

## Thulium Fiber Laser Lithotripsy in COVID Positive Patients

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### ABSTRACT

**Background:** Thulium fiber laser technology has been shown to provide more power through a small fiber to enable faster stone fragmentation. In the Covid era, positive patients were postponed for a few weeks before any surgery to ensure their safety. However, with complete ureteric obstruction with large stones, delayed ureteroscopy and stone fragmentation could potentially compromise renal function. We aim to evaluate the Thulium Fiber Laser outcome as an alternative to holmium YAG laser as intracorporeal lithotripter in Covid-19 positive patients.

**Methods:** From March-July 2020, during the peak of the corona outbreak, 11 COVID-19 positive patients were admitted through the emergency department with obstructing ureteric stones underwent urgent JJ stent insertion 2 weeks later from the initial surgery a definitive treatment offered.

**Results:** The average age was 36+-11.7 years, all-male, all fit and healthy despite their Covid-19 status. The average stone size was 11+-3.1 mm with a volume of 395.8+-280 mm<sup>3</sup>. The Hounsfield unit measurement was 1033.3+-57.7. Seven underwent short general anesthesia and 4 had spinal anesthesia. The average laser duration was of 593.9+-357.5 seconds, and the average stone ablation speed was 0.66+-0.19 mm<sup>3</sup>/Sec. The overall stone-free rate was 90.9%. All 11 patients were discharged safely on the same day with only 1 patient readmitted with steinstrasse and underwent urgent ureteroscopy. None of our patients developed late complications.

**Conclusion:** Using the Thulium laser technology allows for a quick and safe alternative to Holmium for fragmenting ureteric stones with a high stone-free rate.

### Keywords

Thulium fiber laser, Covid-19 patients, Lithotripsy, Urolithiasis.

### Introduction

The prevalence of kidney stone disease has increased in the modern era because of increasing obesity, diabetes, and changes in dietary habits on urinary stone formation [1].

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The last decade has witnessed the development of smaller diameter scopes, increased scope flexibility, improvement of accessories, and holmium laser technology has led more urologists to attempt management of larger renal stones with flexible ureteroscopy and holmium laser lithotripsy [2]. That leads to the notable increase in the use of ureteroscopy (URS), so that URS is now the most common surgical therapy for upper urinary tract stones Worldwide [3,4].

The thulium fiber laser is a new technology that has a significant potential for urinary stone treatment. Based on preliminary in vitro studies, the thulium fiber laser surpasses Holmium: YAG laser in many aspects such as integration of smaller fibers, low delivery of pulse energy, super-high pulse repetition rate ranges. All of which lead to faster more efficient stone fragmentation [5]. These new standards may become particularly advantageous for ureteroscopy and open paths that were not been amenable to Holmium: YAG laser [5].

In the era of COVID-19, many countries worldwide have deferred elective surgical cases to try and reduce infection risks not only to patients but also to staff [6]. However, with obstructing ureteric calculi, deferring operating would cause a huge detriment to the patient. Therefore, limiting exposure as much as possible became the corner stone of operating on COVID positive patients. This opted centres to instigate triage of patients whom delaying operations would not be in the patient's best interest [7].

Traditionally, obstructing or symptomatic stones, were stented, and after a few weeks final surgery conducted. However, with the pandemic extending into its second year, this model became risk for viral transmissions. Therefore, we opted through the use of the Thulium laser fiber, which reduces stone fragmentation time to re-institute semi-urgent procedure in these patients. We report the safety and efficacy in our case series in such patients.

## Methodology

The study was approved by our institutional research board (IRB). Charts of patients with calculi and previous positive COVID 19 PCR were selected. Initially all patients underwent JJ stent insertion during their acute COVID-19 infection. After they became negative based on COVID-19 PCR, definitive endourology surgery scheduled. All involved staff had full PPE protection. All our patients underwent either ureteroscopy or retrograde intrarenal surgery (RIRS) from June 2020 to July 2020 using the TFL as intracorporeal lithotripter. The patient's charts retrospectively reviewed.

All surgical procedures were performed by one of our experienced urologists. Each patient was diagnosed before the operation by a computerized tomography (CT) scan to evaluate the calculi. RIRS was the first option for patients with renal calculi and ureteroscopy was performed for patients with ureteral calculi.

Under general anesthesia, all patients were treated using either flexible ureterorenoscopy (f-URS) or semirigid ureteroscopy and

TFL intracorporeal lithotripsy with 200µm fiber. The intracorporeal TFL lithotripsy modality (dusting vs popcorning) was decided intraoperatively by the operating surgeon depending on the size and composition of the stone. At the end of the procedure a contrast study was performed to confirm that there was no leakage. A double-J stent with thread was retained if indicated with the upper coil within the renal pelvis. The stent was removed at the first follow-up, 3 to 5 days postoperatively. Low dose computer tomography scan was performed 4 to 6 weeks after the surgery, the stone status reported by radiologists as a matter of routine, Stone-free status described no post-operative residual stones.

Demographic, stone data, intraoperative, postoperative and laser data were collected. All patients were categorized into two groups as stone-free and remaining with residual stones. Data from both groups were analyzed to identify factors associated with stone-free outcomes.

Statistical analysis was conducted using PASW (SPSS) Statistics version 18.0 software. Data was presented as mean ± SD or as percentages.

