

RevoLiX™

Thulium Laser



RevoLix™ – why ?

RevoLix is the only laser specifically developed for soft tissue surgery. The **RevoLix** laser wavelength is 2 micron. This wavelength is similar to Holmium but the emission is continuous instead of pulsed. **RevoLix** unifies the advantages of formerly existing surgical laser principles in a single unit:

- **RevoLix** laser beam is delivered by flexible laser fibres. Incision and vaporization of tissue is similar to CO₂ laser technology. This is ideal for endoscopic, laparoscopic, open and minimally invasive surgery.
- **RevoLix** excellent haemostasis is proven for the treatment of high risk BPH patients under anticoagulant medication [9].
- **RevoLix** provides the highest tissue vaporization rate published. Unlike green lasers the **RevoLix** vaporization efficiency does not decrease during surgery because the absorbing chromophore is water [10]. **RevoLix** tissue effect is shallow. Incisions are smooth and clean.

RevoLix – what are the advantages ?

Cutting efficiency of soft tissue and haemostasis is superior to any known alternative. Saline or water is used for irrigation reducing the risk of TUR syndrome [2].

Excess laser radiation is absorbed by the irrigation and does not affect tissue more than 3 mm from the tip of the fibre tip. Tissue damage is limited to 0.2 to 1.0 mm.

Visualization is excellent. Neither bleeding nor visible laser glare affects the vision of the surgical site. Colour neutral laser safety glasses maintain true colours. Endoscope lenses remain free from splatter when used in laparoscopic surgery.

RevoLix – what are the benefits ?

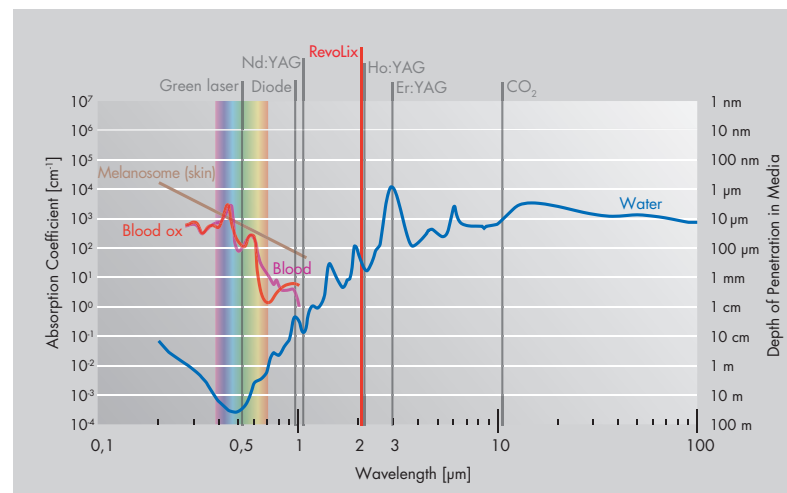
- No blood loss, no transfusions
- Quick recovery
- Short hospital stay
- Less postoperative care
- Short catheterization time in BPH treatment
- Precise surgery
- No deep tissue penetration
- Safe operation
- Excellent haemostasis
- Treatment of patients under anticoagulant
- Ejaculation protective BPH surgery
- Multi-disciplinary

RevoLix™ – why 2 micron continuous wave ?

The **RevoLix** wavelength at 2.0 micron is excellent for incision and vaporization. It is safe in an aqueous irrigation and it provides superior haemostasis. The effect of the laser on tissue is independent of tissue vascularization.

These outstanding properties are due to the efficient absorption at the **RevoLix** wavelength of 2.0 micron by the water molecule which is ubiquitous in any tissue.

Strong absorption and continuous wave emission provides precise cutting and vaporization of soft tissue with excellent haemostasis. There is no deep penetration or uncontrolled necrosis. Clean cuts and excellent haemostasis are achieved by moving the fibre across the surgical site.



Absorption spectra of body chromophores

This graph shows the absorption of the most important body chromophores (RED for blood, BLUE for water, BROWN for melanin) at different wavelengths. Depth of penetration is shown at the right. Laser wavelengths are shown as vertical lines.

Green laser: In the absence of haemoglobin the Green laser at 532 nm experiences close to no absorption in tissue because at this wavelength water is almost transparent. Under laser treatment haemoglobin bleaches due to the temperature increase in tissue caused by the laser. This explains the ever decreasing vaporization efficiency during a Green laser treatment.

