CHAPTER 3
HOW TO PERFORM PERIMETRY YOU CAN TRUST

INTRODUCTION

PERIMETRY – A SUBJECTIVE TEST

Perimetry is an elaborate test that depends, to a great extent, on subjective factors such as the patient’s cooperation and comfort, as well as on using the correct patient information and set-up. Due to this subjective component, untrustworthy visual field tests are common. The extent of untrustworthy results largely depends on how well perimetry is performed in clinical practice and has been reported to range from 3% to 29% of all visual field tests performed.¹⁻⁵

In view of the relatively high occurrence of untrustworthy visual fields, it is extremely important to make sure that the time invested in perimetry is well spent, because poorly performed perimetric tests have hardly any diagnostic value. It therefore pays to take the time and care necessary to obtain trustworthy results by following certain rules to avoid the most common pitfalls.
PERIMETRY – NEED FOR A TEAM APPROACH

Three key players are involved in perimetry: the patient, the examiner and the eye doctor. All three should work collaboratively to obtain optimal perimetric test results. FIG 3-1 shows how each member of the team can contribute. When this approach is successfully implemented, perimetry can be performed in a positive atmosphere.

FIGURE 3-1 In perimetry, it is essential that doctors, examiners and patients have a positive attitude towards perimetry and that each member of the team contributes to achieving optimum results.

THE IMPORTANT ROLE OF THE DOCTOR

THE DOCTOR-PATIENT RELATIONSHIP

Patients who understand why perimetry is needed and its importance to their eye care are likely to be more motivated to undergo a perimetric test. Due to the relationship and trust they establish with their patients, doctors are in the best position to convey the importance of perimetry to their patients.
THE DOCTOR-EXAMINER RELATIONSHIP

Eye doctors should also clearly convey the importance of perimetry to the visual field examiners who work with them in the clinic. For example, the doctor is responsible for ensuring that the visual field examiners understand the importance of trustworthy perimetric results to the clinical decision-making process. The visual field examiners should know that the doctor has a genuine interest in building their perimetric knowledge and skills. Towards this goal, the doctor must provide training and give feedback to the examiners. It is also crucial for the doctor to have reasonable expectations in terms of the time required to perform trustworthy perimetric tests. Doctors should arrange for their visual field examiners to be able to dedicate time exclusively to performing perimetric tests. This means that they should be free of other tasks that might reduce the examiner’s focus on the patient.

THE IMPORTANT ROLE OF THE VISUAL FIELD EXAMINER

The visual field examiner is in a unique position to have an impact on the quality of the perimetric results in two ways. Not only are examiners responsible for correctly setting up the perimeter, they also directly oversee the patient during the test.

ROLE IN CORRECTLY SETTING UP THE PERIMETER

The visual field examiner is responsible for entering the correct patient information in the perimeter. This is crucial because this information has a direct impact on whether the results of the test can be trusted. Diligence in performing this aspect of perimetry can significantly reduce the number of untrustworthy tests and interpretation errors. The examiner is also responsible for ensuring that an adequate refractive lens is used.

THE EXAMINER-PATIENT RELATIONSHIP

A crucial role of the visual field examiner is to ensure that the patients perform perimetry to the very best of their capacity each time they take a test. To give their best performance, patients need to be comfortably positioned at the perimeter, they need to know what is expected of them, and they need to understand how to perform the test. A competent examiner will ensure that the patient is not only correctly positioned, but also comfortable. Similarly, a good examiner will convey what is expected of the patient and will give clear instructions on how to perform the test. The examiner can also provide brief rest periods by pausing the test if this will be helpful to the patient. Additionally, the patient should be encouraged to communicate to the examiner any difficulties or problems encountered, and when a brief rest period would be beneficial.

There is more, however, to the role of a visual field examiner. Outstanding examiners will have taken perimetric tests themselves and will understand how the patient feels during the test. This compassionate approach will go a long way in ensuring patient cooperation and will allow the examiner to give genuine encouragement to the patient when needed during the test.
HOW TO PERFORM VISUAL FIELD TESTING

SETTING UP THE PERIMETER

Perimetry should be performed in a distraction-free environment, to enable the patient to concentrate on the perimetric test (FIG 3-2). The room should be quiet, with no activity distracting the patient, and should be at a comfortable room temperature. The cupola should be kept clean and free of dust and particles. Additionally, the room should be dimly lit, to prevent stray light from influencing the perimetric result. A dimly-lit environment is essential when a cupola perimeter, such as the Octopus 900 is used, but is also helpful for non-cupola perimeters.

