LASER - TYPES; FIBRES; PROS AND CONS OF ITS ENDOSCOPIC USE
(E.G. TRANSURETHRAL PROSTATE RESECTION AND URETERIC/URETHRAL STRicture RESCTION)

J.R Sathiya
Hospital Selayang
LASER

• Light Amplification by Stimulated Emission of Radiation

• Excited electron reentry causing photon emission which collides with electron emitting energy by means of photon

• Characteristics : Coherent, collimated, monochromatic
REACTION OF LASER WITH TISSUE

- Reflection, scattering, absorption

- Absorption is most important - converted to thermal energy causing increased temperature at target tissue causing vaporisation or coagulation
REACTION OF LASER WITH TISSUE

- Reflection: Percentage of beam is reflected by tissue and may heat and damage surrounding tissue - Not greatly affected by wavelength, can be ignored.

- Scattering: Diversion of part of laser beam away from intended direction. Shorter wavelength scattered much higher than longer wavelength.

- Extinction length: Depth of tissue which 90% of the incident laser beam is absorbed and converted to heat. Usually 2.3 of absorption length.
## Table 3: Lasers: crystals, abbreviations, wavelength, techniques and acronyms

<table>
<thead>
<tr>
<th>Active crystal</th>
<th>Abbreviation</th>
<th>Wavelength (nm)</th>
<th>Technique</th>
<th>Acronym</th>
</tr>
</thead>
<tbody>
<tr>
<td>Holmium</td>
<td>Ho:YAG</td>
<td>2140</td>
<td>Holmium laser ablation</td>
<td>HoLAP</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Holmium laser resection of prostate</td>
<td>HoLRP</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Holmium laser enucleation of prostate</td>
<td>HoLEP</td>
</tr>
<tr>
<td>Neodym</td>
<td>Nd:YAG</td>
<td>1064</td>
<td>Visual laser ablation of prostate</td>
<td>VLAP</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Contact laser ablation of prostate</td>
<td>CLAP</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Interstitial laser coagulation (of prostate)</td>
<td>ILC</td>
</tr>
<tr>
<td>Kalium titanyl phosphate</td>
<td>KTP:Nd:YAG (SHG)</td>
<td>532</td>
<td>Photoselective vaporisation of prostate</td>
<td>PVP</td>
</tr>
<tr>
<td>Lithium borat</td>
<td>LBO:Nd:YAG (SHG)</td>
<td>532</td>
<td>Photoselective vaporisation</td>
<td>PVP</td>
</tr>
<tr>
<td>Thulium</td>
<td>Tm:YAG</td>
<td>2013</td>
<td>Thulium laser vaporisation of prostate</td>
<td>ThuVAP</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Thulium laser vaporesection of prostate</td>
<td>ThuVARP</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Thulium laser vapoenucleation of prostate</td>
<td>ThuVEP</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Thulium laser enucleation of prostate</td>
<td>ThuLEP</td>
</tr>
<tr>
<td>Diode lasers</td>
<td>-</td>
<td>830</td>
<td>Interstitial laser coagulation of prostate</td>
<td>ILC</td>
</tr>
<tr>
<td></td>
<td></td>
<td>940</td>
<td>Vaporisation</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>980</td>
<td>Vaporisation</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1318</td>
<td>Vaporisation</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1470</td>
<td>Vaporisation</td>
<td>-</td>
</tr>
</tbody>
</table>

### 2.3  Historical use of lasers

#### 2.3.1  Nd:YAG laser

The Nd:YAG laser has a wavelength of 1064 nm. It has a long extinction length and penetrates tissue by approximately 4-18 mm, making it suitable for haemostasis and tissue coagulation. At that time it appeared to be ideal for the treatment of benign prostatic hypertrophy (BPH) (2). Since 1985, many Nd:YAG laser-driven transurethral treatments have been described for both BPE and BPO (3).

#### 2.3.2  Nd:YAG laser-based techniques

Several Nd:YAG approaches have been extensively studied, including: visual laser ablation of the prostate (VLAP) (4); contact laser ablation of the prostate (CLAP) (5); interstitial laser coagulation (ILC) (6), and Nd:YAG laser hybrid techniques (7).

