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European Association of Urology

Platinum Priority – Editorial

Referring to the article published on pp. 529–540 of this issue

Thulium Fiber Laser Versus Holmium:Yttrium Aluminum Garnet for Lithotripsy: Which Is the Winner?

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For endocorporeal laser lithotripsy (ELL), the development of the holmium:yttrium aluminum garnet (Ho:YAG) laser was a game-changer three decades ago [1]. This pulsed laser still remains the gold standard laser for EEL owing to its favorable characteristics, effectiveness, and safety [2]. However, the recent introduction of a new laser for stone treatment, thulium fiber laser (TFL), with some superior characteristics, is threatening to dethrone Ho:YAG. It has been demonstrated that TFL is effective and safe and has the widest range of laser parameters, including pulse energy, pulse width, and pulse duration, among laser generators, with potential to yield an infinite variety of settings that might be tailored to specific stone characteristics [3]. Consequently, TFL is rapidly gaining ground in endourology and could soon become the new reference for laser lithotripsy. Although several comparative studies have assessed these two lasers over the past few years [4], including two randomized controlled trials (RCTs), the superiority of one laser technology over another has not been unequivocally demonstrated.

In this issue of *European Urology*, Uleri et al [5] offer the most detailed meta-analysis to date on the efficacy of laser lithotripsy with Ho:YAG versus TFL technology for renal and ureteral calculi. The authors should be commended for their exhaustive review, which included a total of 11 relevant articles meeting the inclusion criteria. One of the main strengths of this paper is the wide scope that summarizes the evidence supporting each laser. The conclusion drawn by the authors is that TFL is indeed a promising laser for ELL, with some distinct advantages over Ho:YAG.

Notably, the authors found that operative time, excluding laser lithotripsy performed with Ho:YAG laser with MOSES technology, was significantly shorter for TFL than for standard Ho:YAG laser lithotripsy. Moses technology, developed by Lumenis, is based on a 120-W holmium laser (Lumenis Pulse 120 H; Lumenis, San Jose, CA, USA) with pulse modulation capability that can achieve frequencies of up to 80 Hz. Lumenis recently released Moses 2.0, a new version of this high-power laser that can reach 120 Hz [6]. In this study, the authors found no difference in operative time between TFL and Moses technology. A meta-analysis by Ventimiglia et al [7] concluded that high-power laser lithotripsy is associated with a shorter operative time in comparison to low-power lasers; however, this advantage was lost when normalized to the stone burden.

Uleri et al also found that TFL was associated with higher absolute stone-free rates for renal calculi, but there was no significant difference between the technologies for ureteral stones. Perhaps these findings reflect the greater likelihood of clearance for any fragments generated in the ureter, while the superior dusting capability putatively associated with TFL may contribute to higher stone-free rates in the kidney, from which fragment clearance is less likely.

The authors also determined that TFL was associated with fewer intraoperative and postoperative complications. One possible explanation could be the more common use of low-power settings in the TFL studies included when compared to Ho:YAG settings. An in vitro study recently demonstrated that high power settings are related to more thermal

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https://doi.org/10.1016/j.eururo.2024.02.023

damage and, in inexperienced hands, high frequency settings are likely to cause more thermal-related damage, most notably to the ureter [8].

There are several important limitations to this analysis. One is the lack of high-quality data comparing the two laser technologies, limiting the overall level of evidence. Only two RCTS have compared the two technologies [9,10]. However, both RCTs used the same laser parameters for both lasers, which may not be evaluating TFL at its best because its optimal parameters have not been well defined. Another limitation is the significant risk of bias because of substantial methodological heterogeneity in the meta-analyses. Notably, there were no statistically significant differences in the laser utilization time, operative time, or stone-free rate (defined as residual fragments <2–3 mm) between the two lasers ($p < 0.05$). However, statistical analysis of the heterogeneity of the studies revealed a high I^2 value (substantial heterogeneity), resulting in a lower level of certainty for the meta-analysis findings [11].

An additional limitation of the analysis is that the inclusion criteria for the studies varied, which resulted in stones of different sizes and composition that might have been evaluated in subgroup analyses.

One important comparison that was not highlighted was the laser settings used in each study. Since laser settings determine the fragmentation strategy and impact the fragmentation efficiency, it is important to compare the two lasers with regard to laser settings and the calculated ablation speed and efficiency achieved by each. Furthermore, while optimal laser settings for particular fragmentation strategies have been well defined for Ho:YAG laser lithotripsy, ongoing work is still trying to identify optimal laser settings for TFL lithotripsy. In the two RCTS comparing TFL versus Ho:YAG lithotripsy outcomes (with Moses technology in one trial but not in the other) [9,10], identical laser settings were used for each laser. However, it is not clear that optimal laser efficiency and effectiveness for each laser are achieved with the same laser settings.

Comparisons between Ho:YAG and TFL for lithotripsy remain of critical importance. We encourage further clinical comparisons between the two technologies, ideally in RCTs, using well-defined laser settings aimed at optimizing outcomes for each laser. The use of standardized definitions and reporting systems to assess important outcomes is key. There may ultimately be a role for both laser technologies in optimizing outcomes for any given stone scenario.

Conflicts of interest: Olivier Traxer is a consultant for Coloplast, Rocamed, Olympus, EMS, Boston Scientific, and IPG. Margaret Pearle has nothing to disclose.

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