

# Operating Room Efficiency and Cost Implications of Thulium Fiber Laser versus Holmium:YAG Laser for Ureteroscopic Lithotripsy: A Targeted Review, Analysis, and Model

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## Background

The holmium: yttrium aluminum garnet (Ho:YAG) laser has long been considered the gold standard for ureteroscopic lithotripsy.<sup>1</sup> The evolution of laser technology in the search for a more efficient option sparked the emergence of the thulium fiber laser (TFL).<sup>2</sup> *In vitro* studies suggest that TFL provides several technical advantages over Ho:YAG, including lower stone ablation thresholds, minimized tissue damage, and a wider range of laser settings.<sup>3</sup>

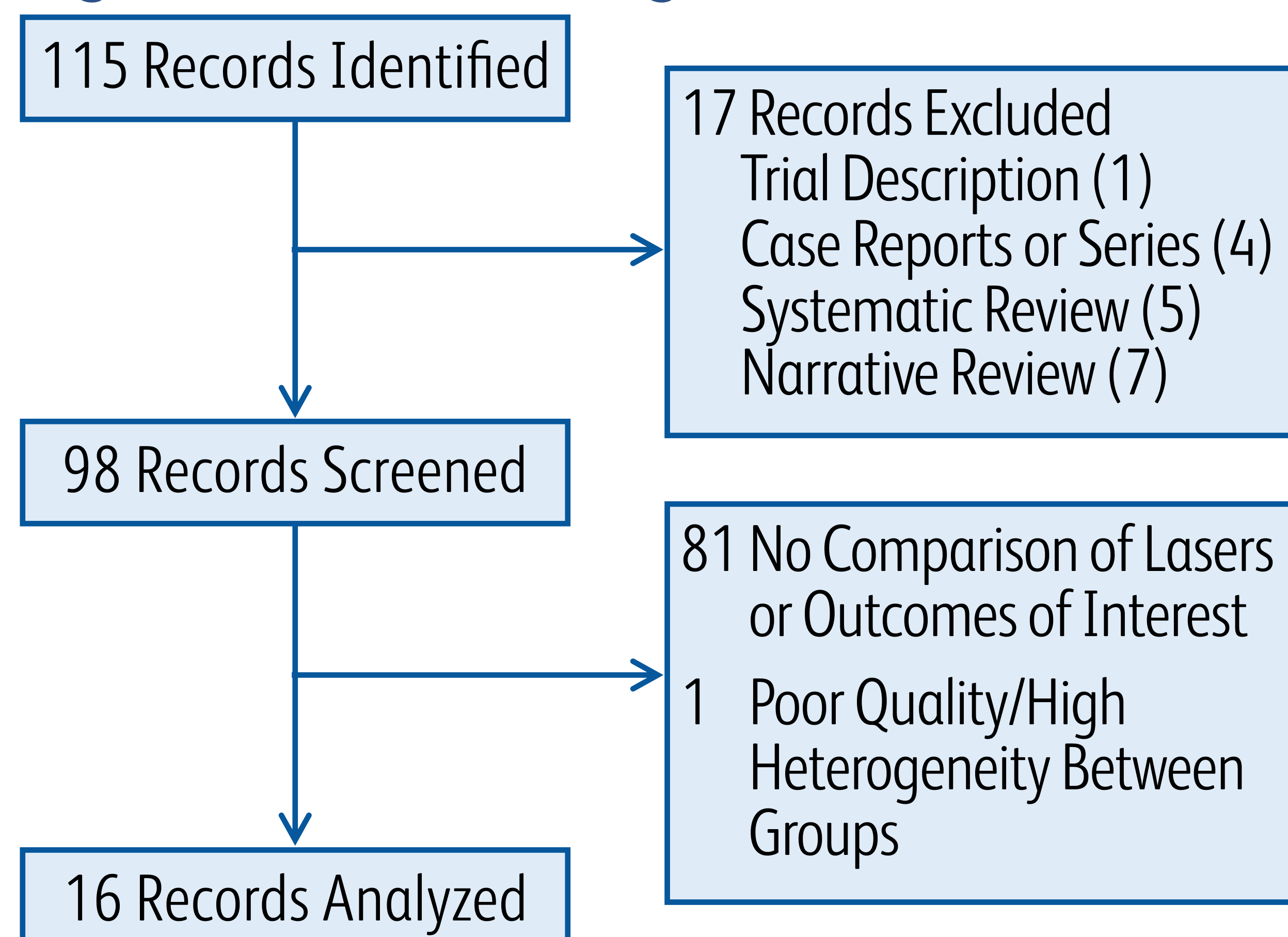
## Objective

This review and analysis seeks to determine whether TFL demonstrates greater efficiency in terms of procedure duration and also stone clearance.

## Methods

A targeted review was conducted of original research published 2021 through 2025 (PubMed) for original studies comparing TFL to Ho:YAG lithotripsy and reporting total operating room (OR) time. The study results on operative time reduction were synthesized and incorporated into an economic model to estimate the potential cost savings resulting from a reduction in total operative time.

## Figure 1: PRISMA Diagram



Search String: ("ureteroscopy"[MeSH Terms] OR ureteroscopy AND "kidney calculi"[MeSH Terms] OR nephrolithiasis OR urolithiasis) AND ("thulium fiber laser" OR "TFL" AND "holmium:YAG laser" OR "holmium laser") AND ("operative time" OR "surgical time" OR "procedure duration" OR "stone-free rate" OR SFR OR retropulsion OR "complication" OR "adverse event")

Database: PubMed Search Date: 12/1/25 Range: 5 years (12/1/20 – 12/1/25)

PRISMA: Preferred Reporting System for Systematic Reviews and Meta-Analyses

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The authors are employees of Becton Dickinson and Company, a manufacturer of TFL systems. Reference reprints and poster printing costs were funded by BD. BD-174540

**Table 1: Publication Analysis**

First Author	Publication Year	Procedure	N	Comparator Arms	Operative Time Difference with TFL (minutes)	P Value	SFR TFL	SFR Ho:YAG	P Value	SFR Measured at