However, all these techniques have been superseded by the advent of newer laser-based techniques (8). As these techniques are no longer contemporary, they will not be discussed further in these guidelines. However, they are discussed in the EAU guidelines on the conservative treatment of non-neurogenic male lower urinary tract symptoms (LUTS) (9).

### 2.4  References

• Chromophobres are chemical groups capable of absorbing light at a particular frequency and thereby imparting colour to a molecule.

• Absorption can only occur when there is a chromophore
3.2.1 Physical properties

All new lasers are extensively studied in preclinical trials in comparison with the most common vaporising laser, i.e. an 80 W KTP or 120 W LBO laser. The specific heat capacities of renal (3.89 kJ/kg/°K) and prostatic tissues (3.80 kJ/kg/°K) are almost equivalent, so making the isolated, blood-perfused, porcine kidney a very useful model for the study of laser procedures (5).

Animal models have been very useful in evaluating laser characteristics, including tissue ablation rate, efficacy of ablation in correlation to the power setting (output power efficiency), haemostatic properties, and the extent of morphological tissue necrosis. Table 4 provides a comparison of different lasers and their individual characteristics derived from a series of ex-vivo comparison studies in a porcine, perfused kidney model. The data has been given as a statistical mean or interval, according to the original publication.

3.2.1.1 Ablation capacity

The tissue ablation rate achieved with KTP and LBO lasers increases with increasing output power. In comparison to the Tm:YAG laser (70 W) KTP laser, the tissue ablation rate reached 3.99 g/10 min (80 W KTP) and 6.56 g/10 min (70 W Tm:YAG) (p < 0.05). When compared to TURP, both laser devices produced significantly lower rates of tissue removal (8.28 g/10 min) (6). However, the LBO laser, with its tissue ablation rate of 7.01 g/10 min laser ablation at 120 W offered a significantly higher ablation capacity compared with KTP laser at 80 W (p < 0.005) (7).

3.2.1.2 Bleeding rate

The KTP laser shows excellent haemostatic potential, with a bleeding rate for the 80 W KTP laser of 0.21 g/min compared with 0.16 g/min for the continuous wave (cw) 70 W Tm:YAG laser. In contrast, TURP is associated with a much higher bleeding rate of 20.14 g/min (p < 0.05) (6). The bleeding rate for the 120 W LBO laser was also higher at 0.65 g/min when compared to 80 W KTP with 0.21 g/min, respectively (p < 0.05) (7).

3.2.1.3 Coagulation zone

In the porcine perfused kidney tissue ablation model, the KTP laser (p = 0.05) showed a 2.5-fold deeper coagulation zone (666.9 µm) than the cw Tm:YAG (264.7 µm) laser and TURP (287.1 µm). Tissue ablation resulted in a dense coagulation zone at the tissue surface (6). The corresponding depths of the coagulation zones at 120 W LBO laser and 80 W KTP laser were 835 µm and 667 µm (p < 0.05), respectively (7).
MECHANISM OF LASER - TISSUE INTERACTION

- Photochemical - Photosensitive dye taken up by certain tissue, application of certain wavelength of light causing thermal damage.

- Photothermal - Direct irradiation of tissue causing vaporisation

- Photomechanical - Spallation, recoil & space change (plasma formation & cavitation bubbles)
LASER IN UROLOGY

- Stone
- Prostate
- Strictures
LASER FOR STONES

- Ho-YAG @ Holmium most commonly used
- Wave length 2140nm, pulse mode
- 200, 365, 500 and 1000 micron fibres
- Works primarily through photothermal mechanism that cause stone vaporization
- Highly absorbed by water, contact with stone paramount for fragmentation.
- Zone of thermal injury 0.5-1mm
- Reduces retropulsion
- Fragments all stones regardless of composition
PROS & CONS - LASER FOR STONE

- Pro: Reduced retropulsion rate, no need to deal with fragments (dusting), reduced tissue damage
- Cons: Costly
LASER FOR STONES

• Nd-YAG - e.g. FREDDY (Frequency doubled double pulsed Nd-YAG laser)

• Photomechanical- Spallation, recoil & phase change (Cavitation bubbles + plasma formation)