Ideally, perimetry should be performed in a room dedicated solely to this purpose. However, if the layout of the clinical practice does not offer a stand-alone perimetry room, opaque curtains around the perimeter and earmuffs offer a cost-effective alternative.

The perimeter is automatically calibrated each time it is turned on. It is important for the calibration to take place in the same lighting conditions as those used during perimetric testing. Calibration can take up to two minutes and should be performed prior to testing patients. Thus, the perimeter should be turned on prior to the patient visit.

Ideally, patient data (date of birth, refraction, etc.) are entered before the patient enters the room. If an electronic medical record system is in use, it will automatically populate the information to the perimeter.
PLACING AN ADEQUATE TRIAL LENS

The trial lens calculator is helpful in determining the adequate spherical and cylindrical trial lenses, based on the patient’s current refraction and age. It is vital to ensure that the patient’s refractive data is up-to-date and it is best practice to determine this prior to each test. The correct trial lens should be put into the trial lens holder prior to seating the patient. Trial lenses with a narrow metal rim should be used, to prevent the rim of the trial lens from blocking the patient’s field of view. If more than one trial lens is used, the spherical correction should be placed closest to the patient’s eye. Special attention should be given to the orientation of cylindrical lenses, which should be oriented in the angle of the astigmatism (FIG 3-3).

To confirm that adequate refraction is used, the examiner should position the patient and ask whether the fixation target is clearly visible.

INSTRUCTING THE PATIENT

Due to the subjective components involved in perimetry, careful patient instruction is fundamental to achieving trustworthy results. Patients will be able to cooperate more effectively and produce more consistent results if they understand what is expected of them and why the test is being performed.

The visual field examiner should therefore take the time to explain the aim of the test, what the patient should expect to see, and what the patient is expected to do (FIG 3-4). It can be helpful for examiners to take a perimetry test themselves, in order to gain a better understanding of what patients are experiencing.

It is fundamental to ensure that the patients know that they are not expected to see all stimuli and that sometimes no stimuli are presented. This will help to reduce some of the potential anxiety experienced by patients, who should also know that they can pause the test if they experience fatigue or have questions.
### STEP-BY-STEP PATIENT INSTRUCTIONS

1. Perimetry tests your central and peripheral vision.

2. Be relatively still once positioned.

3. Always look straight ahead at the fixation target. Do not look around the bowl for stimuli.

4. Press the response button whenever you see the stimulus.
   a. The stimulus is a flash of light.
   b. Only one stimulus is presented at a time.
   c. The stimulus might appear anywhere.
   d. Some stimuli are very bright, some are very dim, and sometimes no stimulus is presented.
   e. You are not expected to see all stimuli.
   f. Do not worry about making mistakes.

5. Blink regularly to avoid discomfort.
   a. Don’t worry about missing a point, the device does not measure while you blink.

6. If you feel uncomfortable or are getting tired
   a. Close your eye for a moment, the test will automatically stop.
   b. The test will resume once you open your eye.

7. If you have a question
   a. Keep the response button pressed; this will pause the test.

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**FIGURE 3-4** Proper instructions to the patient are essential for the patient to understand their task and consequently to perform perimetry well. The sequence of instructions listed in this Figure can be used.
SETTING UP AND POSITIONING THE PATIENT

Trustworthy and accurate perimetric results are more likely to be obtained when the patient is comfortable during the test. It is also important to ensure that the patient is correctly positioned and that the non-tested eye is covered. The optimum ways to ensure patient comfort and correct alignment will be discussed in this section.

CORRECT EYE PATCH POSITION

Before fully positioning the patient, the eye not being tested should be covered with an eye patch that allows the patient to blink freely (FIG 3-5). If the eye patch is maintained in place with a cord, it is important to ensure that the cord does not obstruct the patient’s field of view for the tested eye. If an adhesive eye patch is used, it is important to make sure that it adheres well all around the eye. All eye patches should be translucent, to avoid adaptation to the dark by the untested eye, which would alter the results of subsequent testing of that eye.⁶

CORRECT PATIENT POSITION

The patient should be seated in a comfortable position that can be easily maintained throughout the test. A height-adjustable chair with a backrest and, if available, armrests should therefore be used. The perimeter should be placed on a height-adjustable table to ensure that the patient is comfortable. Different Octopus models offer different types of positioning: the Octopus 900 offers a straight-upright patient position and the Octopus 600 offers a forward-leaning position.

