WHITEPAPER

REFLEX TECHNOLOGY

Transforming Anterior and Posterior YAG Treatments with a New Generation Laser

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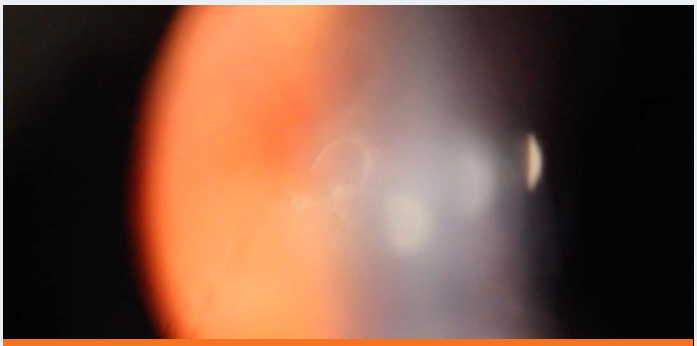
Since its introduction into the field of ophthalmology in the 1980s, use of neodymium-doped yttrium aluminium garnet (Nd:YAG) laser therapy has remained reserved for anterior segment procedures.[1] Limitations arising from inadequate vitreous visualization and inefficient laser energy delivery rendered the use of Nd:YAG laser technology too high-risk for posterior segment procedures. However, with new technologic advancements designed to address the specific limitations of conventional Nd:YAG lasers, Reflex Technology™ (Ellex Medical Lasers, Adelaide, Australia) is now expanding treatment possibilities and providing a single, safe and highly effective YAG laser platform for capsulotomies, peripheral iridiotomies and laser vitreolysis-based floater treatment.

LIGHTING UP THE ENTIRE VITREOUS

To appreciate how an Nd:YAG laser like the Ultra Q Reflex™ (Ellex Medical Lasers, Adelaide, Australia) safely and effectively treats many types of floaters when conventional Nd:YAG lasers cannot, it is important to look closely at the design of both lasers. Traditional Nd:YAG lasers deliver their illumination from a low, non-coaxial position, which makes it difficult to clearly visualize the middle and posterior vitreous - where the bulk of symptomatic floaters reside. It is not just visualization of the floater that is limited by the non-coaxial position of the laser and light source of conventional Nd:YAG lasers; spatial context, which is vital for safe application of a laser beam in the posterior segment, is poor in conventional YAG laser technology. To achieve the precise spatial context required for safe posterior YAG procedures, both “off-axis” (slit lamp in the oblique position) and “on-axis” (slit lamp in the coaxial position) illumination is required. This ensures that when a surgeon looks into an eye, he or she can clearly establish where the lens, floater and retina lie in relation to the floater and to each other.



Floater viewed on-axis with Ultra Q Reflex system (Image courtesy of Paul I. Singh, MD.)

Floater viewed off-axis with Ultra Q Reflex system (Image courtesy of Paul I. Singh, MD.)