• Pro: Does not need direct contact, cheap, safer for tissue

• Cons: Large fragments, ineffective for large stones, more retropulsion
# LASER FIBERS

<table>
<thead>
<tr>
<th>Wavelengths</th>
<th>Holmium and Nd: YAG (2120 and 1064 nm)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Scope Comp.</strong></td>
<td>Flexible, semi-rigid and rigid endoscopes</td>
</tr>
<tr>
<td><strong>Core Diameter</strong></td>
<td>272 µm</td>
</tr>
<tr>
<td><strong>Max. Outer Dia.</strong></td>
<td>450 µm (1.4F)</td>
</tr>
<tr>
<td><strong>Min. Working Channel</strong></td>
<td>1.7 F</td>
</tr>
<tr>
<td><strong>Max. Energy</strong></td>
<td>1.5 J</td>
</tr>
<tr>
<td><strong>Max. Power</strong></td>
<td>45 W</td>
</tr>
</tbody>
</table>

**Max. Rep. Rate**

At any energy setting, repetition rate should be adjusted so as not to exceed maximum power listed above.

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**Accessories Part Number**

- **Sterilization Tray**: 0627-920-01
- **Ceramic Scissors**: 5402-0152
- **Fiber Strippers**:
  - 200 µ: 5402-0164
  - 365 µ: 5402-0163
  - 500 µ: 5402-0151
  - 1000 µ: 5402-0159
- **Inspection Scope**: 0622-921-01
- **Cleaving Tool**: 5402-0141

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**Laser Delivery Systems**

<table>
<thead>
<tr>
<th>Part Numbers</th>
<th>0º</th>
<th>15º</th>
<th>30º</th>
<th>70º</th>
</tr>
</thead>
<tbody>
<tr>
<td>VersaTip</td>
<td>0622-651-00</td>
<td>0622-651-15</td>
<td>0622-651-30</td>
<td>0622-651-70</td>
</tr>
<tr>
<td>InfraTome</td>
<td>0624-084-00</td>
<td>0624-084-15</td>
<td>0624-084-30</td>
<td>0629-084-70</td>
</tr>
<tr>
<td>DiskeTome</td>
<td>0624-829-01</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VersaLink/Tip Sterilization Tray</td>
<td>0619-760-01</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VersaLink Handpiece</td>
<td>0624-175-01</td>
<td></td>
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</tr>
</tbody>
</table>
Optimal Power Settings for Holmium:YAG Lithotripsy

Jason Sea, Lee M. Jonat, Ben H. Chew,* Jinze Qiu, Bingqing Wang, John Hoopman, Thomas Milner and Joel M. H. Teichman†

From the Department of Urologic Sciences, University of British Columbia, Vancouver, British Columbia, Canada, and Biomedical Optics Program, Department of Electrical Engineering, University of Texas, Austin and University of Texas Southwestern Medical Center, Dallas, Texas

Abbreviations and Acronyms

COM = calcium oxalate monohydrate
MAPH = magnesium ammonium phosphate hexahydrate
TF = total fragmentation

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* Financial interest and/or other relationship with Boston Scientific, Cook Urological, Percutaneous Systems and Poly-Med.
† Correspondence: Department of Urologic Sciences, St. Paul’s Hospital, Burrard Building C307, 1081 Burrard St., Vancouver, British Columbia, Canada V6Z 1Y6.

Purpose: We determined the optimal Ho:YAG lithotripsy power settings to achieve maximal fragmentation, minimal fragment size and minimal retropulsion.

Materials and Methods: Stone phantoms were irradiated in water with a Ho:YAG laser using a 365 μm optical fiber. Six distinct power settings were tested, including 0.2 to 2.0 J and 10 to 40 Hz. For all cohorts 500 J total radiant energy were delivered. A seventh cohort (0.2 J 40 Hz) was tested post hoc to a total energy of 1,250 J. Two experimental conditions were tested, including with and without phantom stabilization. Total fragmentation, fragment size and retropulsion were characterized. In mechanism experiments using human calculi we measured crater volume by optical coherence tomography and pressure transients by needle hydrophone across similar power settings.

