the list of references we continue to explore both basic science\textsuperscript{11} and applied\textsuperscript{12} aspect of these treatment in continuous effort to increase our understanding and provide better designs and better fitting and instructions. All these recent advances are provided at the workshop.

Prior workshops at the Academy were scored extremely high by attendees.

**Workshop content**

Lectures about the peripheral prisms approach presented at the American Academy of Optometry meetings some years ago were well attended, but provided only a theoretical basis and background information. Over the years the material available about the peripheral prism has increased substantially. This expanded material will be covered in the early portion of the workshop. The second portion of the workshop will provide hands-on experience in fitting the press-on version of the peripheral prisms and in fitting and ordering the permanent high power prisms. In addition, the workshop will provide hands-on experience in training patients in the use of the prisms, in providing instructions for their use, and in measuring the field expansion effect using confrontation and other perimetric techniques (participants practice the use of tangent screen for this procedure at the workshop). The specific procedures needed for fitting the prisms including frame selection, frame fitting, positioning of the prisms (including observation of patient’s head posture when walking with and without prisms), and positioning of bifocal segments, will be demonstrated and practiced by the participants.

The workshop will start with about an hour and a half lecture presenting the background for fitting prisms for hemianopia, reviewing the main prior techniques their
effects and limitation, and presenting the motivation and rational for the peripheral prism designs, as well as a brief review of the evidence base for their use from a growing body of clinical studies. The second part of the workshop include a demonstration of the interactions with patients from fitting to evaluation of posture and to training procedure and confrontation fields demonstrations of the effects and limitations. The third portion of the workshop is composed of hands on practice of the procedures and techniques demonstrated in the second part as described below.

Participants will be instructed in the fitting of the press-on prisms first on each other, giving them an opportunity to practice the procedure and appreciate firsthand the optical “image-shift” effect of the prisms. Participants will walk with the prisms and will be able to notice the positive effect as well as possible side effects of the prism and appreciate the need for adaptation. Volunteer patients with hemianopia will be available to provide the participants with an opportunity to measure and appreciate the field expansion effect using confrontation and other perimetric techniques. The effects of the horizontal and oblique designs will also be compared. The interaction with actual patients is invaluable contribution to the experience of the participants and in all prior workshops we were able to recruit at least 2 patients to participate, and as many as 4.

Finally “reach and touch” training exercises for in-office and home use will be taught. The purpose of these exercises is to familiarize the patient with the “image-shift” effect of the prisms (i.e., the prism shifts the image toward the seeing field). Such exercises should assist the patient in adapting to using the prisms. The potential obstacles detected with the prisms are perceived in a wrong direction due to the prism shift. While the correct location of a detected obstacle may be verified through the central, prism clear, section of the lens, the time needed for such eye movements may slow down the patients avoidance maneuver. The adaptation to prism direction using the exercises should alleviate this problem. Participants will first practice these exercises on each other (from the perspective of both the practitioner and patient) and then with the volunteer patients.

Chadwick Optical will provide precut press-on prisms in both horizontal and oblique designs and a fitting template for the permanent prisms, as well as additional accessories (frames and frame adjustment tools) as needed. Participants will be provided with a complete fitting protocol for the press-on and permanent prisms, as well as written details of the training procedures. Two volunteer patients with hemianopia will be recruited for the workshop (with the help of local optometrists). The participation of patients was found to be extremely valuable by past participants. We usually have two or three past trainees or other optometrists experienced in fitting the peripheral prisms join us to the hands on session and helping the participants in the various aspects of the procedures.
References