HOLMIUM LASER ENUCLEATION OF THE PROSTATE (HoLEP)

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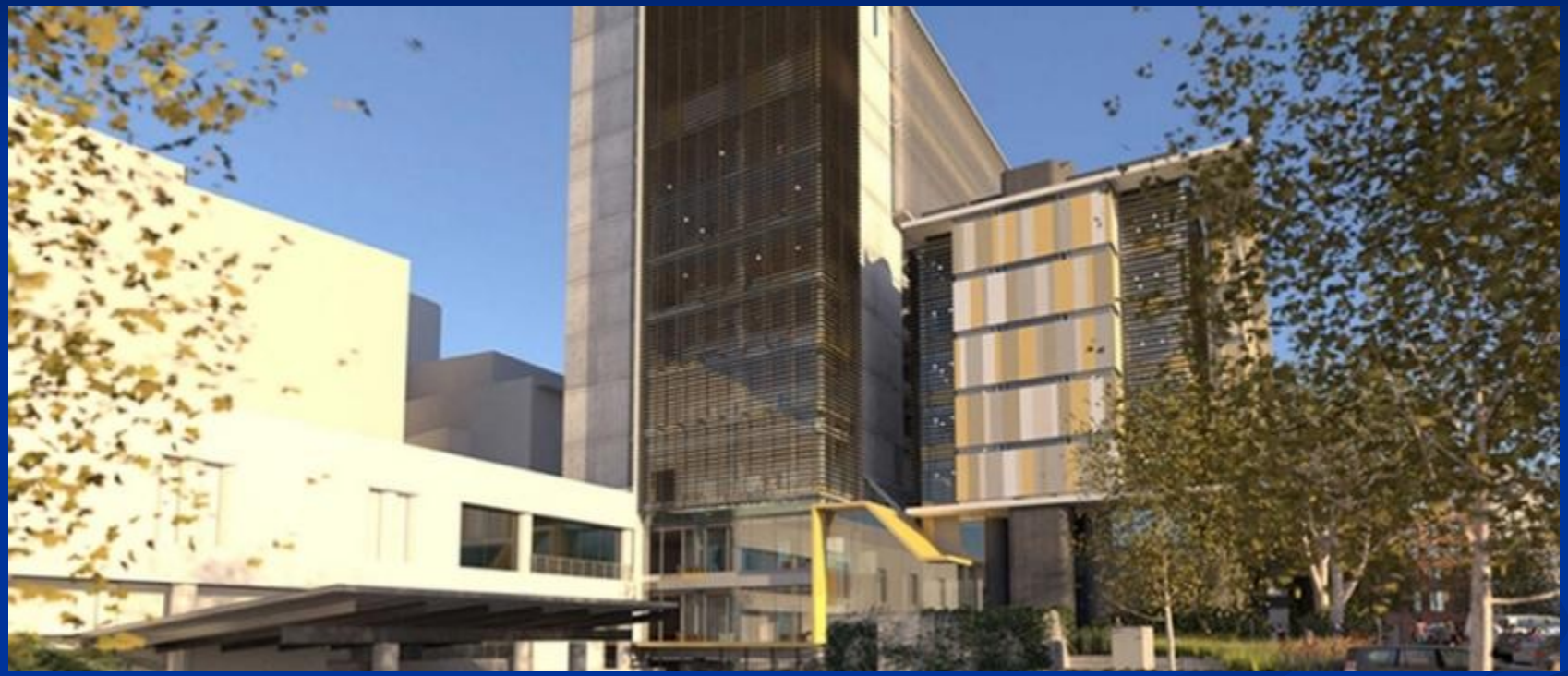
ST VINCENT'S HEALTH AUSTRALIA