Results: Without stabilization increased pulse energy settings produced increased total fragmentation and increased retropulsion (each p <0.0001). Fragment size was smallest for the 0.2 J cohorts (p <0.02). With stabilization increased pulse energy settings produced increased total fragmentation and increased retropulsion but also increased fragment size (each p <0.0001). Craters remained symmetrical and volume increased as pulse energy increased. Pressure transients remained modest at less than 30 bars even at 2.0 J pulse energy.

Conclusions: Holmium:YAG lithotripsy varies as pulse energy settings vary. At low pulse energy (0.2 J) less fragmentation and retropulsion occur and small fragments are produced. At high pulse energy (2.0 J) more fragmentation and retropulsion occur with larger fragments. Anti-retropulsion devices produce more efficient lithotripsy, particularly at high pulse energy. Optimal lithotripsy laser dosimetry depends on the desired outcome.

Key Words: urinary calculi; lithotripsy; lasers, solid-state; efficiency; calcium oxalate
LASER FOR PROSTATE

• Coagulation, vaporisation, resection, and enucleation

• Contemporary laser systems
  • KTP:YAG and LBO:YAG (green light/PVP)
  • Diode lasers (various)
  • Ho:YAG
  • Tm:YAG
COAGULATION

- Nd:YAG laser

- deep coagulative necrosis, delayed (4–8 weeks) sloughing and secondary ablation of the obstructive tissue

- no immediate removal of tissue → no tissue available for histological examination

- visual laser ablation of the prostate (VLAP) and interstitial laser coagulation (ILC)

- VLAP & ILC were effective for subjective and objective improvements

- associated with adverse events “post-laser voiding syndrome” - early postoperative dysuria, urgency, prolonged catheterization

- both VLAP (20%) and ILC (15%) had high reoperation rates
VAPORISATION

• Laser beam is directed by a bare fibre

• Straight or sideways onto the prostate tissue

• Channel of evaporated tissue is created through the prostate

• No tissue is available for histological examination
**HoLAP (Ho-laser ablation of the prostate)**

- HoLAP was first reported in 1994 using a 60-W Ho-laser
- declined with the development of holmium resection and enucleation
- resurgence with high-powered 100-W Ho-laser
- HoLAP vs TURP
  - IPSS improvements and Qmax similar between groups at 12 months
  - shorter catheterization and hospitalization times
• **Ho-LAP**

  • large glands (>80g)
  
  • short-term efficacy ➔ AUA symptom score (SS) and Qmax improvement

  • insignificant blood loss

  • no stress incontinence

  • short catheterization and hospitalization

  • HoLAP (80–100 W) vs PVP of the prostate (80 W) [2]
    
    • comparable in all parameters but operative times favour PVP

  • durability

    • subjective and objective voiding variables were durable

    • 47% reduction in AUA-SS and an 83% increase in Qmax from baseline

    • the reoperation rate was 15% after 7 years
• **PVP**

  • first reported in 2003 with 80W KTP laser - a higher-powered 120W LBO laser (GreenLight HPS) & more recently the 180W LBO system (GreenLight XPS)

  • improve vaporization speed

  • efficacy & durability

    • 3 RCTs for GreenLight PV vs TURP

    • similar in the two groups; a mean increase in Qmax of 136% and a 61% mean IPSS improvement for the 80W GreenLight laser group

    • large prostates reported a significant difference in IPSS and Qmax at 6 months in favour of TURP

    • 1 RCT GreenLight PV vs open prostatectomy (OP)

    • similar improvements in IPSS score, quality of life (QOL), and Qmax
• **PVP pros**

  • less blood loss
  
  • shorter duration catheterization
  
  • shorter hospital stay
  
  • retrograde ejaculation rates were similar between PVP and TURP groups
  
  • no difference in between erectile function (EF) in patients undergoing OP/TURP and GreenLight PV
3.2.5 **Conclusions and recommendations for the use of KTP and LBO lasers**