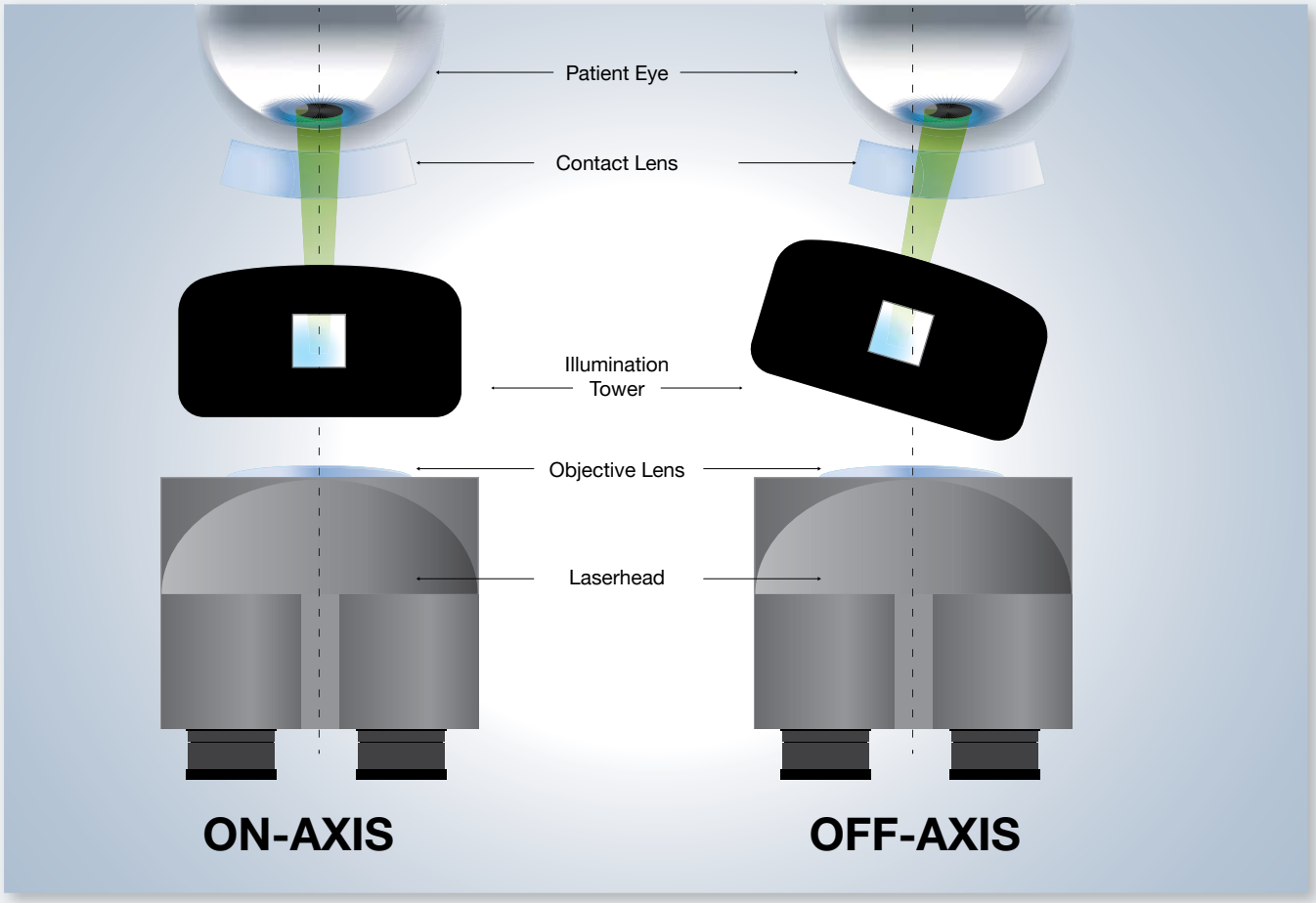
REFLEX TECHNOLOGY

The Ultra Q Reflex™ and Tango Reflex™ lasers (Ellex Medical Lasers, Adelaide, Australia), both feature the proprietary Reflex Technology™ platform, which offers coaxial (on) and off-axis illumination. This allows clear visualization of the internal eye from the cornea all the way to the retina, and as such, provides much-needed spatial context for procedures like laser vitreolysis. The ability to achieve both visualization and laser firing in multiple illumination settings ensures that regardless of where a surgeon is in the eye and where he or she wants to see in the eye, an appropriate illumination setting is available to provide the spatial context needed.

Furthermore, it permits use of the illumination tower coaxially to enhance the view of the target opacity by using the fundus red-reflex as a contrast comparison. This is similar to the use of red reflex with a surgical microscope during cataract surgery: it enhances focus and creates greater contrast.

Three years of personal experience with the Ultra Q Reflex™ has revealed how a capability of the device, best described as 'titratable illumination', can customize a surgeon's visual experience during surgery. Because the illumination level provided with Reflex Technology™ is adjustable, it is possible to precisely titrate the amount of coaxial illumination as needed.