FIGURE 3-5 An eye patch should cover the eye that is not being tested. It should be positioned so as to not obstruct the patient’s vision in the tested eye.
For the Octopus 900 and all older Octopus models, the patient should sit as close as possible to the device. Then the height of the table should be adjusted until the patient’s forehead touches the headrest. The patient should place his or her chin on the chinrest and forehead on the headrest (FIG 3-6). It is important to ensure that the patient maintains direct contact with the device throughout testing.

For the Octopus 600, the patient is positioned in a forward-leaning and downward-gazing position (FIG 3-7). The correct position is obtained by first seating the patient in an upright position at a distance of approximately 20cm/8 inches, with the eyes at the upper level of the headrest, to allow enough space to lean forward. By inclining from this position, the patient is automatically positioned at the correct height. The patient’s head leans in fully onto the headrest, providing stable fixation.
CORRECT EYE POSITION

Once the patient is correctly positioned in the device, it is important to ensure that the eye is also correctly positioned. Overall, the eye should be well-aligned with the fixation target and should be relatively close to the trial lens. However, the lens should not touch the eyelashes, allowing the patient to blink freely and avoiding the lens being smeared with make-up.

CORRECT PUPIL POSITION

The left-hand panel shows an eye in the video monitor that is correctly positioned, with the cross-hair target located within the boundaries of the pupil. The right-hand panel shows an eye that is incorrectly positioned, with the cross-hair target located outside the boundaries of the pupil.

CORRECT TRIAL LENS POSITION

The Octopus perimeters provide a video monitor so that the examiner can see the patient’s eye. When the patient looks straight at the fixation target, the pupil should be aligned with the cross-hair target provided on the video monitor. The patient is correctly positioned when the cross-hair target is within the boundaries of the pupil (FIG 3-8). The position of the pupil can be adjusted by changing the position of the chinrest.

It is important for the patient’s eye to be as close as possible to the trial lens, in order to avoid the typical “ring” defect (i.e., trial lens rim artifact) that occurs when the patient is positioned too far away from the trial lens (FIG 3-9). The eyelashes should not touch the lens, however.
When a visual field test assesses both the central and the peripheral visual fields, it will be necessary to remove the trial lens for the part of the test that covers the periphery, in order to avoid trial lens rim artifacts. Also, visual fitness to drive is assessed binocularly (both eyes open). In this case, no trial lens should be used.

**CORRECT FIXATION**

It is essential for patients to maintain steady fixation throughout the test. The Octopus perimeters offer three different fixation targets (Fig 3-10) to promote steady fixation in as many patients as possible. Most patients will be able to maintain fixation using the standard cross mark fixation target. If patients have difficulty understanding where to look when the cross mark fixation target is used, the central point fixation target can be used, provided that the test pattern does not test the central point. For this reason, the central point fixation target is not recommended for the G, M, N and D patterns (see Chapter 5) and for any pattern where the foveal threshold function is turned on.

Finally, some patients with severe visual field loss in the macula region may not be able to see the standard cross mark fixation target. In these patients, the use of the larger ring target is recommended, to provide an estimate of the location of the fixation target.

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**FIXATION TARGETS**

<table>
<thead>
<tr>
<th>CROSS MARK</th>
<th>CENTRAL POINT</th>
<th>RING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard</td>
<td>Alternative</td>
<td>For patients with severe visual field loss in the macula</td>
</tr>
</tbody>
</table>

**FIGURE 3-10** Octopus perimeters offer 3 different fixation targets. The cross mark target is the default target. The central point target can be used in test patterns that do not test the central point. The ring target is recommended for patients with fixation issues due to severe visual field loss in the macula.
MONITORING THE PATIENT DURING THE EXAMINATION

To ensure good patient cooperation and trustworthy results, it is essential to monitor patients throughout the examination and not leave them unattended and unmonitored. During the test, it is helpful to encourage patients by telling them that they are doing well and by letting them know how much of the test they have already completed. This will help them to remain attentive and may reduce anxieties that might negatively influence the results.

