Clinical Techniques for Prescribing Bioptic Telescope Devices

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Course Description:

This course presents a practical, clinical approach to evaluating visually impaired individuals for bioptic telescopes. It teaches a clinical protocol for the assessment of an individual's visual needs, clinical methods for determining appropriate patients, and for establishing a prognosis for likely prescription success. Methods for fitting and training patients and practice management tips are also included. It is hoped that the attendee will leave with practical knowledge that they can apply with their next low vision patient.

1. Challenges of Low Vision Care

The major optical goal in low vision care for central vision loss is to magnify the image sufficiently to make it discernable by the patient. Patients know that they can read the newspaper headlines but not the small print, so in effect we make the small print as large as the headlines. However, magnification minimizes the field of view, distorts the image, shortens the working distance, and constrains the depth of field—all of these work to undermine fluency and increase fatigue. Large print, electronic magnification, reading machines and books on tape can address these factors.

2. The activity distance determines the type of management

Optical magnification requires that the material to be viewed be held at the focal length of the optical system. For hi- add readers and magnifiers this is usually much closer than the habitual working distance of the user, but with training and practice it can usually be accommodated. Conversely, some activities must be performed at distances defined by the activity such as computer screens, cooking, reading music, seeing faces, theater, TV, signs, blackboards, and traffic signals for example. In activities such as these the optical device must provide a working distance supportive of the activity—and magnify the image enough to be able to resolve it by the use of telescopic aids, either focusable or fixed-focus using reading caps selected for specific working distances. Of course, there are instances where simply moving close-enough is an option, but when that is impossible, impractical or inappropriate, telescopic aids provide the only option.

3. Reading is a solitary activity

Reading is usually done at home or in isolated situations. It is usually the first activity that the patient hopes to improve, and it is usually the easiest to support as print is high contrast, lighting can be controlled, and the devices prescribed are often familiar to most individuals. Reading is also the most easily replaced through other options—radio, books on tape, sighted readers, and reading machines.

4. Distance vision is a social activity

Distance vision, however, is often a public activity, and impacts social interaction and hence quality of life. The loss of the ability to see body language and make eye contact can be isolating and can contribute to depression amongst the visually impaired. Loss of distance vision usually impacts independence and self-worth much more so than loss of reading and it cannot readily be replaced through other modalities.

5. Refraction--our first option to improve distance vision.
Of course, refraction is our mainstay. If we can make a sufficient improvement in acuity by refraction, (usually a two-line improvement is required for the patient to experience a functional gain), than obviously that would be our first and most convenient option. A brief retinoscopy through the current eyeglasses (if any) can be valuable to see how close to neutral the reflex is as well as its quality. If the reflex is dull due to media issues, consider therapeutic options that might improve it. No amount of lens power will impact acuity if there are significant media opacities. If the patient is post cataract surgery with IOLs, it is unlikely that they will have a significant refractive error.

Generally, by the time a patient gets to a low vision practitioner, if a new refraction would have been of value, it would have already been prescribed. Remember, small changes don't make big differences! If a patient sees 20/400 a half diopter or 10 degree axis change will be of little value. Changes in refraction will have more potential impact when acuity is 20/70 or better as a modest change might yield 20/50 and that can be helpful. Improving acuity from 20/400 to 20/300 is unlikely to impact the patient's functional life. I find K's can be a very valuable tool. The character of the mires as well as cylinder can often be missed and this data can sometimes make a difference in better seeing individuals.

I always use a trial frame; I find it more reliable and it allows for a better rapport with the patient. Trial frames are especially important with high cylinders, because it lets the patient maintain their normal posture rather than an unnatural one induced by the phoropter, which can avoid a host of refraction hassles.

Remember to make a sufficient enough power change for the patient to notice. If they can't notice a half-diopter change, then try one or even two-diopter changes. There's no use in making changes smaller than what the patient can reliably respond to- everyone will just get frustrated and you'll not make any progress. Remember also that the high-contrast acuity chart is a poor determiner of functional value- I find it much more helpful for the patient to look at a low contrast target such someone's face at the furthest distance that they can normally see it. If the patient can notice a difference, then it's likely to be of functional value. If they don't notice a difference than I don't pursue it further. Keep in mind also that acuity will fluctuate as fixation varies. Don't let a fleeting acuity improvement fool you into thinking it's the refraction change that's helping. The prescription change has to be enough to make a "real" difference! Remember that if the patient can "almost see something" they still can't see it!

