YAG Laser Vitreolysis: Treatment of Vitreous Strands and Opacities

Featuring insight from Cees Van der Windt, MD (Holland), Feike Gerbrandy, MD (The Netherlands), and James H. Johnson, MD (USA)

The following treatment guidelines are provided for information purposes only. It is the operating physicians’ responsibility to familiarize themselves with the latest recommended techniques. Ellex strongly recommends that physicians new to the technique undertake extensive education/training in YAG laser vitreolysis.

A. Options for Management of Vitreous Strands/Opacities:
   1. Do nothing. Reassure: “try to live with it”.
   2. Perform YAG Laser Vitreolysis
   3. Perform Floater-Only Vitrectomy (Rarely offered due to high risk profile.)

B. Equipment Requirements for YAG Laser Vitreolysis:
   • An Nd:YAG laser optimized for use in the posterior segment, in addition to use in the anterior segment. Not all YAG lasers are suitable for use in the vitreous cavity. For the user to be able to visualize and treat the vitreous strand/opacity, the illuminating light source must be positioned on the same vertical optical axis as the oculars and laser energy beam. Most YAG lasers use a lower angle of illumination, well suited to common anterior procedures but ill-adapted to use in the vitreous. For example, if light enters the eye at an angle that differs markedly from the visual axis of the operating physician it will only illuminate the anterior portion of his/her field of view. Consequently, vitreous strands/opacities positioned in the posterior vitreous will be difficult to visualize (and treat). In contrast, a raised illumination tower can overcome these issues. It is important to note, however, that this may carry a risk of attenuating (or blocking) the treatment beam energy if the illumination reflecting mirror is in the path of the treatment beam. Provisions must therefore be made to avoid this.

   • A lens specially designed for treating in the vitreous. The choice of lens will depend on the position of the vitreous strand/opacity to be treated. It is important to note that the commonly available Goldmann lens is not suitable for treating vitreous strands/opacities. Refer to Appendix 1 for a list of recommended lenses.

C. Patient Selection:
   1. Patients reporting persistent moving shadows in their vision due to vitreal condensations, fibers, strands, and clouds:
      a. Not associated with active retinal pathology.
      b. Not associated with active inflammation.
      c. Present for 2-3 months and stable in behavior.
      d. Absence of peripheral flashes of light suggesting an incomplete posterior vitreous detachment (and thereby significant risk of retinal detachment/tear).
      e. Absence of strong lenticular astigmatism (as this can make focusing difficult.)
Vitreolysis

C. Patient Selection (continued):

2. Other important age-based considerations:
   a. Older patients (>45) with sudden-onset symptoms will most likely have experienced a posterior vitreous detachment (PVD). This is a positive sign for vitreolysis treatment.
   b. Younger patients may bitterly complain of their vitreous strands/opacities, but they are least likely to be candidates for vitreolysis treatment. They often have microscopic floaters located within 1-2 mm of the retina.

3. For your first patients:
   In addition to the above considerations, it is recommended to:
   a. Choose the well-defined, fibrous, Weiss-ring type of vitreous strand-opacity caused by a PVD. These fibrous strands/opacities often behave as if “tethered” by the sheet of vitreous cortex of which they are a part. Because they are fibrous, they absorb the laser energy well and can be vaporized more efficiently. In addition, they are usually located safely away from the crystalline lens and the retina.
   b. Do not attempt to treat the diffuse, cloud-like syneresis type of vitreous strand-opacity, which is much more difficult to visualize and to treat effectively. Treatment of these strands/opacities should be undertaken only once sufficient experience with YAG laser vitreolysis has been gained.
   c. Initially limit treatment to pseudophakic patients to avoid any risk of causing a traumatic cataract should there be a breach of the posterior capsule during treatment.
   d. Patients with multi-focal lenses may be more difficult to treat due to the refocusing of the aiming beams by the IOL.
   e. Although the risk of an acute elevation of IOP is rare, it is wise to avoid treating patients undergoing treatment for glaucoma or those with elevated IOP.

D. Before Getting Started:
It is important to manage patient expectations and to set realistic treatment outcomes:

- The goal of treatment is to achieve a "functional improvement". That is, to allow the patient to return to their "normal, day-to-day" activities without the hindrance of their vitreous strands/opacities.
- The patient should not expect to achieve a 100% clear vitreous (as can sometimes be the outcome with vitrectomy).
- Some vitreous strands/opacities can be easily and efficiently treated; some vitreous strands/opacities cannot be treated.
- Often more than one treatment session will be needed in order to achieve a satisfactory result. It is also important to note that, on average, a treatment session can take from 20-60 minutes.

E. Pre-Treatment:
1. Discuss appropriate expectations and the risks of the procedure with the patient.
2. Undertake full dilated eye examination with attention to retina and periphery. Aggressive dilation with both tropicamide and phenylephrine is recommended. Every millimeter of dilation will be beneficial.
3. Topical anesthetic with 2-3 instillations a few minutes apart.