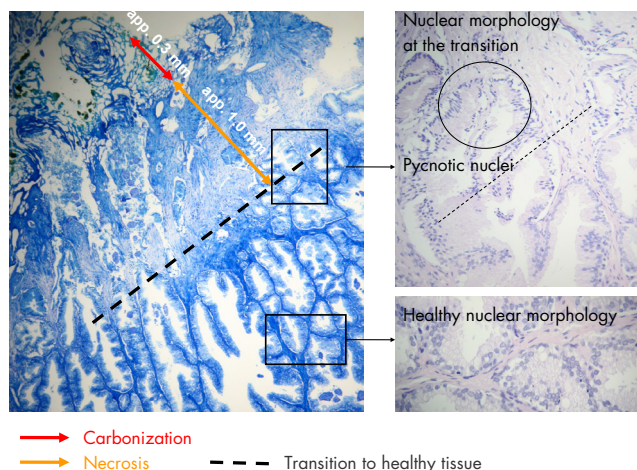
Diode laser: At Diode laser wavelength neither water nor haemoglobin is a good absorber. This explains the deep penetration of diode lasers and the Nd:YAG laser.

RevoLix and Holmium laser: Both lasers are of similar wavelength which is selectively absorbed by the water molecule. The optical penetration of **RevoLix** in tissue is approx. 0.25 mm [13].

Unlike haemoglobin water retains its absorptive properties when heated by any laser. This explains the everlasting tissue effect during **RevoLix** treatment.

RevoLix – why is it safe ?

In an aqueous irrigation the laser effect to tissue is restricted to less than 3 mm in front of the tip of the fibre. Any tissue further afield is shielded by the irrigant. The same mechanism is protecting tissue and organs adjacent to the cut. Any tissue more than 3 mm distant is unaffected by the **RevoLix** laser. Unlike to Green lasers this eliminates the risk of unintentional tissue damage during laser surgery. Penetration and tissue damage is almost independent of power and is the same for all **RevoLix** lasers.

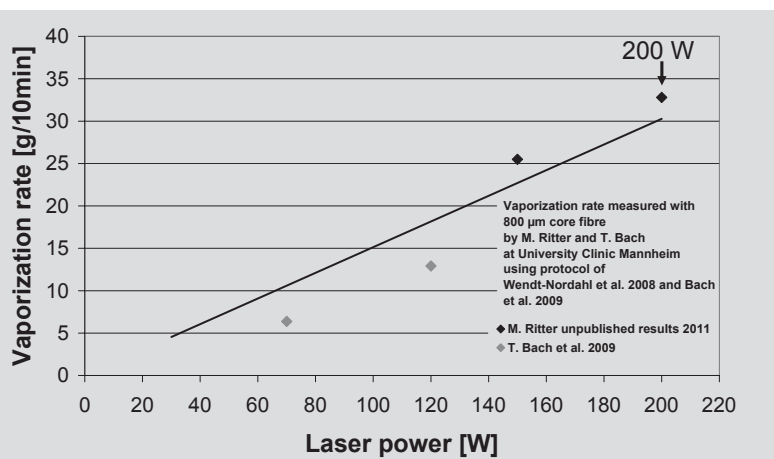


Histology of excised prostatic tissue after vaporization with RevoLix 200 watt laser

The RevoLix laser family RevoLix 120 – RevoLix 200

After its clinical introduction in 2003 the **RevoLix** laser experienced continuous development. The initial 70 watt model for basic surgery was upgraded to 120 watt which is ideal for the enucleation of prostate.

The added value of the **RevoLix 200** is the increased tissue vaporization rate to more than 3 grams per minute. This value was determined in a blood-perfused porcine kidney model [11]. In BPH surgery tissue vaporization eliminates the necessity for mechanical tissue morcellation.



Vaporization rate vs laser power at 2 micron

RevoLix – BPH protocols and learning curve

RevoLix offers a variety of BPH options [8]:

- ThuVAP
- ThuVoRP
- ThuVEP + ThuLEP

Your learning curve benefits from the range of these protocols. The beginner will start with vaporization and later will progress cutting chips which increase in size and finally ending up in enucleation – all with the same instrument.

Throughout the learning curve there is no additional surgical risk. For the **RevoLix** novice only the OR time is longer at the beginning of the learning curve [12].