<table>
<thead>
<tr>
<th>Conclusions</th>
<th>LE</th>
</tr>
</thead>
<tbody>
<tr>
<td>In patients with small to moderate-sized prostates, TURP remains the standard of care.</td>
<td>1a</td>
</tr>
<tr>
<td>KTP PVP and LBO PVP are safe and effective in the treatment of BOO and BPE in patients with a small or medium prostate gland.</td>
<td>1b</td>
</tr>
</tbody>
</table>
| Over a follow-up of 3-5 years, re-treatment rates appear comparable to those with TURP. | 1b (at 3 yr)
| 4 (at 5 yr)                                                                  |         |
| KTP PVP and LBO PVP are safe and effective for patients receiving anticoagulation medication or patients in retention. | 4       |

<table>
<thead>
<tr>
<th>Recommendations</th>
<th>GR</th>
</tr>
</thead>
<tbody>
<tr>
<td>KTP/LBO PVP is an alternative treatment for patients with BOO and BPE for small and medium glands.</td>
<td>A</td>
</tr>
<tr>
<td>KTP/LBO PVP can be offered as an alternative to TURP for patients with refractory urinary retention.</td>
<td>B</td>
</tr>
<tr>
<td>KTP/LBO PVP can be offered to patients using anticoagulant medication.</td>
<td>B</td>
</tr>
<tr>
<td>KTP/LBO PVP is a safe method for volume reduction in large size prostate glands.</td>
<td>A</td>
</tr>
</tbody>
</table>

**BOO = bladder outlet obstruction; BPE = benign prostatic enlargement; KTP = potassium titanyl-phosphate laser; LBO = lithium triborate; PVP = photoselective vaporisation of the prostate; TURP = transurethral resection of the prostate.**
RESECTION

• can be performed by both the Ho and Tm lasers

• end-firing fibre is used

• bilateral bladder neck incisions

• the median lobe resected either as a single fragment/multiple fragment

• lateral lobes are resected in multiple small prostate chips that are subsequently irrigated from the bladder

• tissue is available for histological examination
• **Ho-laser resection of the prostate (HoLRP)**

  • first introduced in 1994, superseded by the enucleation technique (HoLEP)
  
  • remains relevant for re-operations and ‘channel’ resections for advanced prostate cancer
  
  • efficacy and morbidity: no difference in the symptom improvement at 6 or 12 months postoperatively when compared to TURP;
    
    • HoLRP achieved a significantly greater increase in Qmax compared with TURP
    
    • HoLRP appeared to be superior to TURP in terms of transfusion rates, duration of catheterization and hospitalization
  
  • durability: longterm results were equivalent to the TURP
ENUCLEATION

• Endoscopic equivalent to open prostatectomy

• both Ho and Th laser can be used

• contact mode: bare-tip laser fibre to enter the surgical plane between the prostate adenoma and capsule

• tissue is available for histological examination

• tissue morcellator is required to remove tissue
• **Ho-LEP**

  • efficacy & morbidity: HoLEP is at least as effective as TURP in relieving the symptoms of BPH

  • meta-analysis of four RCTs comparing HoLEP and TURP found urodynamic relief of obstruction was superior with HoLEP compared with TURP but only when prostate volumes were > 50g

  • catheterization time, hospital stay and blood loss were significantly lower in the HoLEP group compared with TURP

  • erectile dysfunction and retrograde ejaculation is very similar between HoLEP and TURP
3.4.12 **Recommendations for holmium (Ho:YAG) laser treatment**

<table>
<thead>
<tr>
<th>Recommendations</th>
<th>LE</th>
<th>GR</th>
</tr>
</thead>
<tbody>
<tr>
<td>HoLAP can be offered to patients with BOO or BPE with small- to medium-sized prostates.</td>
<td>1b</td>
<td>A</td>
</tr>
<tr>
<td>HoLRP can be offered to patients with BOO or BPE with small- to medium-sized glands.</td>
<td>1b</td>
<td>A</td>
</tr>
<tr>
<td>HoLEP can be offered to any patient with BOO and BPE.</td>
<td>1a</td>
<td>A</td>
</tr>
<tr>
<td>HoLEP can be offered to patients in chronic urinary retention.</td>
<td>2b</td>
<td>B</td>
</tr>
<tr>
<td>HoLEP can be offered to patients on anticoagulant or antiplatelet medication.</td>
<td>2b</td>
<td>B</td>
</tr>
</tbody>
</table>

BOO = bladder outlet obstruction; BPE = benign prostatic enlargement
### 3.5.2 Thulium laser techniques

Four different technical approaches have been described so far:

1. Tm:YAG vaporisation of the prostate (ThuVAP);
2. Tm:YAG vapoablation (ThuVAPR);
3. Tm:YAG vapoenucleation (ThuVEP);
4. Tm:YAG laser enucleation of the prostate (ThuLEP) (8).