St Vincent's Clinic/Private Hospital

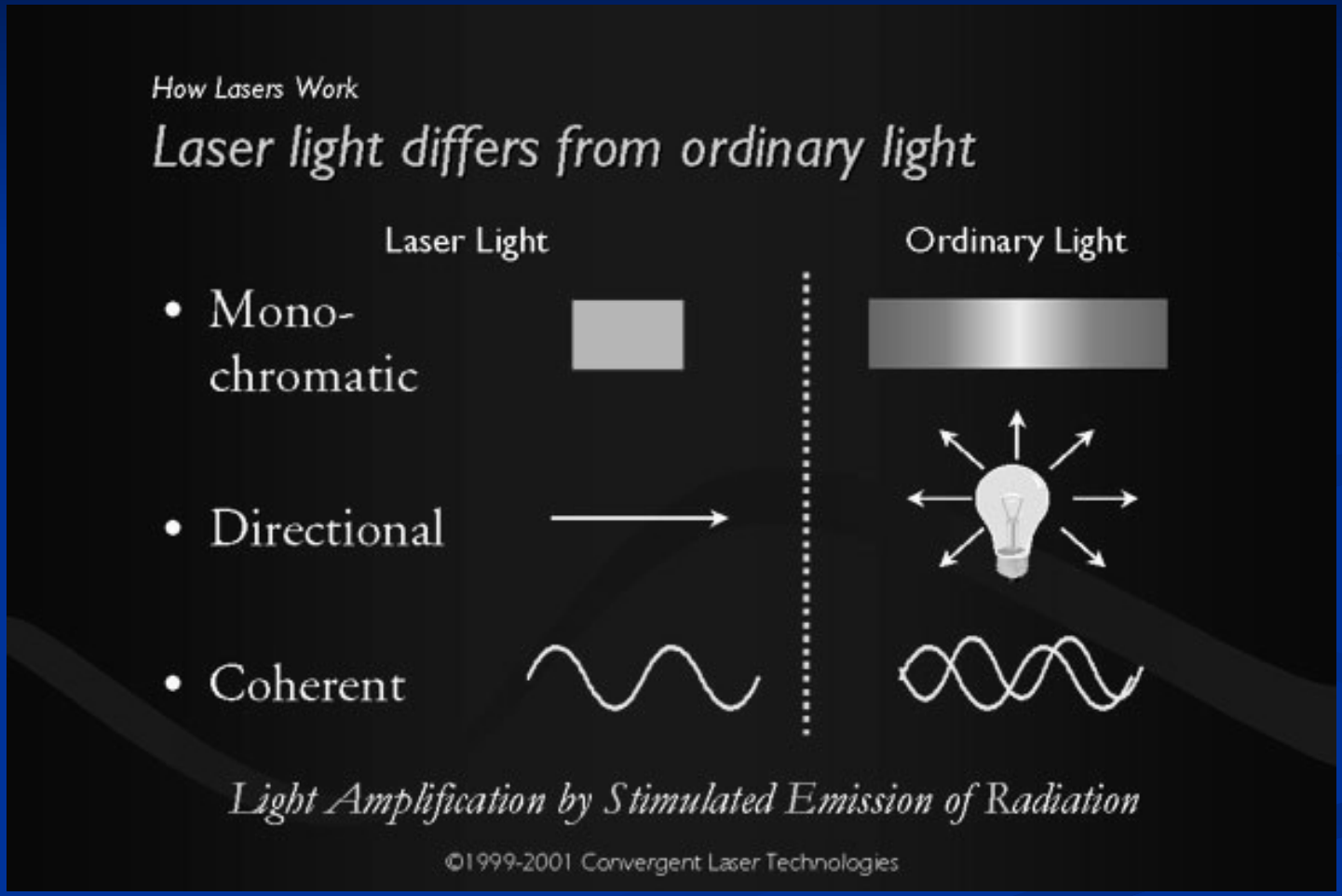


Sydney Australia

HoLEP

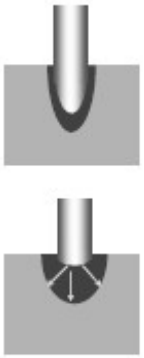
- Physics and Principles
- Technique
- Results