Tissue samples are produced for subsequent histological examination during Vaporesection and Enucleation. **RevoLix** for BPH surgery is efficient and safe [6, 15].

RevoLix – suitable for large glands and how long does surgery take ?

For **RevoLix** there is no limitation in prostate size. Gland volumes of up to 200 ml (TRUS) are reported. Approximately 1.5 grams per minute of tissue are enucleated [14, 15].

RevoLix DUO – one box for BPH and stones

RevoLix DUO is the first universal laser in urology for lithotripsy, BPH, bladder tumours, UTUC, open and laparoscopic surgery. This versatility is achieved by combining a pulsed Holmium-YAG laser and a continuous wave Thulium-YAG laser in a single box. Lithotripsy in the lower, medial and upper tract with rigid and flexible instruments is accomplished by the integrated Holmium laser. Stones are fragmented irrespective of the chemical composition. Highly flexible laser fibres are most suitable for URS of the lower calix with flexible instruments.

Both laser units of the **RevoLix DUO** are available from the same fibre port. This feature allows using the same laser fibre for soft tissue surgery and for lithotripsy.

How do RevoLix lasers match with your theatre ?

RevoLix is extremely user friendly. In the theatre the **RevoLix** laser operates quietly. Large castors allow for easy movement between rooms. **RevoLix** lasers operate from a standard power outlet. No special installation is required. The laser has proven its extreme sturdiness during routine transportation between theatres and use by mobile healthcare services.

Family of Kix footswitches

To activate the laser device the choice of two footswitches is available. The **Kix** footswitch has a single pedal. The **Kix DUO** double pedal footswitch makes 2 selectable power settings available at the tip of your toe. This optional feature allows switching between power settings for cutting and coagulation or between different settings for slow and fast cutting speeds.



Kix DUO double pedal footswitch
Order No. 101 630 144

RevoLix – delivery systems perfected

LISA offers a wide range of specialised delivery systems. Reusable front firing fibres are stripped and cleaved in preparation for the next case. Disposable laser fibres are used in theatre situations where reuse is not allowed. Please refer to the **LISA Surgical Laser Accessories** brochure for laser applicators and reconditioning tools and to the **Surgical Laser Fibres** brochure for various front and side firing fibres.

RevoLix – applications and publications

The **RevoLix** laser system has demonstrated its superiority in surgical disciplines such as urology, neurosurgery*, ENT, gynaecology and bronchoscopy. More than 150 articles are published about surgical applications with LISA **RevoLix** lasers.



Kix single pedal footswitch
Order No. 101 630 147

Literature on RevoLix lasers:

