

# Palomar Q-YAG 5™ Clinical Update Number Three

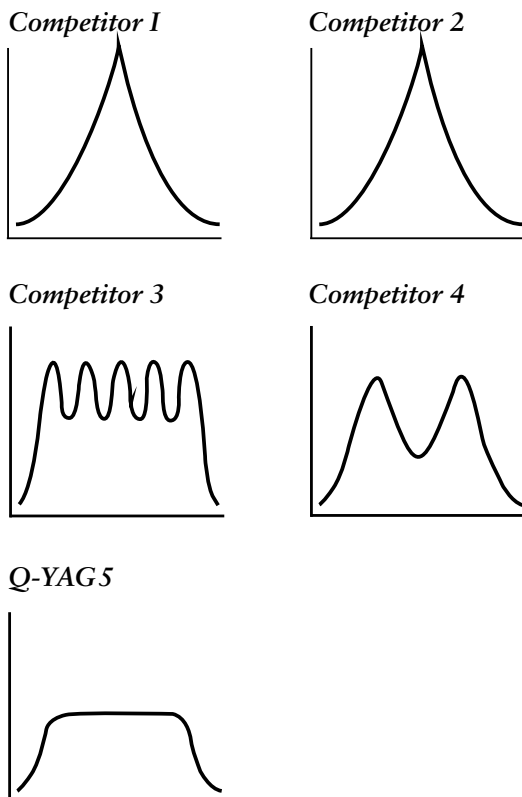
## Treatment Advisory for the Q-YAG 5

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The Palomar Q-YAG 5™ Laser System was designed to improve upon pre-existing technology available on other q-switched Nd:YAG lasers. From the initial commercial development in 1992, through the continued evolution to the present, all other q-switched Nd:YAG lasers have employed the use of articulated arms to deliver the laser pulse to the skin. Newer systems have also been designed with an "unstable resonator" cavity (this design is not related to mechanical stability, it is a terminology that describes the optical design of the cavity optics).

Unstable resonator designs can produce a beam profile that is a "donut," a Gaussian shaped beam, or some combination of the two. This means that the unstable resonator design, when built on an optical deck, will not be able to produce a very flat, uniform beam profile. Any inhomogeneity or irregularity in the beam profile will be accentuated as the output pulse propagates down the arm and through the handpiece to the skin.

### Comparing Beam Profiles



Presently available systems on the market have the above shaped beams (if they are perfectly aligned). The above diagrammed beam profiles will strongly affect the clinical impact of the laser pulse on the skin. Clearly, Competitors 1 and 2 have a significant spike in the center of the Gaussian type of beam profile. This in turn yields a small spot of intensely high fluence at the center of the beam. For example, a 3 mm spot size handpiece might be set at 3.0 J/cm<sup>2</sup> on the front panel of the laser. In fact, the average fluence measured across the entire spot size would be approximately 3.0 J/cm<sup>2</sup>, but the fluence at the center of the Gaussian spot can be as high as 15-20 J/cm<sup>2</sup>. At this extremely high fluence, the plasma formed at the surface of the epidermis may ablate tissue.

Although many users believe that this is an advisable treatment result, much of the energy is actually wasted by the formation of the plasma. In fact, less energy propagates forward deep into the dermis when this happens, so there is a reduced clinical effect, and because of the significant epidermal damage, there is clearly increased fibrosis.

Competitor 3 improved the beam profile as exhibited by the diagram above. But the peaks shown in this diagram also often produce tissue ablation and pinpoint bleeding. There was clearly an improvement with Competitor 3, but nevertheless, considerable tissue damage may still occur.

The newly designed Competitor 4 lasers produce a "donut" shaped beam. This is primarily due to the cavity design, and this type of beam profile is actually a step backward with regard to protecting the skin – it again may produce increased fibrosis.

### The Problem of Tissue Ablation

The initial clinical studies performed with Competitors 1 and 2 were conducted using 2 mm, 3 mm and 4 mm spot size handpieces. Significant tissue ablation occurred and significant tissue debris collected on the optics of the handpieces. Various methods of preventing this tissue splatter were employed, including plastic shields and

other transparent materials placed on the skin. Although some improvement occurred with this shielding, the ablative effects are considered a negative part of the treatment.

Associated with the immediate effects of the tissue ablation, almost every patient exhibited bleeding and/or weeping of the wound. The bleeding would often last for hours and then a subsequent scab would form. Keeping the wound moist and bandaged would lessen the scabbing of the wound, but all of these post-treatment effects complicated the success of the treatment.

### **The Problem of Scarring**

Early studies done with Competitor 1 indicated that the risk of hypertrophic scarring was significantly lower than all previous non-q-switched laser technology. The predicate device used for the FDA (510K) submission was the CO2 laser. Everyone would agree that the CO2 laser always produced an ugly hypertrophic scar, but the thermal effects of the laser burned away the tattoo inks, so it can certainly claim success in removing a tattoo, despite the scarring.

