The use of Holmium Laser for stone lithotripsy is clinically based, in its versatility for different stone sizes, high success rates, shorter procedure time and low complications of the procedure. The following list presents selected publications from the last 10 years, pointing out the advantages of using Holmium Laser for stone lithotripsy in Urology.
Energy to Healthcare

1990
- Introduced UltraPulse® CO₂ and VersaPulse® Holmium laser systems
- patented waveguide delivery system for CO₂ laser.

1996
- Introduced VersaPulse® C

2000
- Introduced VersaPulse® PowerSuite™, world’s first 100W Holmium laser for BPH

2009
- Introduced AcuPulse™ with SurgiTouch

2010
- Introduced VersaPulse P20

2012
- Introduced AcuPulse WaveGuide
- Introduced AcuPulse DUO
- FiberLase Robotic DIG
- MicroLase Fiber
- FiberLase GYN Handpieces

2014
- Introduced Lumenis Pulse 120H
- Xpeeda Fiber
- SlimLine 200 D/F/L Fiber

2015
- Introduced UltraPulse DUO
- Lumenis Pulse 100H
- Lumenis Pulse 50H

2016
- Introduced Lumenis Pulse 30H
- Suction hand-piece
- Otolase Fiber Delivery System

2017
- Launched MOSES™ technology
- Revolutionizing holmium laser lithotripsy

A Heritage of Innovation
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Peer-reviewed publications of using Holmium Laser for stone lithotripsy
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Laser Stone Lithotripsy - an Overview

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| Stone technology: intracorporeal lithotripters. | World J Urol. 35(9):1347-1351. | Scotland KB, Kroczak T, Pace KT, Chew BH. | 2017 | › A review of the different methods used in Intracorporeal lithotripsy, which is the most commonly used surgical method of stone treatment in Urology.  
› Holmium laser lithotripsy was found to be one of the most commonly used tools for intracorporeal lithotripsy and considered as the gold standard. | N/A          |
› The introduction of holmium laser lithotripters, together with the increasing number of requests for minimally invasive procedures has ameliorated outcomes, patients’ safety and comfort, making the use of flexible ureteroscopy for urinary calculi increasingly attractive and widespread among the urological community.  
› Due to its high stone-free rates and low morbidity, flexible ureteroscopy has become a viable option for the treatment of renal stones. | N/A          |
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### Moses™ technology for stone lithotripsy

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› Mean stone size and density were 12.5 mm (SD 8.7) and 993 (SD 353), respectively. Ureteral access sheath was used in 15 (21%) patients. Mean total laser energy per case was 5.2 kJ. Dusting was exclusively performed in 84% of cases. There were 11 complications (13%) (grade 1=5, grade 2=6). The emergency department visit rate was 5.6%. There were no hospitalizations or reinterventions.  
› Outcomes utilizing a dusting technique demonstrated acceptable residual fragments and complication rates. Further study is needed to define the optimal role of dusting technique during laser lithotripsy. | Lumenis system 120W |
Moses technology in a stone simulator.

Comparison of fragmentation efficiency of the conventional regular mode of Holmium laser to the MosesTM contact mode in a stone simulator using flexible ureteroscopy with artificial stones.

A significant reduction in stone retropulsion was noticed when comparing regular mode to the Moses contact mode (mean Grade 2.5 vs. Grade 1; p<0.01). When compared with the regular mode, the Moses contact mode was associated with significantly shorter procedural time during fragmentation (13.9 vs. 9.1 minutes; p≤0.01) and dusting (9.3 vs. 7.1 minutes; p≤0.01). In addition, when compared with the regular mode, the laser pedal was pressed significantly less often with the Moses mode during fragmentation (86 vs. 43 times; p<0.01) and dusting (50 vs. 26 times; p<0.01). Moses contact mode was associated with significantly higher percentage of lasing vs. pausing when compared with the regular mode for both fragmentation (0.8 J/10 Hz) and pulverization (0.4 J/50 Hz) settings (both p<0.05).