- 1) Cui D., Sun F., Zhuo J., Sun X., Han B., Zhao F., Jing Y., Lu J., Xia S.; "A randomized trial comparing thulium laser resection to standard transurethral resection of the prostate for symptomatic benign prostatic hyperplasia: four-year follow-up results"; *World J Urol* (2014) 32; 683-689
- 2) Xia S.J., Zhuo J., Sun X.W., Han B.M., Shao Y., Zhang Y.N.; "Thulium Lasers versus Standard Transurethral Resection of the Prostate: A Randomized Prospective Trial"; *Eur Urol* (2008) Jan. 53; 382-390
- 3) Wei H., Shao Y. Sun F., Sun X., Zhuo J., Zhao F., Han. B., Jiang J., Chen H., Xia S.; "Thulium laser resection versus plasmakinetic resection of prostates larger than 80 ml"; *World J Urol* (2014) 32; 1077-85
- 4) Yang Z., Wang X., Liu T.; "Thulium Laser Enucleation Versus Plasmakinetic Resection of the Prostate: A randomized Prospective Trial With 18 Month Follow-up"; *Urol.* (2013) 82 (2); 396-401
- 5) Zhang F., Shao Q., Herrmann T.R.W., Tian Y., Zhang Y.; "Thulium Laser Versus Holmium Laser Transurethral Enucleation of the Prostate: 18-Month Follow-up Data of a Single Center"; *Urol* (2012) 79 (4); 869-874
- 6) Herrmann T.R.W., Liatsikos E., Nagele U., Traxer O., Merseburger A.S., "EAU Guidelines on Laser Technologies"; *Eur Urol* (2012) 61 783-795
- 7) S2e Leitlinie "Therapie des Benigen Prostatasyndroms (BPS)", 2014, DGU, AK BPS
- 8) Bach T., Xia S.J., Yang Y., Mattioli S., Watson G.M.; Gross A.J., Herrmann T.R.W.; "Thulium:YAG 2 micron cw laser prostatectomy: where do we stand?"; *World journal of urology* 28.2 (2010): 163-168
- 9) Hauser S., Rogenhofer S., Ellinger J., Strunk T., Müller S.C., Fechner G., "Thulium Laser (RevoLix) Vapoenucleation of the Prostate is a Safe Procedure in Patients with an Increased Risk of Hemorrhage"; *Urol Int* (2012) 88; 390-394
- 10) Bach T., Huck N., Wezel F., Häcker A., Gross A.J., Michel M.; "70 vs 120 W thulium:yttrium-aluminium-garnet 2 µm continuous-wave laser for the treatment of benign prostatic hyperplasia: a systematic ex-vivo evaluation"; *BJU international* 106.3 (2010): 368-372
- 11) Wendt-Nordahl G., Hucklele S., Honeck P., Alken P., Knoll T., Michel M., Häcker A., "Systematic Evaluation of a Recently Introduced 2-Micron Continuous Wave Thulium Laser for Vaporesction of the Prostate"; *J of Endourol* (2008) May 22 (5); 1041-1045
- 12) Netsch C., Bach T., Herrmann T.R.W., Neubauer O., Gross A.J., "Evaluation of the learning curve for Thulium VapoEnucleation of the prostate (ThuVEP) using a mentor-based approach"; *World J Urol*, published online 24 June 2012
- 13) Teichmann H.-O., Herrmann T.R.W., Bach T.; "Technical Aspects of Lasers in Urology"; *World J Urol*, (2007),
- 14) Sun F., Han B., Cui D., Zhao F., Sun X. Zhuo J., Jing Y., Liu H., Xia S., Yang Y., Luo G., Guo F.; "Long-term results of thulium laser resection of the prostate: a prospective study at multiple centers"; 2015 33, 503-508
- 15) EAU (European Association of Urology), Eds.; „Guidelines on Management of Non-Neurogenic Male Lower Urinary Tract Symptoms (LUTS), incl. Benign Prostatic Obstruction (BPO)"; Gravas S. (Chair), Bach T., Bachmann A., Drake M., Gacci M., Gratzke C., Madersbacher S., Mamoulakis C., Tikkinen K.A.O., Guidelines Associates: Karavitakis M., Malde S., Sakkalis V., Umbach R.; 2016 March

RevoLix – what are the applications ?

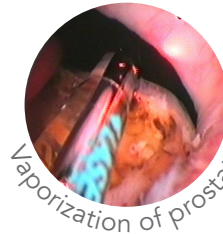
The **RevoLix** laser system has demonstrated its superiority in surgical disciplines such as Urology, Neurosurgery*, Gynaecology, Pneumology and ENT. In Urology **RevoLix** gains much attention for its superior performance in vaporization and resection of the prostatic adenoma (BPH), outpatient treatment of reoccurring renal UTUC and bladder tumours, opening of strictures, incisions and tissue preserving excisions.

Urology

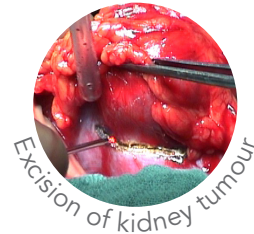
- VapoResection of prostate (ThuVaRP)
- Vaporization of prostate (ThuVAP)
- VapoEnucleation of prostate (ThuVEP)
- Blunt enucleation of prostate (ThuLEP)
- Bladder neck incision
- Opening of strictures
- Vaporization and excision of bladder tumours
- Vaporization of upper track urothelial carcinomas UTUC
- Partial nephrectomy
- Laparoscopy



VapoResection of prostate



Vaporization of prostate



Excision of kidney tumour

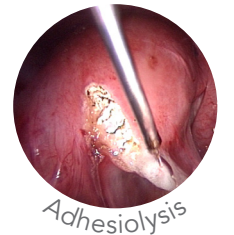


Ureter stone

Lithotripsy

Gynaecology

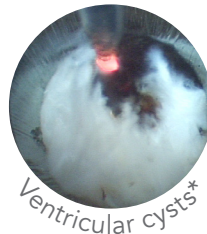
- Hysteroscopy
- Endometriosis
- Adhesiolysis
- Conisation
- Condylomata



