Objective Methods for the Evaluation of the Near Point Functional Effects of Visual Field Loss and the Benefits of Treatment Techniques

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I. Types of Visual Field Loss
- A. Right Hemianopsia
- B. Left Hemianopsia
- C. Altitudinal
- D. Constriction

II. Traditional Objective Assessment Techniques
- A. Confrontation Fields
- B. Tangent Screen
- C. Arc Perimeter
- D. Amsler Grid
- E. Auto Perimeter

III. Functional Observations
- A. Mobility
- B. Inattention
- C. Startle
- D. Self-care
- E. Reading
- F. Posture

IV. Types of Adaptation of Visual Field Loss
- A. Self-directed
- B. External Prompting
- C. Neglect

V. Objective Assessment Techniques
- A. Finger-Touch (Functional) Confrontation Fields
  1. Self directed scanning- accuracy, speed, organization
  2. Eye turn to normal side; head turn to defect side
  3. Alternate between all four quadrants
- B. Lateral Awareness Test
  1. Bernell Near Point Maddox Rod Card
  2. Self directed vs. Prompted vs. Neglect
- C. Saccadic Margin Test
  1. Harts Chart
  2. Right or left drift (as a %)
- D. Kirshner Visual Performance Test (3 up)
  1. Speed
  2. Accuracy
- E. Trial Making Test
- F. Line Bisection Test
- G. Greene Hemianopsia Chart
  1. Orientation -centration (midline shift)
  2. Blind Field Tracking

3. Blind Field Saccadics (large Saccadic margin test)

VI. Yoked Prism- The challenge of adaptation
- A. Internalization of primary position
- B. Relative value of yoked prism as primary gaze recenters
- C. Power limited by optical aberration- swim, tilt, chroma

VII. Yoked prism alternatives
- A. Prescribed as a reminder (external prompt)
- B. Franklin Bifocal with yoked prism in segment only
- C. Double Franklin Bifocal
- D. Base-down Yoked prism- postural benefits persist

VIII. Video Presentation
- A. Patient A: Left Hemianopsia- Self directed adaptation
- B. Patient B: Left Hemianopsia- external prompting- benefits from prism
- C. Patient C: Left Hemianopsia- Neglect

While vision specialists are able to quantify the degree and character of visual field defects using traditional perimetric techniques, the character of the loss itself, as represented in the visual field chart, is not necessarily descriptive of the individual's ability to function with the deficit. There is a need to be able to quantify and qualify an individual's changes in visual function as a result of the visual field loss. Clinical tests that are effective, repeatable, and convenient would provide information which would not only aid in monitoring the recovery of the patient, but might also serve to help direct the vision rehabilitation program.

In a brief review of visual pathway lesions that cause visual field defects, we know that any lesion beyond the chiasm will cause some level of homonymous field loss. The further back we go the more congruous they will become. Lesions to the right cortex cause a left field defect and lesions to the left of course cause right field defects. This is important because anatomically related structures may also be affected from stroke and brain injury that may also be involved. As that the right parietal cortex is also involved with visual-spatial processing, left visual field defects may also be accompanied by hemi-spatial neglect. This is rarely encountered with right visual field defects, though it has been reported, usually though, in association with a more diffuse cortical involvement. The majority of our discussions today will involve frank right and left hemianopsias as they are most common.

Our traditional assessment tools as mentioned earlier are all familiar to you. They are quite effective at describing the character of the defect, assuming of course that we have a patient who is capable of helpful responses. Even in confrontation visual fields, individuals may pose many challenges in effectively assessing their fields. What must be stressed, however, is that these patients have full, frank defects. There is no vision within it. Doing an automated threshold test is not only usually a waste of time, it is also exhausting and may make your patient less capable of continuing through the assessment. We like to use a simple handheld arc perimeter, available through Bernell, that can be brought up to the patient, and where there fixation and responses can be supervised closely and where the entire test takes very little time.

There are of course, a number of observational and historical factors that can contribute to a functional assessment of an individual's level of functioning. Do they bump into walls, trip over objects underfoot, or walk with an imbalanced, perhaps side-stepping gate? Do they startle readily from one side. Do they miss self-care such a shaving or combing the hair on one side or the other. Do they lose their place while reading at the right or left margin, or do they have some sort of postural change that Padula has called a midline shift.