When refraction is the best you can achieve and acuity remains inadequate for the patient's goals, than there's only one option left to further enhance distance vision- make it bigger! And, of course, we have only two ways to do that—walk up close enough to see it, or, make it closer optically. This discussion will center on optical telescopes, though we will discuss electronic displays as well.

6. Low Vision Telescope Optics "101"
As is well known, optical telescopes are available in two designs—Galilean and Keplerian. Each has its distinct characteristics and attributes.

Galilean telescopes are small and lightweight due to their rather simple optical design. They produce a bright image but offer rather narrow fields of view (about 5 degrees at 3x) and tend not to be sharp edge-to-edge. They are available as both fixed-focus and focusable versions and are usually prescribed in 1.7x, 2.2x and 3x powers, but are available as high as 6x . Because of their small size and low weight they are convenient for binocular prescriptions.

Keplerian telescopes are longer and heavier as they incorporate prisms to reorient what would otherwise be an inverted image. They offer fields of view at least twice as large (about 12 degrees at 4x) as Galilean telescopes, but due to the greater number of optical components they are dimmer and have reduced contrast. They usually incorporate larger objective lenses to produce brighter images. All commercially available Keplerian telescopes are focusable, including one autofocus device, and are most frequently prescribed in 3x, 4x and 6x powers, though other powers are also available.

7. The prescriptive goal—what are we trying to achieve when we prescribe a telescopic device?
As we discussed above, patients complain that they cannot see far enough away to perform whatever activity they have in mind. They must move closer in order to see it adequately. Patients with 20/40 vision, however, rarely complain of difficulty seeing. Individuals are licensed to drive without restrictions with 20/40 acuity, and children are unencumbered in the classroom with that level of vision.

It is reasonable to assume then, that if we can provide 20/40 acuity through the telescope, most patients should be reasonably satisfied with the functional benefit it provides. So, if the goal is 20/40, a 2x device should be adequate for an individual with 20/80 acuity, 4x for 20/160, and 6x for 20/320. If we prescribe higher magnification to achieve better acuity it will be at the expense of a narrower field of view, which is the major complaint of telescope users. Clinically we find that user's have increasing difficulty when fields become narrower than 5 degrees. So we always need to balance adequate acuity and field of view with the distance the device will be used. Since the field of view is a cone that widens as we go further out , narrow fields will much more problematic closer-in than they would be at 30 feet.

8. The patient's perspective on telescopes.
When we place a telescope in front of the patient their immediate reaction will be that everything appears closer- and of course, that's true, because the image is enlarged by a factor of the power of the device. The value to the patient, however, is not that the image is larger, but that they can see it further away. A 4x device will allow a target normally only visible as far as 10 feet away now be seen as far as 40 feet away. Consider, however, that not all patients receive a geometric acuity gain from telescopes. This is especially true in individuals with neovascular AMD and diabetic retinopathy.

9. Telescopic options for low vision
Low vision telescopes are available as handheld, spectacle clip-on, head born self-contained and bioptic designs. Virtually all styles are available in both Galilean and Keplerian optical designs. When individuals need magnification greater than 6 or 7x, than handheld monoculars (or even binoculars) become the only compelling option. If the telescope would be used only rarely and in episodic activities often a handheld version would be acceptable. If the activity requires that the hands are available, or if the user does not have the dexterity to manipulate the device, or if the telescope would be used for extended viewing purposes, than a head born device is appropriate. Head born designs are available with the telescope centered in the patient's field of view (Full diameter) or positioned above the line of sight so that the user can alternate their view between the carrier lens and the telescope (Bioptic).

10. Telescope Prescribing Protocol
The **Telescope Prescribing Protocol** is divided into two parts—***Hard Signs***, those that can be measured or otherwise determined, and ***Soft Signs***, those that are judgments and are developed through patient interaction.