The safety studies on the q-switched Nd:YAG indicated that the "risk of scarring" was minimal, but the real definition of the scarring was never accurately defined. Hypertrophic scarring rates are indeed quite low. These early studies indicated a rate of under 2%. In comparison to the CO2 laser, the q-switched Nd:YAG was exceptionally safe to use. However, thoughtful evaluation calls for a better definition of a scar.

Hypertrophic scars are clearly raised, visible, and often discolored. Atrophic scars are subtler and manifest as a "textural change" of the skin. Often times the skin in the area of the tattoo will exhibit a slight depression and may also exhibit some mild dyschromia as a result of the numerous laser treatments required to remove the tattoo.

Clearly, this process is safer and less obtrusive than a CO2 laser treatment, but the obvious fibrosis cannot be overlooked. Studies over the last ten years have shown that the degree of fibrosis is related to the amount of trauma and immediate post-treatment bleeding and oozing of the wound. These two post-treatment results are related to the amount of tissue ablation or debris created by

the laser during treatment. In other words, if the user could minimize the amount of debris or tissue ablation, the amount of bleeding would decrease, the wound care would become both simpler and safer, and the risk of either type of scarring would decrease as well.

In reality, almost all tattoos treated to date with the older non-uniform beam technology (Competitor 1 and 2 type lasers) exhibit a significant degree of atrophic scarring (fibrosis).

### **Q-YAG Improvements**

The Q-YAG 5 laser was designed to eliminate the articulated arm and the associated mirrors that are required to deliver the laser pulse, because these parts of the older lasers were expensive and required increased service. In addition, the Q-YAG's design also improves the beam profile to produce a true "flat top" or "top-hat" type of output pulse. If the hot spots or small spikes in the output pulse of light can be eliminated, the bleeding and weeping associated with tissue ablation can be eliminated. If tissue ablation and subsequent bleeding are eliminated, then the post-treatment wound care can be reduced as well.

All of these improvements to the beam quality lead to an improvement in the treatment, a lessening of risk, and a far better clinical result. In addition, the design of the new Q-YAG 5 permitted Palomar to shorten the pulse and increase the peak power of the output pulse. The increased peak power translates to a greater photo-mechanical or photo-acoustic effect on the tattoo inks. More inks can be removed successfully when the wavelengths can be blended and the peak power is higher than the older technologies.

### **Spot Size Issues**

However, an obvious problem has arisen with the users of the Q-YAG 5 who have previously used Competitor 1. All of the observed problems discussed above (tissue debris, bleeding, etc.) at the very least produced a tangible marker of where the laser pulse had been. In other words, it made the treated areas more visible. The degree of instantaneous whitening with Competitors 1-4 is always going to be greater than the degree of whitening observed with the Q-YAG 5 because the irregularities in the beam on the other systems is far greater than any that might exist with the Q-YAG 5. Because of this, a trend of using the small 2 mm

spot size is beginning to develop with some of our users of the Q-YAG.

The rationale for the smaller spot size is to increase the trauma to the tissue, and therefore make it easier to see what has been treated. The other reason for increasing the trauma is for the patient to "feel like something is happening" during the treatment. I have been contacted by a number of Q-YAG 5 users who have relayed those exact sentiments to me. Even though I tell them that the use of the small spot size is counter-productive (unless the tattoo is a very thin line type of tattoo), they still insist that the patient "likes it that way" or "expects that type of result."

Additional studies conducted by Suzanne Kilmer, M.D., also confirmed that the larger the spot size, the greater the forward scattering. The increased forward scattering means that more photons of light are delivered to the depth of the tattoo inks, which ultimately results in a safer and clinically superior outcome.

Therefore, the 4.0 mm or 6.0 mm spot size is always going to produce a better result (unless the tattoo ink is in a very thin line), and with the vastly improved beam profile of the Q-YAG 5, virtually no tissue debris or bleeding will occur. As stated previously, this will lead to less fibrosis, easier and safer healing, and will virtually eliminate scarring.

There are other benefits as well to using the larger spot sizes. Certainly, the larger the spot size, the

faster the treatments, and this in turn makes the treatment more comfortable. Also, if less debris is "blown off" the skin, less debris adheres to the protective window. This means that the absorption of some of the output pulse on the protective window is minimized, resulting in less damage to the main focusing lens. All the practical benefits and improved clinical results of larger spot size use should convince Q-YAG 5 users to change their treatment techniques.

### **Educate Your Patient**

The use of the 4.0 mm and 6.0 mm spot sizes is better for the patient and better for the laser. Educating the patient that they will no longer see the immediate whitening, then bleeding and crusting of the wound is necessary for all patients that have been treated with the previous technology.

Since the impact of the pulse from the Q-YAG 5 resembles a q-switched Ruby laser pulse, a significant amount of swelling will occur (I usually call it an urticarial effect), and whatever whitening did exist is usually gone in a brief period of time. Application of an ice pack quickly decreases the swelling and eliminates any post-treatment discomfort. Patients should be briefed on these details so that they know what to expect and will be satisfied with their treatment.