We have found that individuals with hemianopsias fall into one of three categories. Those who have adapted very well to their loss on their own , who may in fact fool us by their high level of function. There are those who are more challenged, but with therapy and perhaps optical intervention do improve. And then their are those, usually with hemispatial neglect, who we have yet to find ways to effectively support. Our goal today is to show you several methods we have developed that help us assess the nature of the individuals adaptation to their field loss and help predict the outcome of potential treatments. These have evolved over the years, and we have found them to be consistent from visit to visit as well as helpful in developing a treatment plan.

Early in the assessment, after the nature of the field defect has been confirmed by regular confrontation or arc perimeter fields, I perform a quick test that we call Finger Touch Fields or Functional Confrontation. We don't want to know what they see and what they don't see. We already know that. We now want to know how well they can find objects in the bad field and how they go about doing it. We ask them first to touch my finger in primary gaze. We tell them that they can move their eyes or head however they want, and then we place the finger in alternating fields, crossing the midline, and checking all four quadrants. We are watching the patients head and eyes and their search patterns into the effected fields. We mark their accuracy, speed, and organization. Its the first several trials that are often the most instructive as they begin to learn the task. However some don't learn and that's instructive too.

You will notice with this technique that the patient will turn their eyes to the good side, but turn their head to the bad side. The more effective they become, the more likely they will begin to use their eyes when looking to the bad side, but rarely will they become equivalent.

The Lateral Awareness Test uses a Maddox Rod Card available from Bernell as well. We ask the patient to tell us the highest number they can see while looking to the right and then to the left. The patient is allowed to scan as far as they want, though some try to maintain central fixation as if they were doing a field test. You should prompt them to look as far to the side as possible. There is a cognitive component here as the patient ought to realize that the card has numbers beyond what they can see to the bad side. Some will scan, others not. This absolute number gives you a measure of their scanning ability to the affected side.

The Saccadic Margin Test uses a 100 letter Hart's Chart that was originally developed for VT. We subsequently modified it to a larger size with 81 letters that we'll discuss later. The patient is shown the top left letter and then the top right letter, and is then asked to read the first and last letter of each line. The patient may begin to miss letters on the effected side. By counting the number of letters they miss, and since the total is 100, you can report a % of drift. Rarely is the drift greater than 30-35%, though I have seen drifts over 50%. You can think of this drift value as either the patient drifting into the defect, or the defect encroaching into the available field of view. This test is remarkably consistent, and responds with some patients to yoked prism trials. Patients return for follow-up and want to know if they are improving, and they look to this test as a way to know their progress.

We have developed a special "Hemianopsia Chart" specifically developed for this application. The Hemianopsia Chart is a 25 inch square chart with 81 20/115 size Sloan Acuity letters arranged in 9 rows of 9 letters each to form a square. The chart is intended to be used at a distance of 1 meter. Three subtests have been developed that offer information regarding different aspects of visual functioning with a homonymous visual field defect.

1. Orientation: Identifying straight ahead.
Individuals with a hemianopsia may present with an altered perception of their "visual space" which may be repositioned to either the right, left, up or down, or some combination. The degree and orientation of an individual's perception of "straight ahead" can be readily quantified with the hemianopsia chart.

a. Position the chart so that it is centered in front of the patient so that if you were to extend a line directly forward from their nose it would hit the letter "D" in the center of the chart.

b. Ask the patient to look at the chart and to report which letter appears to be in the very center of the chart. You can allow them to point to or touch the letter if necessary.

c. If the patient identifies the center letter then record the response as centered- "C". If the patient selects a letter two to the right- record the response as 2R. If the patient responds three letters to the left and two letters down- record as 3L2D.

d. At a distance of 1 meter, the center of each letter is 3.65 degrees away from the next. Letters on a diagonal are 5.15 degrees separated. With these references you can transform the actual "mis-orientation" into a degree notation if desired.