A. Hard Signs:

1. **Visual Acuity: Best corrected visual acuity through conventional lenses is in the 20/70 to 20/300 range.**

When acuity is less than 20/300, macular disease is more likely to be wet rather than dry and usually the visual response to magnification is no longer as robust. While 20/40 is the suggested acuity goal while looking through a bioptic (20/30 for demanding discrimination tasks) acuity should be at least 20/50 to be of functional gain to the user. Since bioptic telescopes are most well accepted in powers up to 6x, an acuity of 20/300 (20/50 x 6) is usually the upper limit of an effective telescope prescription. While higher power bioptics are available their utility and benefit to the patient are generally less well received.

Goal: The patient should be able to read fluently to at least the 20/50 line while looking through the telescope.

2. **Contrast sensitivity: Able to see facial features while looking through the telescope at a distance of 12 feet under normal room illumination.**

All telescopes reduce retinal illumination and contrast. Testing visual acuity through a telescope using a conventional high-contrast eye chart is not an appropriate assessment of how the telescope is likely to be used in day-to-day applications. Since most visual activities require low contrast visibility, and that seeing faces is a common goal of telescope devices, using a face as a low contrast test target is an effective and convenient way to determine the patient's functional response to telescope magnification.

Goal: The patient must report that they can see the face much better through the telescope. If they report that the face is larger but NOT easier to see than the prognosis for telescope success is reduced. Consider Galilean devices rather than Keplerian, or handheld Keplerian monoculars with large objective lenses.

3. Ocular Dominance: The better seeing eye is the dominant eye, OR, that while looking through the telescope the dominant eye sees better than the fellow eye.

Most individuals find that sighting through a monocular telescope is much easier when using the dominant eye. In fact, many individuals are unable to aim or sight through a telescope with the non dominant eye. As a result, the ability for the patient to localize through a bioptic telescope will be much more natural if they are using their dominant eye.

An easy way to determine the dominant eye is to ask the patient to look through a handheld telescope without suggesting which eye to use. They will usually bring it to their dominant (preferred fixating eye) reflexively. If they ask which eye they should use, suggest they bring it to whichever eye seems more natural. On occasion, patients will show no ocular preference, and can sight equally well with either eye, however this is a rare exception.

Goal: The better seeing eye is the dominant eye. If the better seeing eye is not dominant (there is a "dominancy conflict"), it is often desirable to prescribe a binocular system. Another approach, though less successful, is to occlude the dominant eye while the patient is sighting through the bioptic.

B. Soft Signs:

1. Appropriate activity goals for use of the device.
Telescopes are used for distance and midrange visual activities such as seeing faces, TV, the blackboard in school, computer screens, packages on shelves, signs while traveling, playing cards and board games, etc. If the patient's functional goals do not relate to these types of activities, a bioptic telescope may not be an appropriate prescription. While bioptic telescopes can be used for reading, it usually should not be a primary functional goal of the prescription.

Goal: The patient has mid-range and beyond visual activity goals.

2. Dexterity with the device.
Patients who show a natural skill and an intuitive familiarity with using the device will be more successful in their adaptation. Evaluation of such skills should be done out of the examining room and in an environment more akin to a normal setting. The patient should be allowed to walk wearing the demonstration device, look at assorted targets, and look in a mirror to appreciate their appearance with the device in place. It will usually be quite apparent whether the patient will adapt well to using the device. While therapy to learn to use the device can be helpful with adaptation, an individual who shows poor skills with the device will be a less promising candidate.

Goal: The patient responds to the device favorably, can find targets while looking through the device, and improves with practice during the evaluation.

3. Motivation and enthusiasm
No matter how natural it is for the patient to use the device, and no matter how well it enhances their vision, patients must be personally motivated to seek to improve their vision. They must be prepared to confront the challenges integrating such a device into their daily routine. Expectations must be tailored to each patient's needs and habits. While some individuals might wear a bioptic for many hours every day, others may only need it for specific activities that occur much less frequently. Some individuals do not care to wear a device in public that is unusual in appearance, while others have no such concerns. The review of these psycho-social issues is an integral part of determining an adaptation prognosis.