### 3.5.4 Conclusions and recommendations for use of Thulium:YAG lasers

<table>
<thead>
<tr>
<th>Conclusions</th>
<th>LE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ThuVAPR</strong> showed equivalent effectiveness when compared to TURP in one RCT and one non-randomised prospective controlled trial with small and medium volume glands. Tm:YAG treated patients showed shorter catheterisation time and shorter hospitalisation time. Adverse events were significantly lower than in TURP (intra-operative and post-operative bleeding).</td>
<td>1b</td>
</tr>
<tr>
<td>Currently, only one RCT with a short follow-up has compared ThuVEP to HoLEP. Nevertheless, three prospective cohort studies with a follow-up of 18 months demonstrated efficacy for ThuVEP, as well as low perioperative complications and retreatment rates.</td>
<td>1b</td>
</tr>
<tr>
<td>Study data are awaited comparing ThuVEP and ThuLEP to HoLEP. HoLEP is the most extensively studied transurethral enucleation technique to date and long-term anatomical data are of particular interest.</td>
<td>4</td>
</tr>
<tr>
<td>Recommendations</td>
<td>LE</td>
</tr>
<tr>
<td>--------------------------------------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>ThuVARP is an alternative to TURP for small- and medium-sized prostates.</td>
<td>1b</td>
</tr>
<tr>
<td>ThuVARP and ThuVEP are suitable for patients at risk of bleeding or taking anticoagulant medication.</td>
<td>2b</td>
</tr>
<tr>
<td>ThuVEP can be offered as an alternative to TURP, to HoLEP and OP for large size prostates.</td>
<td>1b, 2b</td>
</tr>
</tbody>
</table>
RETROGRADE LASER ENDOURETEROTOMY

• Endoureterotomy is often first-line treatment for benign ureteral strictures since its introduction in 1997

• Success rates not uniformly evident

• Variations in success rates between published literature most probably arise because benign ureteral strictures are comprised of several different entities, each possibly responding differently to laser endoureterotomy

• Non-ischaemic (e.g. iatrogenic) benign ureteral strictures after calculi management or abdominal surgery are reported to respond well to laser endoureterotomy, with a reported success rate between 68.4% and 91%
RETROGRADE LASER ENDOURETEROTOMY

• Stricture length is probably the most important predictor of outcome.

• Long ureteric strictures (> 2 cm) tend to be associated with poorer success rates.

• Stricture duration, ipsilateral renal function, stone impaction and stricture localisation (upper, middle or lower) have been also suggested to affect the outcome, though published results are controversial.

• Patients with ureteroenteric and malignant strictures do not respond well to laser endoureterotomony. Success rates in these cases are reported to be less than 60%.
LASER ENDOURETEROTOMY

• The outcome of retrograde laser endoureterotomy compared to open surgical revision is slightly inferior.

• Due to the minimally invasive nature of the technique, laser endoureterotomy is associated with less morbidity and should be considered a first-line treatment option.

• Compared with other well-substantiated, endourological methods (e.g. hot-wire balloon catheter, endoincision with electrocautery or cold knife), laser endoureterotomy has been reported to have the same or superior long-term results.

• Holmium:YAG laser appears the only well tested-treatment modality.
### 7.3 Conclusions and recommendations for retrograde laser endoureterotomy