Particular attention should be paid during the first minute of the test, to ensure that patients have understood what they are expected to do during the test. If a patient shows an unusual response (e.g., no response at all, a response even if there is no stimulus, or unsteady fixation), the test should be interrupted and the patient should be reinstructed. If the results seem compromised, it is recommended to start a new test and discard the compromised one. It is important to note, however, that patients with impaired vision often do not respond due to their condition and not because they answer unreliably.

If a patient shows inconsistent behavior, the examiner should make a note of this on the examination file, to communicate this information to the clinician. The knowledge that the test has reduced reliability may influence the interpretation of the test.

USE OF FIXATION CONTROL

Loss of fixation is a primary reason for unreliable visual field results. Therefore, all current Octopus devices have a built-in Fixation Control for static testing that can track the patient’s pupil at all times and prevent fixation errors. With Fixation Control, the test is stopped automatically if the patient loses fixation (due to blinking, searching for stimuli or head movements) and automatically restarted once proper fixation is regained. Missed stimuli are automatically repeated later during the test. If fixation loss occurs for more than just a few seconds, a warning message will alert the examiner to properly reposition and reinstruct the patient.

Fixation Control consists of several separate control mechanisms, as outlined in FIG 3-11, which can be turned on and off. It is recommended to keep each of the Fixation Control mechanisms active. However, since some patients might not be able to maintain steady fixation for pathological reasons (i.e., reduced central vision, unsteady pupil or nystagmus), individual mechanisms within Fixation Control can be turned off individually, to make patient testing possible. If it is necessary to turn off some mechanisms, careful patient monitoring is key and it is good practice to make a note in the patient file about the patient’s ability to maintain fixation. The clinician should then interpret the results in the light of this information and should consider that the test might have reduced reliability.

FIG 3-11 provides more information about the different control mechanisms of Octopus Fixation Control. Note that the configuration depends on the Octopus model.
**FIXATION CONTROL PREVENTS FIXATION LOSSES**

**BLINK CONTROL**

- **RUNNING**
- **PAUSED**

Prevents fixation loss due to blinking.
- Detects eye closure due to blinking or falling asleep
- Testing occurs only if the patient’s eye is open
- Allows the patient to blink normally
  - Prevents dry eyes
  - Increases patient comfort
- Ensures that no stimuli are missed due to blinking

**CONTACT CONTROL**

- **RUNNING**
- **PAUSED**

Prevents loss of contact with the perimeter.
- Detects contact with the headrest or chinrest
- Testing occurs only if the head is in contact with the device
- Ensures that the head remains close enough to the device to minimize lens rim artifact

**PUPIL POSITION CONTROL**

- **RUNNING**
- **PAUSED**

Prevents fixation losses due to incorrect pupil position.
- Detects off-centered pupils due to incorrect fixation or head movement
- Testing occurs only if the pupil is correctly centered
- Ensures correct gaze direction

**DART CONTROL**

- **RUNNING**
- **PAUSED**

Prevents fixation loss due to rapid eye movement.
- Detects rapid eye movement when the patient is searching for stimuli
- Testing occurs only if the pupil is steadily fixating
- Ensures correct gaze direction

**AUTOMATED EYE TRACKING (AET)**

- **RUNNING**
- **ADJUSTING POSITION**

Automatically adjusts the patient’s eye position.
- Moves the headrest and chinrest to keep the eye in the center of the trial lens
- Maintains optimum position even if the patient is moving around slightly
- Reduces trial lens rim artifacts due to off-centered eye position

**FIGURE 3-11** Fixation control prevents fixation losses by automatically pausing the test during blinks, loss of contact with the device, off-centered pupils and rapid eye movements. The test is automatically restarted once optimum conditions are achieved. Further, Automated Eye Tracking automatically centers the pupil. Note that not all mechanisms are available on the different Octopus perimeter models.
COMMON PITFALLS TO AVOID

There are many factors that can lead to visual field tests that cannot be trusted. By paying attention to and managing these factors, a well-trained examiner will have a substantial positive influence on the quality of the visual field results and on the subsequent clinical decisions. Therefore, this section is dedicated to the most common pitfalls in perimetry and provides guidance on how to avoid them.