Using the stone simulator setup, Moses technology was associated with more efficient laser lithotripsy (shorter operative time) due to significantly reduced stone retropulsion.
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> Overall, laser lithotripsy with Moses technology utilized laser energy in less time to achieve a satisfying stone fragmentation rate of 95.8 mm3/min versus 58.1 mm3/min, P=0.19.  
> The new Moses laser technology demonstrated good stone fragmentation capabilities when used in everyday clinical practice. | Lumenis system 120W  |

PB-2007974 Rev C
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› A significant reduction in retropulsion when using the Moses mode was shown, so that the stone movement was reduced by 50 times at 0.8 J and 10 Hz (p<0.01). The pronounced reduction of retropulsion in the Moses mode was clearly observed during fragmentation setting (high energy) and dusting (low energy, high Hz). In addition, stone fragmentation tests showed that the Moses modes resulted in a significantly higher ablation volume when compared with the Regular mode (160% higher; p<0.001). In vivo assessment also supported the reduction in retropulsion when treating stones in the porcine kidney. Histological analysis of the porcine ureter after direct lasing in the Moses mode suggested less damage than in the Regular mode.  
› The Moses technology resulted in more efficient laser lithotripsy, in addition to significantly reduced stone retropulsion, and displayed a margin of safety that may result in a shorter procedural time and safer lithotripsy. | Lumenis system 120W |
## Dusting and fragmentation approaches in Holmium laser Lithotripsy

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› Both dusting and fragmentation with extraction approaches to ureteroscopic stone treatment are effective. Each approach has relative advantages and disadvantages, which should be considered.  
› Although dusting tends to be associated with shorter procedure times and a lower risk of ureteral damage, this approach may place the patient at increased risk for future stone events should all of the resultant debris not be expelled from the collecting system. The active removal associated with fragmentation with extraction, in contrast, may provide for a more complete initial stone clearance. | N/A                   |
› The stone-free rate was significantly higher in the basketing group (74.3% vs 58.2%, p = 0.04) . In patients who underwent a basketing procedure operative time was 37.7 minutes longer than in those treated with a dusting procedure (95% CI 23.8-51.7, p <0.001). There was no statistically significant difference in complication rates, hospital readmissions or additional procedures between the groups.  
› The two techniques of dusting and active basket extraction should be in the armamentarium of the urologist. | Lumenis system 120 W   |
## Optimizing Use of the Holmium:YAG Laser for Surgical Management of Urinary Lithiasis

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| Holmium Laser Lithotripsy in the New Stone Age: Dust or Bust?       | Front Surg 29;4:57.              | Aldoukhi AH, Roberts WW, Hall T, Ghani KR. | 2017 | › A review on using different settings during holmium laser ureteroscopy (URS), which can allow the surgeon to choose different combinations that have specific effects on stone lithotripsy.  
› Fragmentation employs settings of low frequency and high pulse energy to break stones that are then extracted with retrieval devices. Dusting is the utilization of high frequency and low pulse energy settings to break stones into submillimeter fragments for spontaneous passage without the need for basket retrieval.  
› Furthermore, use of the long pulse width mode during lithotripsy can reduce stone retropulsion and is increasingly available in new generation lasers.  
› An understanding of holmium laser settings will permit the surgeon to utilize various techniques for stone lithotripsy. |
› The Ho:YAG laser is capable of fragmenting urinary stones of all compositions while maintaining a wide margin of safety.  
› The Lumenis 100 W is the most versatile laser for urology, allowing dusting with a pulse frequency of 50 Hz. |

