TrueSpot™ Advanced optical design for superior spot delivery in retinal photocoagulation

Most photocoagulation systems today are using parfocal beam delivery systems rather than the original defocused technology. TrueSpot™ technology was developed to be a parfocal design with a minimal amount of defocus to take the edge off of corneal power density, and give an even, sharp-edged retinal burn, a high level of spot size accuracy and superior spot viewing.

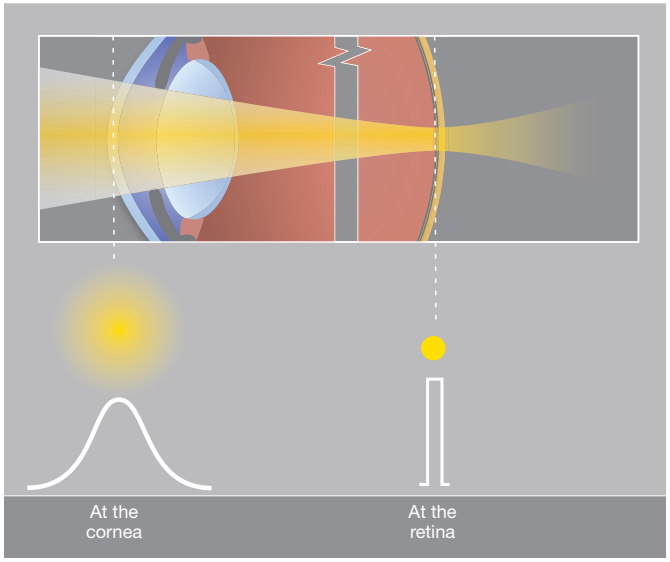
Background

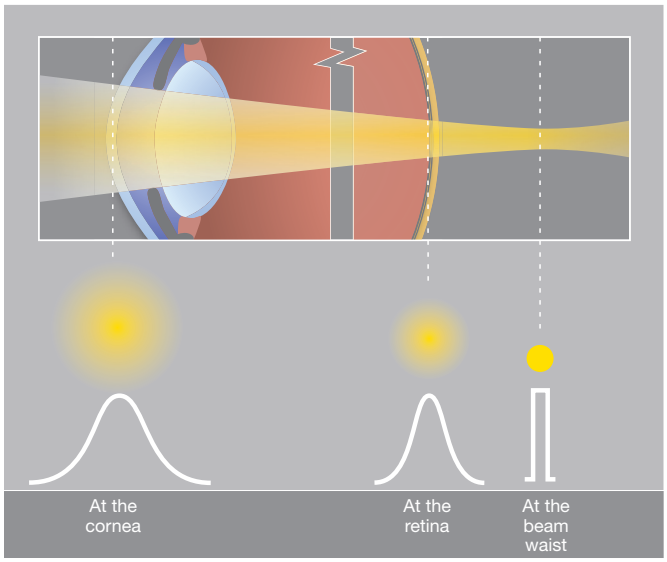
Historically, laser systems utilized a defocused or parfocal optical delivery system for retinal photocoagulation. In the past, parfocal systems became the technical industry standard, being used by manufacturers such as Zeiss, Iridex and Quantel. Despite many advantages that parfocal technology provides, it still yields problems such as its inability to be titrated[4,8]. As a result, TrueSpot technology was developed to use the positive characteristics of parfocal technology while eliminating its disadvantages.

Defocused Beam Delivery Systems

A defocused optical system uses a beam with very high beam divergence. The beam profile on the retina is gaussian, with gradually decreasing energy density towards the periphery. Spot size is changed through a defocusing anteroposterior movement of the entire beam so that the retina is no longer positioned at the beam's waist[7], which causes the burn to become increasingly blurry (Figures 1 and 2).

A key advantage of defocused over parfocal technology is that the high beam divergence results in very low corneal radiant exposure, even at larger retinal spot sizes and thus minimizes the risk of inadvertent corneal burns. Also, the system permits titration - a fine tweaking of the retinal spot size and thus its energy density - by means of slit lamp movement.





Figures 1 and 2: Defocused beam delivery principle for 100µm and 500µm spot sizes.

Parfocal Beam Delivery Systems

A parfocal system delivers an almost collimated beam with a low beam divergence. The beam profile on the retina is sharp edged ("top-hat") providing consistent and even energy distribution that results in crisp, well defined retinal burns. Due to the almost parallel shape of the beam, the beam diameter on the cornea is very close to the retinal diameter for most spot sizes. As a result, the energy density on the cornea is almost equal to the energy density on the retina (Figure 3).

