LASERS IN UROLOGY

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LASER is an acronym which stands for "Light Amplification by Stimulated Emission of Radiation." It was originally proposed by Albert Einstein in 1917 AD. However, we had to wait till 1960 AD to see first visible laser light production by Maimen using a ruby crystal. Six years later, Parsons used ruby laser in canine bladders and after next two years, Mulvany attempted to fragment urinary calculi using similar laser[1].

Lasers used in the urological practices are Potassium titanyl phosphate (KTP: YAG), Lithium borate (LBO: YAG), Diode Lasers, Holmium (Ho: YAG), Thulium (Tm: YAG) and Thulium fiber laser (TFL) innovated over different time periods [2,3]. They differ in their wavelength, frequency and energy range and tissue characteristics. Currently, Ho:YAG and TFL are most commonly used lasers in urology.

Ho:YAG laser is the most commonly used laser after 1993. It is pulsed laser with wavelength of 2100nm having penetration depth of 0.4mm and coagulation effect upto 2mm. Technological advancement in the parameters like energy, frequency and pulse duration has broadened its applicability. Now it is suitable for the use in lithotripsy, tissue incision, ablation and enucleation [4,5]. Till now, it is considered gold standard laser procedure in endourological armamentarium. However, postoperative fever, sepsis, bleeding and local temperature rise at the site of lithotripsy are the concerns [5].

Thulium fiber laser is also a pulsed laser with wavelength of 1940nm was introduced into the urological practice in 2018 [3,5]. However, it gained popularity only after 2020, when it received European Certification. It came as an alternative to Ho: YAG. Emitting pulsed infrared light at a wavelength of 1940 nm, which is close to the water absorption peak, a fourfold higher absorption coefficient is achieved with TFL compared to Ho:YAG, corresponding to a low threshold for tissue ablation and stone lithotripsy . Cavitation bubble dynamics also differ from Ho:YAG, and TFL produces a stream of bubbles smaller than those seen with Ho:YAG use . TFL is therefore expected to be very efficient at disintegrating stones in clinical practice [6,7]. Compared to Ho:YAG, TFL has the ability to function at very low energies and extremely high frequencies making it more versatile. In vitro study has shown that TFL works 4-5 times faster, produces finer dusts, has hemostatic properties and produces less fiber burnback compared to Ho: YAG [8].

Though initial results with TFL for both stone and soft tissue are encouraging, we still have to wait for further in vivo studies to decide whether TFL is the laser of future.

REFERENCES

1. https://www.baus.org.uk/museum/122/lasers (Accessed 3rd January 2023)
2. Dołowy Ł, Krajewski W, Dembowski J, Zdrojowy R, Kołodziej A. The role of lasers in modern urology. Cent European J Urol. 2015;68(2):175-82. doi: 10.5173/ceju.2015.537. Epub 2015 Jun 18. PMID: 26251737; PMCID: PMC4526611.
3. Ulvik Ø, Æsøy MS, Juliebø-Jones P, Gjengstø P, Beisland C. Thulium fibre laser versus holmium: YAG for ureteroscopic lithotripsy: outcomes from a prospective randomised clinical trial. European Urology. 2022 Mar 14. https://doi.org/10.1016/j.eururo.2022.02.027
4. Kuntz RM. Current role of lasers in the treatment of benign prostatic hyperplasia (BPH). Eur Urol. 2006 Jun;49(6):961-9. doi: 10.1016/j.eururo.2006.03.028. Epub 2006 Mar 31. PMID: 16632179.
5. Kronenberg, P., Somani, B. Advances in Lasers for the Treatment of Stones—a Systematic Review. Curr Urol Rep 19, 45 (2018). https://doi.org/10.1007/s11934-018-0807-y
6. P. Kronenberg, O. Traxer .The laser of the future: reality and expectations about the new thulium fiber laser-a systematic review. Transl Androl Urol, 8 (Suppl 4) (2019), pp. S398-S417, 10.21037/tau.2019.08.01
7. L.A. Hardy, C.R. Wilson, P.B. Irby, N.M. Fried. Thulium fiber laser lithotripsy in an in vitro ureter modelJ Biomed Opt, 19 (2014), Article 128001, 10.1117/1.JBO.19.12.128001
8. Corrales, M., Traxer, O. Initial clinical experience with the new thulium fiber laser: first 50 cases. World J Urol 39, 3945–3950 (2021). https://doi.org/10.1007/s00345-021-03616-6