Castellani <sup>4</sup>	2023	Flexible ureteroscopy for laser lithotripsy of renal stones	568 <sup>a</sup>	Ho:YAG w/MOSES vs. TFL	+3	0.45	85%	56%	<0.001	3 months
Gauhar <sup>5</sup>	2025	Flexible ureteroscopy for laser lithotripsy of renal stones	192 <sup>a</sup>	100W Ho:YAG vs. TFL, all w/FANS	+2	0.7	64.6%	52.1%	0.11	30 days
Gupta <sup>6</sup>	2024	Laser lithotripsy for mid- and lower ureteral stones	80	Ho:YAG vs. TFL	-0.41	0.866	100%	90%	0.095	1 month
Chai <sup>7</sup>	2024	Laser lithotripsy for bilateral renal stones	733	High-power or MOSES Ho:YAG vs. TFL	-2.32	0.286	68.9%	54.5%	<0.001	6 weeks to 3 months
Tg <sup>8</sup>	2025	Laser lithotripsy for ureteral stones	110	Ho:YAG vs. TFL	-2.42	0.005	100%	100%	N/A	3 months
Gupta <sup>9</sup>	2025	Flexible ureteroscopy for laser lithotripsy of renal stones	66	Pulse-modulated Ho:YAG vs. TFL	-3 <sup>b</sup>	>0.9	82%	79%	0.9	6 weeks
Jaeger <sup>10</sup>	2022	Laser lithotripsy for ureteral or renal stones, age ≤ 21	125	Ho:YAG vs. TFL	-6	0.77	70%	59%	0.01	90 days
Kozubaev <sup>11</sup>	2025	Flexible ureteroscopy for laser lithotripsy of renal stones	126	Ho:YAG vs. TFL	-7.02	0.031	93.8%	91.8%	0.488	Not specified
Martov <sup>12</sup>	2021	Laser lithotripsy for ureteral stones	174	Ho:YAG vs. TFL	-7.7	<0.05	100%	94.3%	Not reported	1 month
Kudo <sup>13</sup>	2025	Laser lithotripsy for ureteral or renal stones	96	Ho:YAG w/MOSES vs. TFL	-9	0.10	97.9%	95.8%	1.00	1 month
Ulvik <sup>14</sup>	2022	Laser lithotripsy for ureteral or renal stones	120	Ho:YAG vs. TFL	-11 <sup>b</sup>	0.008	92%	67%	0.001	3 months
Ahmad Para <sup>15</sup>	2023	Laser lithotripsy for ureteral stones	478	Ho:YAG vs. TFL	-11	0.05	Not reported	Not reported	Not reported	Not reported
Chandramohan <sup>16</sup>	2023	Laser lithotripsy for mid- and lower ureteral stones	180	Ho:YAG vs. TFL	-13.1	0.024	97.6%	96.5%	0.982	1 month
Bulut <sup>17</sup>	2025	Laser lithotripsy for upper one-third ureteral stones	215 <sup>c</sup>	Pulse-modulated Ho:YAG vs. TFL	-13	<0.001	97.1%	95.6%	0.002	4 weeks
			299 <sup>c</sup>	Ho:YAG vs. TFL	-16	<0.001	97.1%	86.8%	0.002	4 weeks
Patil <sup>18</sup>	2022	Mini-PCNL with active suction sheath	102	Ho:YAG w/MOSES vs. TFL	-18.18	0.001	100%	100%	N/A	1 month
Rico <sup>19</sup>	2025	Flexible ureteroscopy for laser lithotripsy of renal stones	200	Vapor Tunnel Ho:YAG vs. TFL	-18.5	<0.001	81%	82%	0.85	4 weeks