Goal: The patient is excited about how they are seeing with the bioptic and embrace the opportunity to improve their vision.

C. Summary: In the final determination of an appropriate bioptic prescription, a combination of the hard and soft signs will create an overall prescribing prognosis that is appropriate for the individual patient. This systematic approach can be helpful to the clinician in advising the patient of the likelihood of their successful adaptation to bioptic telescope systems.

D. Rating Suggestion: Assign a value of 2 points to each of the 6 factors above, and assign a rating scale in ½ point increments. A score of 9 or above offers a favorable prognosis. Six or below suggests a poor prognosis.

11. Bioptic telescope fitting steps:

a) Determine the eye that will use the telescope
b) Position the telescope eyepiece to align with that eye
c) Adjust the bridge so that the bottom of the eyepiece aligns with the top of the pupil

d) Adjust the telescope angle of inclination to site straight through the eyepiece when the head is tilted down
e) Set the focus

12. Patient management protocol:
Not only must we determine the prognosis for a bioptic telescope for the patient, we must also instruct the individual regarding the impact and value of the device and also explain the factors that contribute to establishing their likelihood of success. We present a possible outline of how this patient interaction might flow.

a. Indoctrinate the patient
    1. Explain the impact of low vision on lifestyle
    2. Explain characteristics of low vision telescopes
b. Evaluate the patient and demonstrate telescopes
    1. Show handheld devices first- demonstrate DOF, FOV, and focusing
    2. Show spectacle-mounted systems next
    3. Realistic experiences- out of the exam room- show packages on shelves, faces, pictures, TV, flowers, signs, etc.
c. Qualify the patient-
    1. Explain hard signs- VA, contrast, dominancy
    2. Explain soft signs- goals, dexterity, and response
d. Recruit the patient
    1. Establish a prognosis- based upon hard and soft signs
    2. Discuss the challenges and need for training and practice

13. Clinical Issues for Prescribing Bioptic Telescopes

a. Carrier lenses: Order the eyeglass prescription the patient normally wears for distance vision. Prescribe a bifocal if that is what the patient usually wears. We normally use flat-top designs and avoid trifocals and progressives.
b. Maintain at least 10mm between the top of the bifocal and the bottom of the eyepiece.
c. Eyepiece Corrections: Depending upon the brand of telescope prescribed you may need eyepiece corrections for all prescriptions (DFV) or only for higher prescriptions with sphere power above +/- 12D, or 3D cylinder (Ocutech).
d. Illumination Control: Slip-behind sun filters are available in a selection of colors. Filter caps and internal filters can also be ordered.

14. When should I consider prescribing autofocus?
Autofocus telescopes are most valuable for visual activities from 15 feet and closer or when visual attention will be frequently alternated from near to distance such as from the desk to the blackboard, or when extended near-point activities are required such as playing cards, musical instruments, or using the computer. If the primary application of the bioptic is for activities 15 feet or further away, manual focus devices will be as effective, as bioptics require little if any focusing when looking at objects beyond 15 feet away.

15. Why not consider electronic vision displays?
The potential promise of electronic displays to enhance distance vision is very appealing, however the technical challenges have not yet caught up with the dream we can envision. While displays might boast virtual images with fields of view of 40 degrees, that is at 1x power, which would diminish to 10 degrees for example with a 4x power. While they can offer very high amounts of zoom magnification, it

is difficult for a user to stabilize an image of greater than 7x. While contrast and contour enhancement is feasible, the integration of such options have not found there way into commercial devices in a compelling way. While in low light electronic displays can be very helpful, display brightness is presently insufficient for viewing out of doors which is why head borne devices have a cowling to reduce ambient light, a characteristic that undermines their applicability for mobility activities.