ON-AXIS	OFF-AXIS
1. **Provides great visualisation of the middle and posterior vitreous**	1. **Beneficial for visualising floaters in the anterior segment**
2. **Allows for spacial context- especially near the retina**	2. **Reduces impact of Red Reflex which allows for floaters to appear "white"**
3. **Red Reflex provides greater visual contrast**	3. **Helps to better define the posterior capsule**



For example, a floater in the middle-to-posterior vitreous requires use of coaxial illumination for spatial context. However, if a surgeon finds the lighting too bright and the floater is challenging to visualize with the red reflex, it is possible to incrementally adjust the amount of coaxial illumination. This can be done until the perfect level of lighting needed to maximize the contrast of the floater, yet keep the spatial context, is achieved. This simple function makes a significant difference to the laser vitreolysis process and is something conventional lasers cannot do.

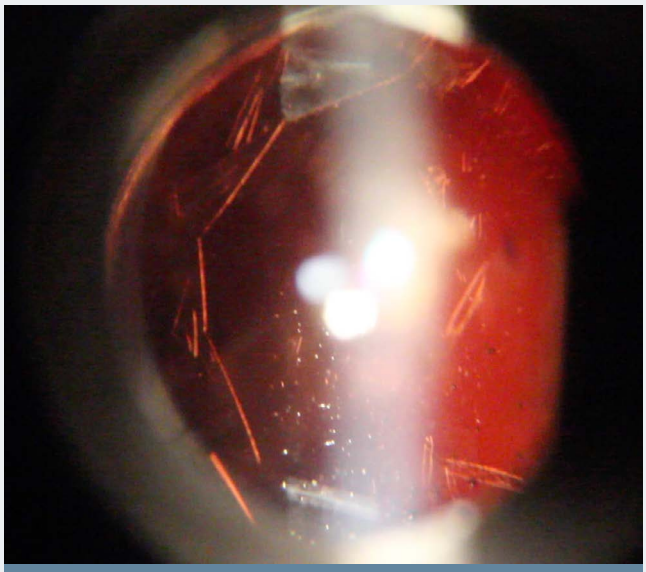
PREVENTING POST CAPSULOTOMY FLOATERS

The benefits of coaxial illumination extend beyond safe laser floater removal, and in fact help to prevent the notoriously common patient complaint of sudden floater development after capsulotomy. A small pilot study carried out in my Wisconsin practice, involving 16 patients, suggests that YAG capsulotomies performed with the Ultra Q Reflex™ (Group 1) result in a lower incidence of postoperative floaters compared with a standard YAG laser with conventional illumination (Group 2). Specifically, at postoperative week 1, floaters were reported as present in 25% versus 75% of Group 1 and Group 2, respectively. And by one month after capsulotomy no patients in Group 1 experienced floaters, whereas around 40% of patients in Group 2 still had floaters. Both treatment groups consisted of eight patients who received the same procedure and off-axis firing technique.

The only difference in their treatment was that those treated with the Ultra Q Reflex™ underwent immediate inspection of the anterior vitreous for small pieces of broken capsule – which can give rise to subsequent floaters – using the laser's coaxial illumination function. Identified capsular fragments were vaporized, but this was not performed in the conventional group, as the standard illumination laser did not have the ability to identify and treat all of the post-capsulotomy fragments via the co-axial position.[1] Despite the small size of the study, its findings reflect what users of the Ultra Q Reflex™ report anecdotally: coaxial illumination helps to visualize and vaporize post-capsulotomy fragments at the time of the procedure, thus preventing postoperative complaints of floaters.