Patient behavior (i.e., lack of patient cooperation), errors in the set-up procedure, and external obstructions blocking the stimuli from reaching the retina, are all commonly occurring sources of untrustworthy visual field results. Many of these pitfalls can be avoided by paying close attention to the set-up procedure, by observing the patient carefully during testing, and by making adjustments or repeating instructions if necessary, which is the focus of this section. Chapters 7 and 8 provide information on how to detect visual field results that cannot be trusted after the test is completed.

INCONSISTENT PATIENT BEHAVIOR

LEARNING OR PRACTICE EFFECT

When taking their first tests, patients often do not fully understand the nature of the test and hesitate to press the button when seeing faint stimuli near the sensitivity threshold. This translates into visual field results that are worse than the patient’s true visual field, as illustrated in FIG 3-12. In subsequent testing, the patients then perform better and their visual field results resemble their true visual function more closely.

While learning and practice effects most often occur for patients taking their first visual field examination, they can also occur when switching from one perimeter to another, due to small differences in the design (see Chapter 12).

EXAMPLE OF A LEARNING EFFECT

FIGURE 3-12 Example of a patient with normal vision with a strong learning or practice effect from the first to third visual field tests. The fourth and fifth tests represent the true visual field of the patient.
While learning or practice effects cannot always be prevented, their frequency can be reduced by careful patient instruction and observation. Running a practice test prior to real testing is a good procedure if time allows. Careful observation during the first minute of the test is also helpful. If a patient does not understand the task of performing perimetry, the patient will often be hesitant during the first part of the test, or will not press the response button at all. If this is observed, it is recommended to interrupt the test and reinstruct the patient.

**FATIGUE EFFECT**

Visual field tests require alertness and attention. When patients become tired, their attention level may decrease and their answers may become less consistent, resulting in a visual field that is worse than the patient’s true visual field (Fig 3-13). To reduce fatigue effects for patients who have difficulty concentrating for long periods of time, it may be appropriate to use tests that are shorter in duration, despite the associated loss of accuracy. This may generate more meaningful visual field results by reducing the unreliability due to the fatigue effect. Individual differences exist in how quickly patients experience fatigue, and this should be considered when selecting a test.

To further reduce fatigue effects, patients should be advised to blink regularly to avoid dry eyes and discomfort, given that Fixation Control is active. Artificial tear drops prior to the test may also reduce fatigue effects due to dry eyes. Additionally, patients should be encouraged to take brief rests, by closing their eyes to relax, if they feel that they are getting tired. Usually, this adds only a few seconds to the test duration, but significantly improves the reliability of the results. Furthermore, using a beeping sound upon each stimulus presentation may help the patients to concentrate better on the test. Box 3A provides more information about the advantages and disadvantages of this option.

Sometimes fatigue is noticeable as drooping eyelids. In such cases, it is best to actively interrupt the test for a while and to allow the patient to rest before continuing testing.

**INFLUENCE OF FATIGUE EFFECT ON VISUAL FIELD**

![FIGURE 3-13 Example of a patient tested on the same day and eye within 15 minutes. Note the significant worsening of the visual field in the second test, due to fatigue.](image-url)
**Common pitfalls to avoid**

**LOSS OF FIXATION**

If a patient does not consistently fixate on the central target, the test will lose its reference point and it will not be possible to identify the location of abnormal visual field points (FIG 3-14). This is called fixation loss and is one of the most common sources of unreliable fields. It occurs especially if the patient is insecure about his or her performance and starts looking around, searching for stimuli. To avoid fixation losses, it is therefore crucial to explain carefully to the patient that it is perfectly normal not to be able to see all of the stimuli.

The Octopus Fixation Control should be enabled whenever possible, to avoid unreliable visual fields due to fixation losses. It should only be turned to a lower setting or completely turned off if a patient is not able to maintain steady fixation, for pathological reasons (i.e., reduced central vision, unsteady pupil or nystagmus). Direct observation of the patient’s fixation behavior early in the test can also be helpful in this regard.