2. Blind Field Tracking- Tracking into the hemianopic field.
Individuals with homonymous visual field defects may have difficulty crossing the midline to track into and continue along within the hemianopic field. Patients must learn to track their eyes into the hemianopic field smoothly to support many visual tasks. Their ability to do so can be quantified with the hemianopsia chart.

a. With the hemianopsia chart placed at 1 meter, ask the patient to read the letters across the top line of the chart going from the normal field side "good side" into the visual field defect "bad side." You should expect that they will read the first several letters fluently, and then as they reach and read into the visual field loss, they may slow down markedly. Record the number of letters that the patient reads fluently as a value of their tracking ability into the visual field defect. By repeating the task several times on subsequent lines you can determine whether the patient is capable of self adapting by increasing fluent tracking into the bad field, or whether the

hemianopsia is encroaching upon the intact visual field. These subsquent line retests have been helpful to develop a prognosis regarding adaptation to the field defect..

b. If the patient has a left hemianopsia, they should start reading with the top right letter. If they are able to read four letters before they slow down- record as 4L. If they have a right hemianopsia they should start reading from the left. If they can read all nine letters fluently- record 9R. Record subsequent trials as ie: 4L, 4L, 5L etc.

3. Blind Field Saccadics- Scanning into the hemianopic field.

This is the same as the saccadic margin test that we do with the Harts Chart. We have begun to use this method rather than the paper method. We record the % the same as if it were a 100 letter chart

The Kirshner Visual Performance Test is the equivalent of a "Tread Mill" for the eyes. It allows you to test scanning, visual organization, visual-motor integration, and cognition in a close to real world activity. The patient looks at the target of 3 letters or numbers and then has to find the same string within one of five columns, cross through it and continue to the next line. It allows you to measure speed and accuracy. As there are three sets of tests per page, you can try different intervention methods to evaluate their effect upon performance. One problem with this test is that if the patient gets overly stuck on one or two responses it can greatly through off the results. An observational component is helpful, though certainly not quantifiable, with this test.

The Trail Making Test, The Line Bisection Test and others may also be helpful to quantify the level of visual function. These have been around for many years, however they are difficult to quantify.

Adaptive therapy to improve scanning to the effected side for reading includes such techniques as red lining the margin, finger pointing, reading guides and rotating the page. Dan Gottlieb has developed a prism segment technique that creates a monocular diplopia that allows subjects to see an image of the effected field superimposed upon the remaining field. Many patients have benefited from this technique however it does not apply to reading tasks.

Yoked prism techniques where the prism base is directed in the same direction for each eye has been promoted for many years. This technique, in effect, moves the image away from the field defect. It has been rather controversial as that Bailey and others has questioned the difference between this approach and simply moving the reading material further away from the defect, an adaptation that most patients develop on their own. Of course, the defect moves along with the line of sight, where-ever it is directed. We do have an internalization of primary position, and a muscle proprioproceptive sense of straight ahead. We know that repositioning an image optically does create a visuo-motor mismatch that may be beneficial in this instance. And individuals may demonstrate more fluent oral reading with yoked prism than without.

In any event, yoked prism power is limited by optical constraints. Powers above 8pd create excessive swim, tilt, and color fringes. Fresnel lenses while thinner cause additional image compromises that in our experience have been problematic and have caused patient rejection.

The question of adaptation to yoked prism is important. We have evaluated several hybrid yoked prism adaptation that attempt to minimize the adaptation effect and may yield a convenient external prompt to remind patients to attend to the affected side. These include Franklin bifocal lenses with yoked prism in the segment only, and a double Franklin with no prism in the center, a top position with distance Rx and yoked prism and a bottom bifocal power with yoked prism as well. The transition in and out of the prism correction causes the image to jump right and left and helps remind the individual to look to the effected side. Base-down yoked prism used to support an inferior altitudinal defect has been described by Allan Cohen at the NorthPort VA on Long Island. The postural benefits of vertical prism do not appear to attenuate over time.

We will now show you videos of three subjects. Each has a full left homonymous hemianopsia. The first subject fits into the first category of individuals who have adapted very well. The second has had a harder

adaptation but responds to treatment. The third has severe hemispatial neglect and performs poorly on these tests. He did not respond to any treatment techniques. These cases demonstrate the three categories of hemianopsia adaptations and show how we utilize the tests we have presented.