F. Treatment:
The treatment spot size and pulse width are fixed at 8 microns and 4 ns respectively. The only parameters that will vary are the energy of the pulse and the number of pulses fired in one shot i.e. single, double, or triple. The offset of the treatment laser beam in respect to the aiming beam can also be set anterior through to posterior (refer to Section H: “Anterior and Posterior Offset”).

G. Treatment Steps:
1. Prior to commencing treatment, explain to the patient that they will hear the sound of a shutter opening with each laser shot, and that this is a normal part of the laser system’s operation.
2. Place the contact lens on the patient’s cornea.

1. Energy to Use; Number of Pulses; Number of Shots
   - Because the YAG laser energy has to pass through more optical media than during capsulotomy treatment, more energy will typically be required to perform vitreolysis. Regardless, always start with a low level of energy and titrate up until there is adequate vaporization and optical breakdown of the vitreous collagen.
   - Commence treatment with a single pulse per shot. Set energy at the minimum level required to create the optical breakdown in the vitreous cavity (typically 2-2.5 mJ).
   - Most treatments can be performed at between 2.5-4.5 mJ energy.
   - It is possible to increase to 2 pulses (double) or 3 pulses (triple) per shot before increasing the energy per shot. Always be aware of the total energy being delivered per shot.
   - More energy will be required if the floater is located deep in the posterior vitreous. For example, the same floater may be vaporized at 3 mJ in the anterior vitreous, at 4 mJ in the mid-vitreous and 5 mJ in the posterior vitreous.
   - It is recommended to limit the number of shots per treatment session to a maximum of 500.

2. Vision and Aiming Beams
   - It is important to obtain a clear view of the structure to be treated with 100% confidence of the location of the laser focal point in three-dimensional space. Accidental shots to the lens or to the retina may occur if the red aiming beams are not coincidental or superimposed. It is also important to maintain an adequate distance of more than 2-3mm from the lens and more than 3-4mm from the retina. (Note: When starting out, consider observing a wider margin of safety and treat only in the central third of the vitreous and always avoid the direction of the macula.)
   - If the aiming beam is not clearly in focus, do not fire. If in doubt, focus on the vitreous strand-opacity and pull back the joystick slightly; this will enable you to clearly visualize the two aiming beams before refocusing them to one spot.
   - The vitreous strand-opacity may be seen to move or become mobile during the laser treatment due to the shock wave introduced with each shot fired.
   - When firing directly at a mobile vitreous strand-opacity, always wait for it to settle into position before continuing with treatment.

3. Direction of Treatment
   - In the presence of multiple vitreous strands/opacities, commence the treatment anteriorly and proceed inwards. This will enable you to first remove those vitreous strands/opacities that may impede your vision of the posterior structures. Likewise, treat from the top down as gas bubbles may impede vision of higher vitreous strands/opacities if the lower ones are treated first.
   - Avoid treating in the direction of the macula.
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H. Anterior and Posterior Offset:
- It is possible to position the optical breakdown in front of (anterior offset) or behind (posterior offset) the structure to be vaporized. When the energy is increased, the optical breakdown and resulting plasma move closer to the operating physician. This offset capability permits greater accuracy in positioning the optical breakdown.
- When working deeper in the posterior vitreous, chromatic aberration will focus the treatment beam further behind the aiming beam. Use the anterior offset to position the optical breakdown in the same plane as the aiming beam focus.
- This is particularly critical when working close to the retina where extreme care must be taken, particularly when working at higher energies.
- Note: Some physicians prefer to manually defocus the system with the joystick rather than via the Anterior/Posterior Offset control.

I. Post-Treatment:
1. Generally, post-treatment medications are not necessary.
2. In very rare cases, inflammation of the anterior segment may be observed. In the unlikely event that this occurs, it can be treated with non-steroidal anti-inflammatory agents such as Acular or a steroid such as Pre Forte for a few days.
3. There are no restrictions on patient activities.
4. Patients may see small, dark specks in their lower field of vision in the initial 15-30 minutes following the procedure. These are small micro-gas bubbles at the roof of the globe. They dissolve quickly and disappear.
5. Patients cannot adequately assess the treatment results until the pupils have constricted back to normal.
6. It is recommended that the patient be followed up the next day for visual acuity and IOP testing.
7. Follow-up treatments can be undertaken on consecutive days, although it may be advantageous to wait a few days for the eye’s condition to stabilize.

J. Side Effects and Complications:
Reported side effects and complications are rare. Side effects may include:
- Accidental retina hit or shock-wave contusion of retina or sub-retinal tissues. In the periphery, this could be asymptomatic. Avoid treating over the macula in the posterior third of the vitreous.
- Retinal detachment. While this is worth mentioning in the patient consent form, retinal detachment related to YAG laser vitreolysis has not been reported in 20-years of vitreolysis experience.
- Traumatic cataract. Patients may experience a rapid onset of symptoms if there is a breach of the posterior capsule. It may make cataract surgery more urgent and more complicated.
- Increased intraocular pressure. Rare, but more likely in older patients with compromised trabecular meshwork drainage combined with treatment of dense, vitreous strands/opacities in the anterior vitreous.
- Uveitis.