**INFLUENCE OF LOSS OF FIXATION ON VISUAL FIELD**

**CORRECT FIXATION**
Real defect is detected

**LOSS OF FIXATION**
Real defect is missed and/or artifactual defect is identified

**FIGURE 3-14** If there is a loss of fixation, visual field defects will not be in their exact location, but will either be shifted together with the fixation or masked. In the above example, loss of fixation took place during the entire test. In practice, loss of fixation is typically brief, resulting in more random defect patterns.

**ADVANTAGES AND DISADVANTAGES OF USING SOUNDS UPON STIMULUS PRESENTATION**

A beeping sound upon stimulus presentation may be helpful for some patients, to maintain their attention during the perimetric test, because it provides them with a steady rhythm to follow. Additionally, it provides reassurance to the patient that the test is running and everything is working normally.

However, the beeping sound may also encourage patients to press the response button even though they cannot see a stimulus. This may increase false answers, resulting in unreliable visual fields. In addition, if more than one perimeter is in a room, the beeping sound of neighboring machines may be distracting.

By default, it is thus recommended to turn the beeping sound off and to only use it for selected patients that have difficulties with maintaining concentration throughout the test.
LACK OF PATIENT ATTENTION

Visual field tests require the patient’s full attention. Distractions such as noise can negatively influence the patient’s test performance. In addition, some patients experience anxiety when performing visual field tests, due to fear that they are not performing well, or anxiety about the outcome.

TRIGGER-HAPPY PATIENTS

Some patients, consciously or unconsciously, want to positively influence the result of the visual field test (e.g., if their ability to drive is at stake, or if they fear a bad diagnosis). These patients may be trigger-happy, pressing the response button even if they do not see a stimulus. False positive trials where no stimuli are presented are used to detect trigger-happy patients (for more details, see Chapter 7). It is important to watch for false positive answers carefully during the examination. If a patient responds to more than one false positive stimulus during the test, it will be helpful to interrupt the test immediately and restruct the patient, in order to avoid an unreliable result. Note that a beeping sound upon stimulus presentation may encourage trigger-happy patients to press the response button and it is thus recommended not to use this, except in specific situations.

MISTAKES IN THE SET-UP PROCEDURE

ACCURATE ENTRY OF PATIENT INFORMATION

Patient data, such as date of birth and refraction, need to be entered in the perimeter. It is important to ensure that this information is accurate. For example, if the wrong date of birth is entered, most representations of the visual field test will be inaccurate, because each set of measured sensitivities is compared to the data for an average normal person of the same age, rather than an average normal person who is younger or older. FIG 3-15 illustrates the influence of incorrect patient age on the patient’s visual field.

INADEQUATE CORRECTION OF REFRACTIVE ERROR

Inadequate correction of refractive error can lead to a blurring of the stimulus. If the patient does not have a sharp image of the stimulus, the visual field results will be worse than the patient’s true visual field. Additionally, a lens with too much plus power can lead to an artificially enlarged visual field, while a lens with too much minus power will have the opposite effect.

The first source of error is that the patient has been incorrectly refracted, or that the examiner uses the wrong refraction for a patient. To avoid this, it is recommended to check the refraction on the same day as the perimetric test. Even if the patient’s refraction has been checked previously, it is possible that it may have changed since then, especially among older patients.

The second source of error is the incorrect choice of trial lens. It is important to consult the user manual for the respective perimeter, as the choice of trial lens depends on the perimeter model. The paragraphs below describe
**Common pitfalls to avoid**

**BOX 3B**

**CORRECT AGE**

58 years

**INCORRECT AGE**

Too old: 88 years

Too young: 18 years

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**INFLUENCE OF INCORRECT PATIENT AGE ON VISUAL FIELD RESULTS**

**FIGURE 3-15** If the date of birth of a 58-year-old patient (A) is incorrectly entered, so that the patient’s age is 88 in the perimeter, the results will be artificially good (B). If the same patient is entered as an 18-year-old patient, the results will be artificially bad (C).

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the choice of trial lens for the current Octopus models 900 and 600.

Patients need their far-distance correction for relaxed vision. Depending on age, an added near-distance correction for presbyopia is also needed, because perimeters test at near distances. It is important to use the adequate correction for presbyopia proposed by the perimeter’s manufacturer, and not the patient’s reading glass prescription. Special attention should be given to noting the sign (plus or minus) of the correction. If a minus lens is employed when a plus lens should have been used, the patient’s vision may become blurry.

