Mini Review
Volume 13:1, 2023

Journal of Civil & Environmental Engineering

ISSN: 2165-784X

Open Access

A Brand-New Generation of Ablative Solid-State Laser's First Clinical Results

Raf Dewil*

Department of Chemical Engineering, University of Connecticut, Farmington, Belgium

Abstract

In refractive surgery, solid-state lasers emerged as an alternative to excimer systems at the beginning of the 2000s. Solid-state laser systems were capable of producing excellent clinical outcomes despite some of the limitations imposed by technology at the time. The clinical outcomes of five eyes treated by a new solid-state laser system in three patients are reported in this prospective case series. Prior to surgery, corneal top and-tomography, aerometry and confocal microscopy were used to examine the patients. After undergoing a refractive treatment with the solid-state ablation laser and a femtosecond LASIK procedure with the Ziemer LDV Z8, each patient was followed up for up to a year. None of the operated subjects showed any higher-order or spherical aberrations when the aspheric optimized profiles were used. During the follow-up, no BCVA lines were removed from any of the eyes. The safety index for patient 1 was 5 six months after surgery, while it was equal to 1 for patients.

Keywords: Clinical outcomes • LASIK procedure • Solid-state

Introduction

Excimer eye treatment appears to have been used in the past, according to existing records. Laser vision correction applications rapidly developed due to clinical prospects and mature laser technology. PRK, or photorefractive keratectomy, was first offered and was approved by the FDA. Shortly thereafter, laser-assisted in-situ keratomileusis (LASIK) emerged as the industry standard for laser vision correction. The first excimer lasers were made commercially available in the late after some fundamental research. Ultraviolet laser pulses could be used to ablate materials under intense illumination. As a team with the idea of ablative laser vision revision was created. A new class of laser crystals was introduced concurrently with the availability of industrial excimer lasers for use in ophthalmology. From the deep ultraviolet to the mid-infrared, a wide range of frequency conversion schemes were possible with these crystals.

Literature Review

The initial attempts to construct solid-state deep UV laser sources followed almost immediately from this. The first system, LaserHarmonics, was developed by LaserSight; Novatec developed another system, LightBlade. Even though the technology's initial clinical results were promising, it had to contend with intense competition from excimer laser systems. High pulse energies offered by excimer lasers made it possible to already perform large beam ablations at low repetition rates for refractive surgery. In order to meet market expectations regarding ablation speed at the time, the utilization of a solid-state laser operating at a frequency of 10 Hz indicated that an increase in the repetition rate was required. At the time, solid-state laser sources were not as capable of producing high pulse energies in order to achieve reasonable treatment times as excimer sources, which were available as industrial components with a sufficient output. An overview of the current refractive surgical lasers, which span the wavelength range of 205 to 220 nm and include excimer laser systems as well as solid-state laser systems in development, was provided. Solid-state lasers failed to deliver the tens of millijoules of pulse energy required to achieve cutting-edge large beam ablation for clinical use in a comparison of their respective performance parameters [1,2].

Discussion

The researchers highlighted the potential advantages of solid-state ablation laser technology in these initial studies. They reported smooth ablation surfaces and stable energy output in addition to excellent beam quality. Dair and colleagues also found that solid-state lasers in Balanced Salt Solution (BSS) and 0.9% Sodium Chloride solution absorbed radiation by up to two orders of magnitude less than an excimer system, based on Hale and Querry's research on radiation extinction coefficients over a large portion of the electromagnetic spectrum. Solid-state ablation lasers that emit at longer wavelengths would offer the advantages of not using toxic gas and operating silently, as well as being less dependent on the hydration state of the cornea and the humidity of the surgical environment [3].

In contrast, excimer lasers that emit at 193 nm were found to be crucial to achieve target ablation. Despite being established, the above-mentioned benefits necessitated the creation of a new laser system by a company with no prior experience in excimer laser products using technology not available in the early days of solid-state lasers. As a result, Ziemer Ophthalmic Systems decided to develop a new ablation laser using solid-state laser technology rather than excimer laser technology. Last but not least, confocal laser microscopy imaging revealed a slight edema at the interface one month after surgery. In addition, neither the interface nor the tissue that was adjacent contained any avital cells. Based on the surgeon's extensive experience in refractive surgery, the observations reported closely resemble those seen in typical LASIK refractive surgery performed with excimer lasers. It is important to note that the excellent initial results described above could be achieved without a nomogram and match the excellent safety and efficacy profiles achieved by other research groups using solid-state lasers [4-6].

Conclusion

Additionally, the wet ablation procedure and other previously reported characteristics of solid-state laser sources, such as their silent operation and lower susceptibility to corneal hydration, were replicated. The wet procedure may result in less thermal stress and, as a result, less tensile stress in the irradiated tissue, facilitating a quicker healing time. The new solid-state ablation laser's first clinical results are encouraging and highlight the technology's potential advantages. In the field of refractive surgery, solid-state lasers with a new level

***Address for Correspondence:** Raf Dewil, Department of Chemical Engineering, University of Connecticut, Farmington, Belgium, E-mail: raf.dewil@euven.be*

Received: 02 January 2023, Manuscript No. jcde-23-89661; **Editor assigned:** 04 January 2023, PreQC No. P-89661; **Reviewed:** 16 January 2023, QC No. Q-89661; **Revised:** 21 January 2023, Manuscript No. R-89661; **Published**: 28 January 2023, DOI: 10.37421/2165-784X.2023.13. 489

of performance are feasible and capable of exceeding expectations. The results that have been presented show that the historically established development gap between solid-state lasers and excer lasers can now be bridged using the most recent technological advancements.

Acknowledgement

None.

Conflict of interest

No potential conflict of interest was reported by the authors.

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How to cite this article: Dewil, Raf. “A Brand-New Generation of Ablative Solid-State Laser's First Clinical Results.” *J Civil Environ Eng* 13 (2023): 489.