<sup>a</sup>Propensity score matched cohort

<sup>b</sup>Both mean and median values reported, values for median operating time listed

<sup>c</sup>The same 102 TFL subjects are included in each comparison arm

Mean Operative Time Difference: -7.9

## Results

115 records were identified. After exclusions, 98 records were reviewed, and 16 were analyzed (Figure 1). Reported differences in total operative time ranged from 3 minutes faster with Ho:YAG to 18.5 minutes faster with TFL. The mean reduction in total operative time across all studies was 7.9 minutes for procedures performed with TFL. This corresponded to an estimated per-case cost savings of \$386 (2025 USD). Of the 15 studies reporting stone-free rates, all but one demonstrated equivalent or superior outcomes for patients treated with TFL.

## Discussion

The finding of shorter operative time in TFL ureteroscopic lithotripsy procedures compared to Ho:YAG ureteroscopic lithotripsy procedures determined in this analysis echoes the statistically significant results reported in two systematic reviews – one evaluating 11 studies<sup>1</sup> and one evaluating 17 studies.<sup>3</sup> A second observation of this analysis is that TFL ureteroscopic lithotripsy, with shorter total operative time, also appears to be associated with higher stone-free rates compared to procedures performed with Ho:YAG lasers. That finding is consistent with two systematic reviews which found higher stone-free rates to be associated with TFL ureteroscopic lithotripsy procedures.<sup>1,3</sup>

## Model

Operative Time Savings	7.9 min.
Cost of OR Time	\$48.91 cost/min.*
Savings per Case with TFL	\$386

\*Mean cost of ambulatory OR time<sup>20</sup> (2014 USD) represented in 2025 USD<sup>21</sup>

## Conclusions

Ureteroscopic laser lithotripsy procedures performed with TFL may reduce total operating room time by approximately 8 minutes per case. That time savings represents a \$386 per-case cost savings over procedures performed with a Ho:YAG laser. In addition, the use of TFL may be associated with equal or improved stone-free rates at one month or later post-procedure.

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