To save time and avoid mistakes, it is recommended to always use the built-in trial lens calculator to determine the required refractive lens. The trial lens calculator always uses the patient’s actual best far-distance correction. It then automatically calculates the necessary age-dependent near-distance correction. It determines and recommends the trial lens with the lowest possible power, in order to minimize the risk of artifacts. **BOX 3B** presents the underlying assumptions of the trial lens calculator.

It is best practice to ask each patient prior to starting the test whether they can see the fixation target sharply and, if necessary, adjust the refraction so as to avoid inadequate correction of the refractive error.

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**RATIONALE USED IN THE DESIGN OF THE TRIAL LENS CALCULATOR**

**DETERMINATION OF APPROPRIATE SPHERICAL LENS**

The current Octopus perimeter models 600 and 900 present stimuli at a distance of 30 cm (11.8 inches) from the eye. This corresponds to an approximate refraction of + 3.25 diopters (D), as calculated using the following formula:

\[
\text{Power (D)} = \frac{1}{\text{stimulus distance (m)}} = \frac{1}{0.3} = 3.33
\]

To enable the patient to focus at this distance, the patient’s far-distance refraction values are needed. Depending on the patient’s refraction, different scenarios occur:
**Normally sighted patients:**

Young emmetropic patients can accommodate at 30cm, so they do not need an additional trial lens. With increasing age, patients gradually lose their ability to accommodate their eyes (i.e., to change their lens power) to objects presented at near distances. To facilitate near optical correction, additional diopters (D) of refractive power are needed depending on the age of the patient (see table below).

**Hyperopic and presbyopic patients:**

Hyperopic patient may have difficulty to focus at 30 cm. For these patients, a trial lens is needed, corresponding to their refraction (R). As with emmetropic patients who are older, additional diopters (D) are needed to support their near optical correction (presbyopia) (see table below).

**Myopic patients:**

Near sighted patients of up to -3 D do not necessarily need corrective lenses, as they can focus at 30 cm. Patients with strong myopia (greater than -3 D) will have difficulty focusing at 30 cm and need additional correction. For refractive values above -3 D, add 3.25 D to the refractive value (e.g., for R = -4 D; use a -0.75 D lens). As for presbyopic and emmetropic patients, with increasing age, near optical correction is more difficult and additional diopters are needed.

**Corrections in the cupula perimeter of Octopus 900**

Cupula perimeters allow for full-field peripheral testing that extends beyond the range of a trial lens. Therefore, all lenses and the lens holder must be removable to allow for peripheral testing. No trial lens should be used for testing beyond 30° eccentricity. The Octopus 900 has a built-in trial lens calculator to determine which trial lens should be used. The following look-up table shows the outputs of the Octopus trial lens calculator.

<table>
<thead>
<tr>
<th>Age</th>
<th>Hyperopic</th>
<th>Emmetropic</th>
<th>Myopic</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>R &gt; 0 D</td>
<td>R = 0 D</td>
<td>R = -0.5 D</td>
</tr>
<tr>
<td>&lt; 30</td>
<td>R</td>
<td>No lens</td>
<td>No lens</td>
</tr>
<tr>
<td>30 – 39</td>
<td>R + 1.0 D</td>
<td>+1</td>
<td>+0.5</td>
</tr>
<tr>
<td>40 – 44</td>
<td>R + 1.5 D</td>
<td>+1.5</td>
<td>+1.0</td>
</tr>
<tr>
<td>45 – 49</td>
<td>R + 2.0 D</td>
<td>+2.0</td>
<td>+1.5</td>
</tr>
<tr>
<td>50 – 54</td>
<td>R + 2.5 D</td>
<td>+2.5</td>
<td>+2.0</td>
</tr>
<tr>
<td>55-59</td>
<td>R + 3.0 D</td>
<td>+3.0</td>
<td>+2.5</td>
</tr>
<tr>
<td>&gt;= 60</td>
<td>R + 3.25 D</td>
<td>+3.25</td>
<td>+2.75</td>
</tr>
</tbody>
</table>

**Correction in the central field perimeter of the Octopus 600**

In order to simplify the clinical workflow, the Octopus 600 perimeter has a built-in +3.25 D lens that covers the central 30° of the visual field. All patients, irrespective of age, therefore receive the maximum correction for presbyopia. Only their actual refraction (R) is needed. If younger patients are over-corrected, they are able to compensate by relaxing their lens without negative effect on their visual field.