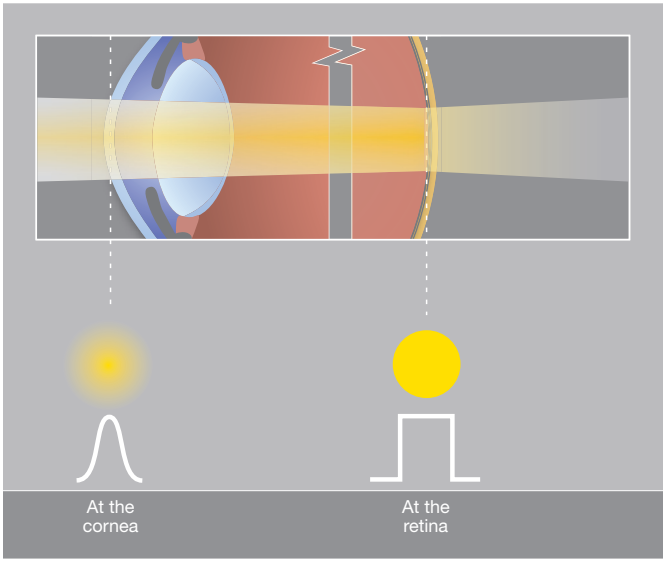


Figure 3: Parfocal working principle and beam profiles for 500µm spot size.

L'Esperance established that corneal radiant exposures greater than two 2 J/mm^2 is unfavorable[5] and studies suggest that they may cause inadvertent corneal burns, especially when certain indirect contact lenses are used[6]. Another trait of the parfocal beam is its very large depth of field at the beam waist[4]. Because of this, small focusing errors do not significantly impact the intensity of the spot, which is a user safety advantage. However, this characteristic does not permit slit lamp titration, which many surgeons prefer with defocused systems.

TrueSpot Beam Delivery System

The TrueSpot beam delivery system was designed to emphasize positive characteristics of parfocal technology, while eliminating its disadvantages. In order to achieve this, the TrueSpot system is a compact parfocal system with accurate spot size calibration (Figure 4). This means that corneal radiant exposure is significantly lower than the retinal spot energy and remains under the corneal burn threshold[6]. The sharp edged, top hat profile that the beam has on the retina results in a very crisp, defined retinal burn with even energy distribution. In addition, the wide depth of field at the retina can accept small focusing errors while still allowing a certain amount of manual slit lamp titration.

TrueSpot technology is highly precise, providing an actual retina burn that is never more than 6% smaller than the chosen spot size, in order to prevent unforeseen energy density increases. The system automatically adjusts the aiming beam to the selected spot size, ensuring that the aiming spot always covers the burn size for maximum safety. Integrated color compensation considers transmission differences of the different wavelengths of the aiming beam and the treatment beam, and ensures a true sharp retinal spot image at all times.

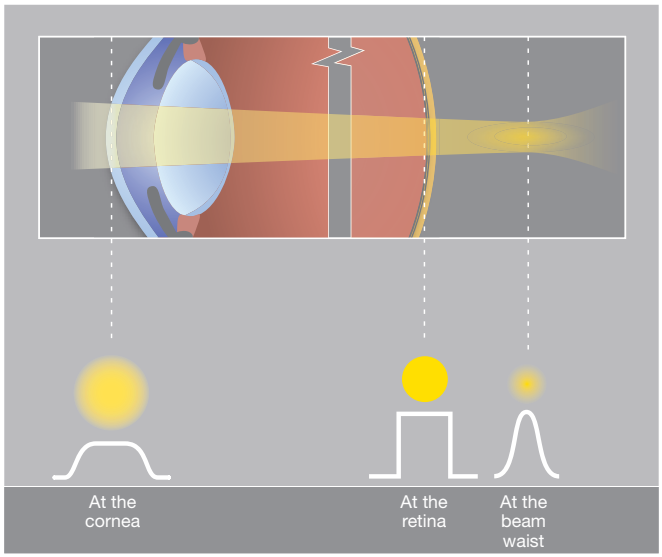


Figure 4: TrueSpot working principle and beam profiles for 500µm spot size.

Conclusion

TrueSpot technology is a superior beam delivery system that provides consistently sharp edged retinal burns at all spot sizes. The integrated automatic aiming spot adjustment and possibility of manual slit lamp titration offer increased comfort and usability.

References

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