## Results

Eleven patients were enrolled in this study, with demographic data shown in table 1. Eleven patients (100 %) were male, the age ranged from 22 to 57-year-old with a mean of 36 years old, the most common presenting symptom was pain, all the 11 patients were COVID positive and during the acute phase of their COVID infection they presented with acuter renal colic. Initially managed by JJ stent insertion followed by laser lithotripsy after they became COVID negative confirmed by PCR. Stone located in the ureter in 10 patients (91%), and in the renal pelvis of the kidney only in one patient (9%), Patient and stone demographics are depicted in table 1.

All the surgeries were performed as a day care procedure. The operative room time, from the start of the procedure to waking the patient, ranged from 35 to 123 minutes with an average of 66 minutes per surgery. Intraoperative stone ablation speed was as fast as 1mm<sup>3</sup>/second. One patient out of 11 (9%) reviewed developed early post-operative complication in form of Steinstrasse, he was operated 4 days after the surgery, the intraoperative finding showed tiny stone fragments flushed out of the lower ureter using the irrigation flow. No other procedure related complications were noted.

All the patients reviewed in this research were followed in our outpatient department and they were asymptomatic and none of them presented to the accident and emergency department complaining of renal colic over the past one year. Ten out of eleven patient included in this research were stone free 91%. Three out of 11 (27%) were having abnormal creatinine preoperative ranging from 110-117 µmol/L, in the post-operative follow-up the creatinine was within normal range.

**Table 1:** The demographic of the patients and the characteristics of the stones.

Sex	
Male	11 (100%)
Female	0 (0%)
Age, mean $\pm$ SD	36 ( $\pm$ 11.7)
Stone Characteristics	
Stone position	
Renal Pelvis	1 (9%)
Ureteral	10 (91%)
Stone Volume mean $\pm$ SD	395.8mm <sup>3</sup> ( $\pm$ 280)
Hounsfield mean $\pm$ SD	1213 HU ( $\pm$ 188.9)
Stone Ablation Speed mm <sup>3</sup> /Sec, mean $\pm$ SD	0.66 ( $\pm$ 0.19)
Operative Room Time in minutes, mean $\pm$ SD	66 ( $\pm$ 28)

## Discussion

The holmium: Yttrium–Aluminum–Garnet (Ho: YAG) laser, known as holmium laser, is a commonly used laser for endourologic procedures, particularly for intracorporeal lithotripsy. Ho: YAG can fragment all types of stones. Hence it is recommended as the gold standard for intra-corporeal lithotripsy for endoscopic management of urinary tract stones [8]. However, there are still several limitations, which lead to prolonged operation time like worsening of endoscopic view during laser operation due to what known as “snowstorm” effect, lower energy could be passed through the smallest fiber that results in the prolonged operation time and limited efficacy and retropulsion, which sometimes may become clinically significant.

Recently, with the advent of the next-generation laser lithotripsy: the thulium fiber laser (TFL), higher energy levels can be transmitted through a smaller fiber. This has led to a more efficient stone fragmentation in a quicker time frame [9,10]. In a comparative study between holmium and thulium, Martov et al concluded that TFL technology was associated with excellent efficacy/safety ratio with a significantly reduced fragmentation time [11].

Furthermore, Hardy et al, in their comparison between the two laser fibers, found that the TFL produced a higher stone fragmentation rate and had smaller fragments than the holmium laser [10]. This is significant as it leads to smaller residual stones sized that can be washed out easier, while with large residual fragments, added techniques, such as basketing the stones, would need to be used. Furthermore, higher stone fragmentation rates again lead to a quicker procedure time, therefore, less time the patient is in the operating theatre.

These factors were crucial in the current era of the Covid pandemic, especially for Covid positive patients. As we are aware, the virus is a respiratory virus that can lead to lung and oxygenation compromised [12]. Therefore, prolonged procedures have the potential to further compromise this. Hence many elective procedures were also postponed, in addition to reducing infection transmission risk.

Nonetheless, the use of the TFL with a significantly higher stone

fragmentation rates, can reduce operative time to the point, where patients are more streamlined in and out of theatre with minimal respiratory compromised risk. Albeit, all our patients were Covid positive, however, operated on after a negative result, however, the long-term effects of the respiratory compromise left by the virus is still being studied and under investigation [12,13]. Therefore, prediction of how second insults on the lungs would have through operations is unknown.

Furthermore, early reports have shown that the virus also has a detrimental effect on the kidney, especially with existing renal failure [12,14]. As ureteric obstructed patients invariably lead to insults to that kidney, the effects of a prolonged procedure in the renal system, whereby the pressure is higher than the normal physiological pressure, is also unknown. However, limiting the time of increased intra-renal pressure secondary to ureteroscopy, may also alleviate the risk of furthering kidney damage.

Though the exact effects of the virus are yet to be completely understood, mitigating any potential long-term consequences of adding further insults to possible existing organ damage would no doubt be in the patient’s best interest.

In our small series, we were able to relieve the obstruction and pain caused by the stones, and also able to reduce operative time and ensure a stone free status in all the patients. However, further studies into the effects of ureteroscopy on these cohort of patients is warranted to better understand the risks.

## Conclusion

Thulium laser stone fragmentation in previously positive Covid patients is safe and leads to a short operative time, entailing a more streamlined, shorter hospital stay.

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