EFFICIENT ENERGY USE

Importantly, the Ultra Q Reflex™ and Tango Reflex™ lasers also ensure efficient dispersion of energy even at the higher levels required for posterior YAG procedures i.e. laser floater removal. When a laser is fired into the eye to vaporize a target, some



YAG Capsulotomy performed on-axis with the Ultra Q Reflex. ((Image courtesy of Paul I. Singh, MD.)

energy is inevitably dispersed throughout the ocular tissue. The higher the level of laser energy used, the greater the energy dispersal and potential for collateral damage. This is a primary reason for hesitancy among surgeons when considering laser floater removal. Anterior YAG procedures i.e. posterior capsulotomy, often use average energy levels of 1 or 2mJ, but for posterior YAG procedures, such as laser vitreolysis, this rises to 5-6 mJ or higher. If used at these higher energy levels, conventional YAG lasers with larger convergence zones – that is, energy dispersion levels – carry a potential risk of collateral damage. In contrast, the Ultra Q Reflex™ and Tango Reflex™ lasers have been designed to ensure efficient, controlled plasma and energy delivery.

These lasers feature a truncated Gaussian beam, which allows for increased efficiency (up to 40%) and a quicker rise and fall in energy compared with conventional YAG lasers. This change in the energy beam profile increases efficiency of the beam, ensuring more of the energy is delivered to the target instead of dispersed into surrounding tissue. This, in turn, reduces energy requirements for vaporization. In fact, this efficient use of energy generally speeds up the performance of both anterior and posterior segment procedures as fewer shots and less energy are required to achieve the same treatment effect as a standard YAG laser.[2]

It is also important to note that when a YAG laser is fired, the dispersion of energy (convergence zone) in the eye rises non-linearly with the laser's power setting. In other words, at 1 mJ, the convergence zone is approximately 110 microns, but when increasing the power to 5 mJ, the convergence zone increases

by approximately 27% to reach 150 microns. The efficiency of the device is further bolstered by a feature that addresses a much-overlooked, but highly inconveniencing disadvantage of Nd:YAG lasers – the tendency to overheat quickly. The majority of surgeons who regularly perform Nd:YAG procedures can probably attest to the frustration faced when their laser overheats, shuts down and resets after firing just 200 to 300 shots. To avoid this interruption to workflow, both Ultra Q Reflex™ and Tango Reflex™ feature a proprietary air-cooled laser cavity that enables thousands or more shots to be fired without any device overheating.[2] The ability to work without interruption is invaluable for seamless workflow in a practice performing dozens of Nd:YAG laser procedures in a single clinic. This is further bolstered by the high efficiency of the laser.

THE FUTURE OF ND:YAG LASER THERAPY

Reflex Technology™ presents an exciting opportunity for YAG laser procedures in ophthalmology. By offering surgeons the ability to perform both anterior and posterior segment YAG procedures from a single device, and with greater efficiency and lower energy requirements, it stands to expand the variety of treatments a single practice can offer its ophthalmic patients. Such treatments range from glaucoma and posterior capsular opacification to floater removal, and it offers this increased variety of treatments in a manner that can increase workflow efficiency. To achieve this, however, attention must now be given to increasing awareness of the new technologic capabilities of next-generation Nd:YAG lasers among ophthalmic physicians. Doing so will ensure that many patients with troublesome floaters no longer have to tolerate their symptoms or risk vitrectomy, and surgeons can start to enjoy the freedom that comes with performing a wide range of ocular procedures with confidence in the safety and efficiency of the device.

ABOUT REFLEX TECHNOLOGY

The Reflex Technology™ laser platform aligns the operator's vision, the target illumination, and the treatment beam along the same optical path and the same optical plane. This allows physicians to focus on-axis with more depth and spatial reference when treating posterior floaters. Furthermore, it permits use of the illumination tower coaxially to enhance the view of the target opacity by using the fundus red-reflex as a contrast comparison.

In contrast, traditional YAG lasers deliver the illumination and laser from a low, non-coaxial position with larger convergent zones, making it extremely difficult to target and treat floaters. These conventional YAG lasers also require the use of high levels of energy, which poses a significant risk of damage to surrounding ocular tissue, as well as of side effects such as cataract and intraocular pressure (IOP) spike.

- **Coaxial Illumination:** allows for visualisation beyond the posterior capsule.
- **Ability for "on and off" axis visualization:** helpful for both posterior and anterior floaters.
- **Shorter, more efficient laser energy:** allows for non-linear rise in energy with minimal disruption of surrounding tissue

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