**DETERMINATION OF APPROPRIATE CYLINDER LENS**

**Cylinder Correction (Octopus 900)**

A cylinder correction can be discarded when the prescription is 0.25 D or less, because it does not alter the result of the visual field test. For cylinders from 0.5 to 1 D, the spherical equivalent is used and added to the spherical lens needed for each patient. The spherical equivalent is calculated using the following formula:

\[
\text{Spherical equivalent} = \frac{1}{2} \times \text{cylinder correction}
\]

This formula is an approximation that adequately corrects for small cylinders, but does not sufficiently correct for cylinders larger than 1 D. For cylinders larger than 1 D, a cylindrical correction is needed. Remember to get the cylinder axis oriented to the proper angle on the lens holder. (For the special case of the Octopus 600 refer to the user manual).
EXTERNAL OBSTRUCTIONS BLOCKING STIMULI FROM REACHING THE RETINA

LENS RIM ARTIFACTS

If the edge of the trial lens blocks the patient’s view (Fig 3-16), the visual field results will be adversely affected and will show absolute defects at the edges. To avoid trial lens rim artifacts, the patient should be positioned so that the eye is as close as possible to the trial lens without touching it, and aligned in the center of the trial lens holder. The Octopus 900 provides a measurement function to warn if the lens is too far from the eye.

INFLUENCE OF LENS RIM ARTIFACTS ON VISUAL FIELD RESULTS

A) NO ARTIFACT

B) LENS RIM ARTIFACT

Fig 3-16 If the patient is correctly positioned close to the trial lens (A), rim artifacts do not appear within 30° of the field of view. If the patient is too far away from the trial lens (B), the edge of the visual field shows the rim of the lens.

FACIAL STRUCTURE OF THE PATIENT

It is important to observe the physiognomy (facial structure) of the patient. A prominent nose, a heavy brow or long eyelashes can alter the field of view, leading to misinterpretation of the visual field results. If there is a prominent facial structure, it is recommended to turn or tilt the patient’s head to the side slightly, without losing fixation.

DIRTY CONTACT LENS

Since very high corrections can lead to peripheral distortions, it is advisable for a patient with very high corrections to wear contact lenses. Patients with moderate myopia may also leave their contact lenses in. If contact lenses are used, they must be inspected before the test. Dirty contact lenses reduce the amount of light entering the eye, resulting in a diffuse defect. This will also appear in the Defect Curve as a downward shift of the entire curve.
PUPIL SIZE

The amount of light entering the eye is controlled by the diameter of the pupil. As a rule, the pupil must have a diameter of at least 3 mm for the results of the test to be trustworthy. Small pupils decrease the amount of incident light on the retina and result in a uniform depression of the visual field (FIG 3-18). Increasing diffraction around the margin of the pupil may also be observed. These artifacts may simulate glaucomatous visual field defects. To avoid this, patients with a pupil size of less than 3 mm, as measured in a dimly-lit room, may be dilated before the perimetric examination. Highly artificially dilated pupils may, however, occasionally lead to mild peripheral visual field distortions.

FIGURE 3-17 Pptosis (droopy lid) results in external superior obstruction of the visual field that is not related to any pathology of the eye (A). Patients with severe ptosis or dermatochalasis should therefore be tested with the lid taped up (B), in order to assess the visual field without the effect of ptosis, as seen in the example below.

FIGURE 3-18 If a patient’s pupil is too small, the overall sensitivity to light will be reduced, resulting in a visual field with diffuse defect.
Obtaining reliable results is important in order to interpret the visual fields correctly. Unreliable visual fields unfortunately occur relatively often in clinical practice. In more controlled conditions such as the large Ocular Hypertension Treatment Study (OHTS), fixation losses were the most frequently observed cause of unreliable visual fields, accounting for 70% of all unreliable visual fields. The second most frequent cause of unreliable visual fields was false positive errors, which accounted for 18% of all unreliable visual fields. Of all the visual field hemifields included in the OHTS, 0.4% had rim artifacts, while superior and inferior depressions due to facial features accounted for only 0.2% of all hemifields. In less controlled conditions, these numbers may be significantly higher.

REFERENCES