<table>
<thead>
<tr>
<th>Conclusions</th>
<th>LE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Retrograde laser endoureterotomy is a feasible and safe treatment option for ureteral strictures.</td>
<td>3</td>
</tr>
<tr>
<td>Open surgical revision remains the gold standard.</td>
<td>1a</td>
</tr>
<tr>
<td>Ureteral strictures of different aetiologies appear to respond differently to treatment.</td>
<td>2b</td>
</tr>
<tr>
<td>In selected cases, success rate can reach 90%.</td>
<td>3</td>
</tr>
<tr>
<td>Ureteroenteric anastomosis strictures respond poorly to laser endoureterotomy.</td>
<td>3</td>
</tr>
<tr>
<td>Late stricture recurrence should be expected as long as 18 months post-operatively.</td>
<td>3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Recommendations</th>
<th>GR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Retrograde endoureterotomy should be considered a first-line treatment option for ureteral strictures.</td>
<td>C</td>
</tr>
<tr>
<td>Longer follow-up is needed.</td>
<td>C</td>
</tr>
</tbody>
</table>
RETROGRADE LASER ENDOPYELOTOMY FOR UPJO

- Laser endopyelotomy for the treatment of ureteropelvic junction obstruction (UPJO) can be traced back to the early 1990s.

- Laser retrograde endopyelotomy has been a well-established method for the treatment of primary or secondary ureteropelvic junction (UPJ) strictures with success up to 80%.

- Optimal indication for laser endopyelotomy is a short (< 2 cm) UPJO of intrinsic aetiology in the absence of:
  - A very large pelvis,
  - High insertion of the ureter,
  - Renal split function below 20%, and
  - Ipsilateral renal calculi.
RETROGRADE LASER ENDOPYELOTOMY FOR UPJO

• outcome of retrograde laser endopyelotomy compared to open pyeloplasty is slightly inferior

• However, due to the minimally invasive nature of the technique, laser endopyelotomy is associated with minimum blood loss, reduced hospital stay and less post-operative pain and should be one of the first-line treatment options

• a failed endopyelotomy is not a contraindication for secondary open or laparoscopic pyeloplasty

• Ho-YaG only laser with adequate studies
## 8.3 Conclusions and recommendations for laser treatment for UPJO

<table>
<thead>
<tr>
<th>Conclusions</th>
<th>LE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Retrograde laser endopyelotomy is a feasible and safe treatment option for the treatment of UPJO.</td>
<td>3</td>
</tr>
<tr>
<td>Open or laparoscopic pyeloplasty remains the gold standard.</td>
<td>1a</td>
</tr>
<tr>
<td>In selected cases, success rate can reach 90%.</td>
<td>2b</td>
</tr>
<tr>
<td>Treatment morbidity is minimal and major complications are rare.</td>
<td>3</td>
</tr>
<tr>
<td>Treatment failure may occur up to 1 year post-operatively.</td>
<td>3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Recommendations</th>
<th>GR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Retrograde laser endopyelotomy could be one of the first-line treatment options.</td>
<td>C</td>
</tr>
<tr>
<td>Follow-up should be prolonged for at least 1 year post-operatively.</td>
<td>C</td>
</tr>
<tr>
<td>Open or laparoscopic pyeloplasty remain options in cases in which minimally invasive measures fail.</td>
<td>C</td>
</tr>
<tr>
<td>Ensure identification of crossing vessels which is of particular relevance in reducing bleeding complications.</td>
<td>B</td>
</tr>
<tr>
<td>Ureteric stent placement before the procedure is an option that may affect the post-operative success rate.</td>
<td>C</td>
</tr>
</tbody>
</table>
LASER URETHROTOMY

- Success rates of laser urethrotomy for urethral strictures are reported to be as high as 100% in selected cases.
- Short segment urethral strictures tend to respond excellently to this treatment modality.
- Long (> 1.5 cm) or recurrent urethral strictures are reported to demonstrate inferior results.
- The types of lasers tested on laser urethrotomy are the Nd:YAG, the KTP, the argon, the Ho:YAG and the diode laser. No superiority of one type of lasers has been demonstrated.
- Laser associated with lesser treatment failures compared with cold-knife in 1 RCT only.
9.3 Conclusions and recommendation for transurethral laser urethrotomy

<table>
<thead>
<tr>
<th>Conclusions</th>
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<tbody>
<tr>
<td>Transurethral laser urethrotomy is a feasible and safe treatment option for the treatment of urethral strictures.</td>
<td>3</td>
</tr>
<tr>
<td>Cold-knife optical urethrotomy remains the gold standard.</td>
<td>1a</td>
</tr>
<tr>
<td>Success rates as high as 100% are reported in selected cases</td>
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