16. Telescope Training Techniques

a. **Give the patient a tour of the device**: Show them the telescope eyepiece which will be positioned above the line of sight of the eye that will use the bioptic. Explain that they will look through the carrier lenses most of the time and dip their head down to sight through the device.

b. **Translation** (switching fixation between the carrier lens and telescope eyepiece): Look first through the regular eyeglass lens (carrier lens) of the bioptic. It should provide your customary distance vision. Look directly at the object you want to magnify. Drop your head slightly and look up into the eyepiece. You should see a full, round magnified image. You may have to focus it to get the image clear. Practice switching between the carrier lens and the telescope until you can do it easily and without losing your target.

c. Focusing

i. At distance- take advantage of depth of field
ii. At near- preset, hand focus, and head focus

d. **Localization at distance**: Since the field of view through the bioptic is narrow, like a tunnel or a keyhole, it can at first be challenging to find what you want to see. To be successful, one must first look with your "normal" vision through the regular eyeglass lenses, aiming directly at the object you want to see better. While looking directly at the target, slowly dip the head down, and look into the eyepiece of the bioptic. With practice you should be able to switch between your normal vision and the telescope image quickly and accurately. Practice this at home while looking at objects on walls, faces of family, or the TV, until it becomes natural and you can do it easily. With time you can learn to ignore the tunnel field of view.

e. **Localization at near**: Looking at closer objects can be more challenging due both to the narrow field of view and the visual mismatch produced by the bioptic. To learn to find and touch objects within your arm's range, first find the object in the bioptic field of view, and while looking at it, pass your upraised finger across the field of view several inches in front of the target. Once you can see both your finger and the target at the same time, watch your finger as it moves in to touch it. You MUST watch your finger while looking through the telescope to learn to do this. A convenient technique is to practice this while trying to touch the buttons on a telephone keypad.

f. Have the patient put it on, take off, and put the bioptic away themselves. Discuss proper care and cleaning. The eyepiece is apt to get soiled and filmy. It should be cleaned with an approved microfiber cloth. The device should never be placed under a faucet.

17. Trouble shooting bioptic systems

a. **The patient does not see a full field.** Check to see that the telescope is properly aligned and inclined for the patient. Review the eyepiece position fitting method. Adjust the bridge and temples to reposition the aid for the proper line of sight.

b. **The image is not clear.** Check to see that the telescope is properly focused, that the eyepiece and front lenses are clean, and that there is not significant refractive error that might preclude clear vision through the telescope. Also check that the patient is using the appropriate eye to sight through the telescope, and that there isn't a dominancy conflict that undermines the functionality of the device.

c. **The patient complains that the field of view is small.** Check to see if shortening the vertex distance is possible by adjusting the bridge. Also explain that all telescopes narrow the field of view, but that the patient will adapt over time.

d. **The patient complains that they have to drop their head too much to see through the telescope.** Check to see that the frame is as low as possible on the bridge and that the angle of inclination of the telescope is as low as possible.

e. **The patient sees two images.** If the diplopia occurs when only the eye using the telescope is open, readjust the telescope position to eliminate the second image.
If the diplopia occurs only when both eyes are open, then the patient is unable to suppress the eye not using the telescope. This often occurs if the non-dominant eye is prescribed the telescope as the patient will have difficulty suppressing the dominant eye even if it is the poorer seeing eye. One option is to place a sector occluder (either a cut-off clip-on occluder, or opaque tape) across the top of the carrier lens for the non-telescope eye, so that when the patient dips their head to site through the telescope, the fellow eye is occluded. Another option is to prescribe a binocular system.

f. **The image through the telescope is too dim.** Recheck the pupillary distance position. Slight misalignment can significantly decrease image brightness. If this is still not adequate, check that the front and back lenses are clean and free of grease and oil. Check also that the internal optics are not fogged by holding the telescope to a light and looking through it backwards (through the objective lens).

18. A short-and-sweet overview of what I'm thinking when I prescribe bioptics.

a. If the patient has reasonably good acuity (20/80 or better), I'm considering 2.2x and 3x Galilean, or 2.75x and 3.0x Keplerian devices (if field of view is a concern). If acuity is similar between the eyes or if I'm concerned about dominancy issues, I'll consider the same powers in a binocular design.
b. If contrast is an issue, I'm thinking about Galilean designs first.
c. If acuity is between 20/100 and 20/300 I'm thinking 4x and 6x Keplerian designs, especially if there will be near point applications and I want them to be able to focus.
d. If acuity is worse than 20/400, I'm thinking 8x and higher handheld monoculars or hi-power (7x) head born devices.