Lumenis system 120 W

Lumenis system 100 W
# Holmium laser Lithotripsy compared with other methods

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<td>› Stone-free rate was significantly improved (RR 1.15 (95% CI 1.06-1.26, p=0.002) and operation time was significantly reduced (SMD = -2.27 (95% CI -3.42 to -1.11), p = 0.0001) when using a Holmium laser ureteroscopy lithotripsy.</td>
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<td>› Holmium laser ureteroscopy lithotripsy is relatively a more efficient and safe method to treat ureteric stones, since it has shorter operation time and a better stone-free rate.</td>
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<td>› Holmium laser lithotripsy was found to have a significantly reduced operative time (weighted mean difference = -11.52, 95% CI -17.06 to -5.99, p &lt; 0.0001), and increased early stone-free rate (OR 2.69, 95% CI 1.91-3.78, p &lt;0.0001) and delayed stone-free rate (OR 2.12, 95% CI 1.40-3.21, p = 0.0004). A higher postoperative ureteral stricture rate (OR 3.38, 95% CI 1.56-7.31, p = 0.002) was observed in Holmium group over PL group.</td>
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<td>› Holmium laser lithotripsy can achieve shorter mean operative time, better early and delayed stone-free rate compared with pneumatic lithotripsy. Further trials are unlikely to considerably alter this conclusion.</td>
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<td>Application of Pneumatic Lithotripter and Holmium Laser in the Treatment of Ureteral Stones and Kidney Stones in Children.</td>
<td>Biomed Res Int. 2017:2505034.</td>
<td>Zyczkowski M, Bogacki R, Nowakowski K, Muskała , Rajwa P, Bryniarski P, Paradyż A.</td>
<td>2017</td>
<td>Evaluation of the effectiveness of Holmium laser and pneumatic lithotripters in 108 children who underwent ureteral stones and kidney stones lithotripsy procedures in 2 groups. The mean operative time was shorter in the holmium laser group (34 versus 56 minutes, p=0.04) and a higher stone-free rate was observed in the holmium laser but it was not statistically significant. The rate of complications was similar in both groups. The use of a holmium laser reduces the duration of the procedure and increases its effectiveness in comparison with the use of a pneumatic lithotripter.</td>
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<td>A Prospective Randomized Comparison Between Shock Wave Lithotripsy and Flexible Ureterorenoscopy for Lower Caliceal Stones ≤2 cm: A Single-Center Experience.</td>
<td>J Endourol, 29(5):575-9.</td>
<td>Kumar A, Vasudeva P, Nanda B, Kumar N, Das MK, Jha SK.</td>
<td>2015</td>
<td>Evaluate safety and efficacy of shock wave lithotripsy (SWL) and flexible Holmium laser ureteroscopy (RIRS) for lower caliceal calculus ≤2 cm in 195 patients in two groups. Retreatment rate was significantly greater in SWL group (61.1% versus 11.1%; p&lt;0.001). Complication rate was 6.6% in SWL versus 11.1% in group RIRS (p=0.21). For 10-20 mm stones, flexible Holmium laser ureteroscopy (RIRS) was more effective, with significantly reduced retreatment.</td>
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### Success Rate (Stone-Free Rate)

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› Clearance rates were high: for proximal ureteral (97%) and renal pelvic (94%) stones with no major intraoperative complications.  
› Retrograde flexible ureteroscopy is an alternative to percutaneous therapy with acceptable efficacy and low morbidity.                                                                                                              | 365 µm fiber          |
› Delayed stone-free rate was 95% in Holmium laser group and 85% in PIL (p=0.139). In addition, stone migration occurred in only 5 cases in the Holmium group versus 12 cases in the Pneumatic group.  
› Both PIL and Holmium Laser are effective and safe modalities in treating large ureteric stones. Holmium laser had less cases of stone migration.                                                                                     | Lumenis system 100W  
550 µm fiber |
› Stone-free rates were higher (97% versus 79%) in the Holmium group and operative time was shorter (20.5 versus 25.2 min) in the Holmium group.  
› In the ureteroscopic treatment of pediatric ureterolithiasis, laser lithotripsy has a higher stone-free rate and lower complication rate.                                                                                           | N/A                   |
## Reducing procedure time and post-operative complications

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› The operation time in the high-power group was significantly shorter than that in the low-power group (129.20 versus 105.18 minutes).  
› A combination of multitract MPCNL and high-power Holmium laser lithotripsy can greatly decrease the operative time without increasing the intraoperative complications compared with low-power Holmium laser lithotripsy. | Lumenis system  
100W  
1000 µm fiber |
› A lower rate of unplanned visits in the emergency rooms (3% vs 30%) was found in the Holmium group. There was also a trend toward lower rates of rehospitalization in the Holmium group (0% vs 10%).  
› There is a lower risk of unplanned medical visits and rehospitalization when intraoperative retrieving of fragments is performed using Holmium laser lithotripsy. | Lumenis system  
80W  
365 µm fiber |
Risk information: The use of the Lumenis laser systems, accessories and their delivery devices in urology is contraindicated for patients who are unable to receive endoscopic treatments or are intolerant to prolonged anesthesia, as well as for resection or excision of large vascularized organs. Lumenis Holmium laser systems and accessories are solely intended for use by physicians trained in the use of the Ho:YAG (2.1 μm) wavelength. Incorrect treatment settings can cause serious tissue damage. The laser should be used only on tissues that are fully observable. See the system user manual for a complete list of contraindications and risks.