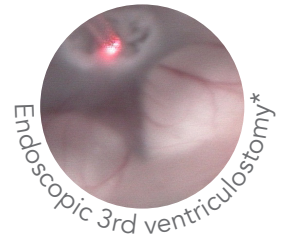
Adhesiolysis

Neurosurgery*

- Fenestration of cysts
- Ventriculocysternostomy
- Catheter recovery
- 3rd ventriculostomy
- Tumour resection
- Haemostasis



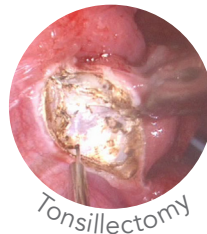
Ventricular cysts*



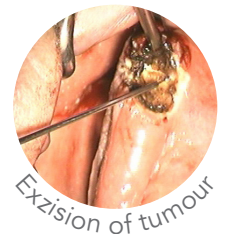
Endoscopic 3rd ventriculostomy*

ENT

- Excision of tumours
- Tonsillectomy
- Conchotomy



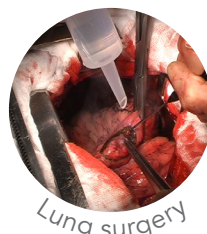
Tonsillectomy



Excision of tumour

Pneumology

- Bronchoscopy
- Airway recanalization
- Desobstruction
- Tissue coagulation



Lung surgery



Airway recanalization

Technical Specifications

RevoLix™



	120 Watt Laser	200 Watt Laser
Tissue laser system	continuous wave DPSS laser	
Wavelength	2013 nm	
Power at fibre tip	5 to 120 W (adjustable)	5 to 200 W (adjustable)
Emission mode	continuous wave, chopped 50 ms - 1000 ms	
Repetition rate (chopped mode)	0.5 - 10 Hz	
Beam delivery	wide range of flexible silica fibres	
Fibre identification	optical	
Aiming beam	635 nm (red) or 532 nm (green), max. 1 mW (adjustable)	
Mains supply	208 - 240 V AC, 50/60 Hz, (1~, N, PE), max. 16 A	
Cooling system	integrated cooling	
Dimensions	H 1025 x W 420 x L 1007 mm (height w/o display)	
Weight	170 kg	
Environmental conditions	15 - 28 °C / 10 - 90 % humidity (non-condensing)	

Technical Specifications

RevoLix™ DUO



	150/20 Watt Laser
Tissue laser system	continuous wave DPSS laser
Wavelength	2013 nm
Power at fibre tip	5 - 150 W (adjustable)
Emission mode	continuous wave, chopped 50 ms - 1000 ms
Repetition rate (chopped mode)	0.5 - 10 Hz
Stone laser system	pulsed Holmium-YAG laser
Wavelength	2123 nm
Power at fibre tip	2.5 - 20 W (adjustable)
Pulse energy	0.5 - 2.6 J
Frequency	5 - 15 Hz
Pulse peak power	7 kW
Beam delivery	wide range of flexible silica fibres, same fibre port for both lasers
Fibre identification	optical
Aiming beam	635 nm (red) or 532 nm (green), max. 1 mW (adjustable)
Mains supply	208 - 240 V AC, 50/60 Hz, (1~, N, PE), max. 16 A
Cooling system	integrated cooling
Dimensions	H 1025 x W 420 x L 1007 mm (height w/o display)
Weight	185 kg
Environmental conditions	15 - 28 °C / 10 - 90 % humidity (non-condensing)

Safety Standards: IEC 60601
CE acc. Council Directive 93/42/EEC

U.S. federal law restricts this device to sale by or on the order of a physician.

Specifications are subject to change without notice.

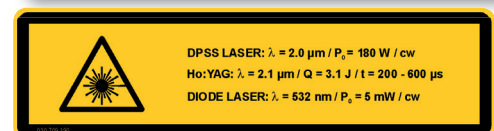
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IMPORTANT NOTICE:

The information provided is a general overview of potential clinical applications of the described products.

National health care regulations vary between countries and may exclude certain clinical applications at your location. The user assumes responsibility to be updated about national deviations from the applications listed above.

*In the USA the products are not intended for use in clinical applications in neurosurgery.



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