Light Amplification by the Stimulated Emission of Radiation



MECHANISM

Two Ways Heating Occurs



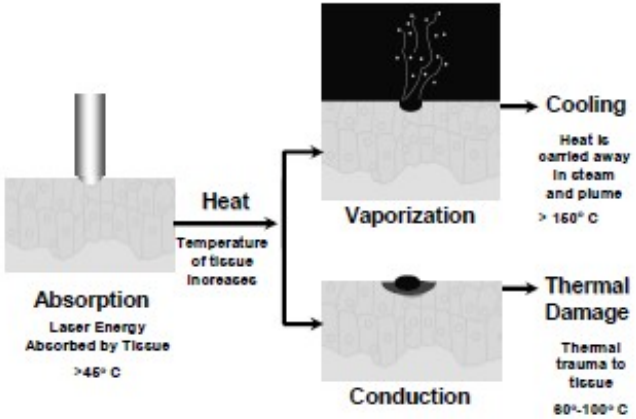
Transmission

Laser instantly heats tissue to a depth determined by the absorption length

Conduction

Heat flows from region heated by laser into adjacent tissue

Where Does the Heat Go?

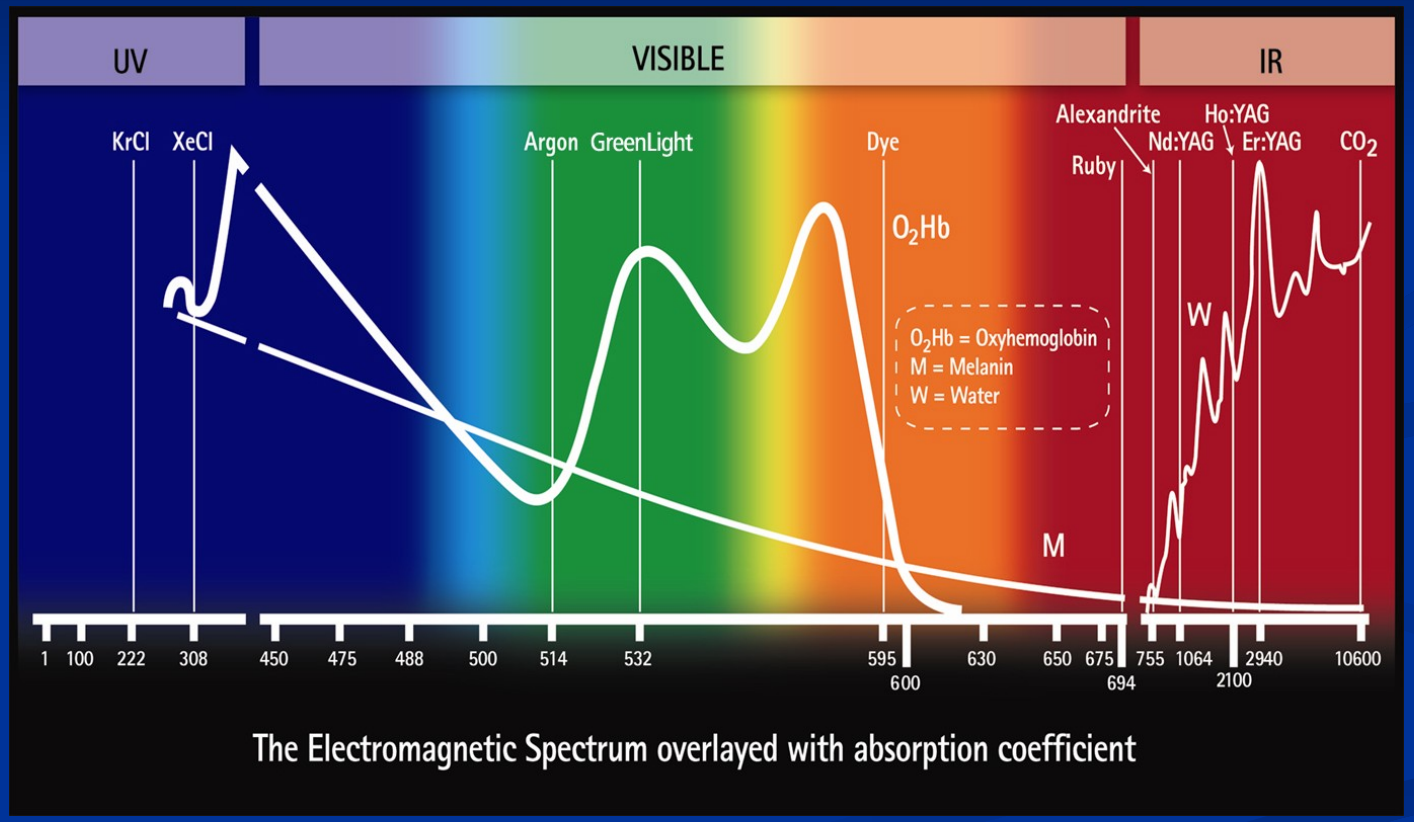


Temp Threshold	Biological Effect
37 °C	Body temperature
45 °C	Hyperthermia
60 °C	Coagulation
100 °C	Vaporization / Cutting
150 °C	Carbonization
300 °C	Melting

← Near tissue contact

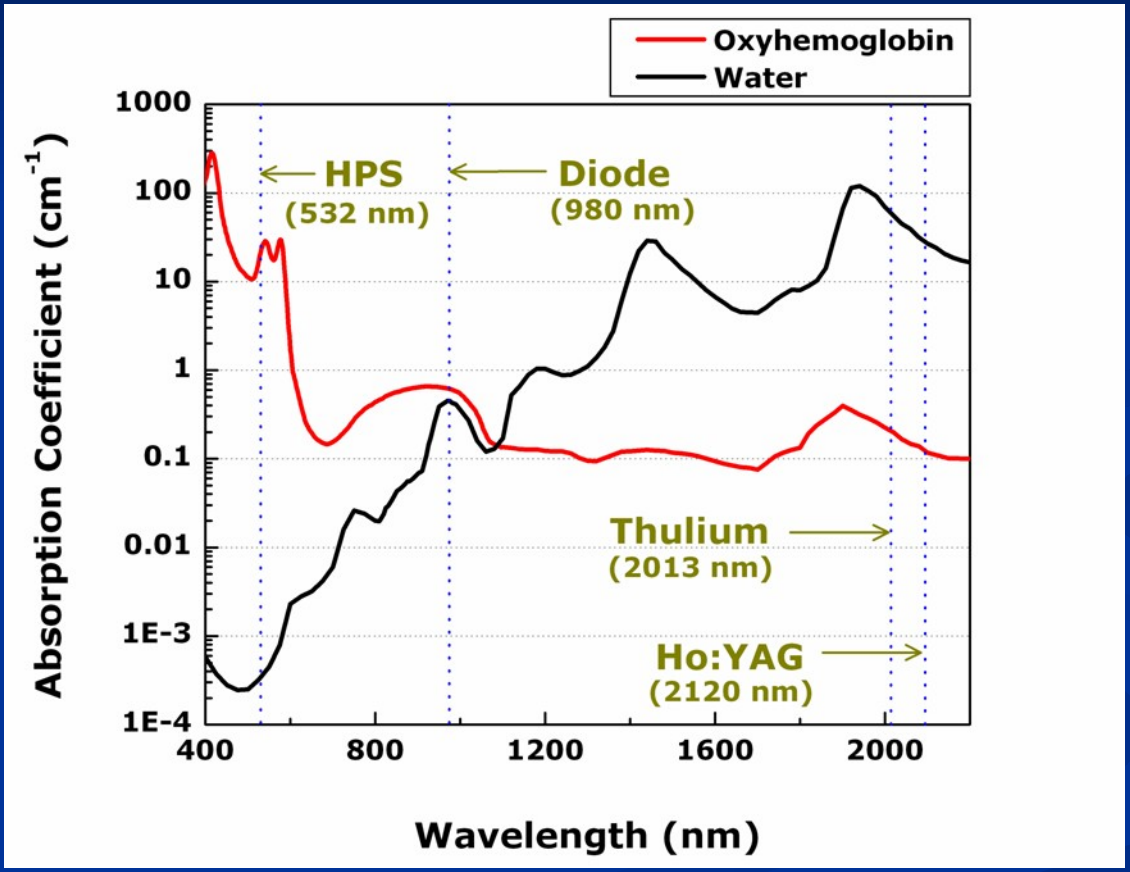
← In contact with tissue

The Electromagnetic Spectrum



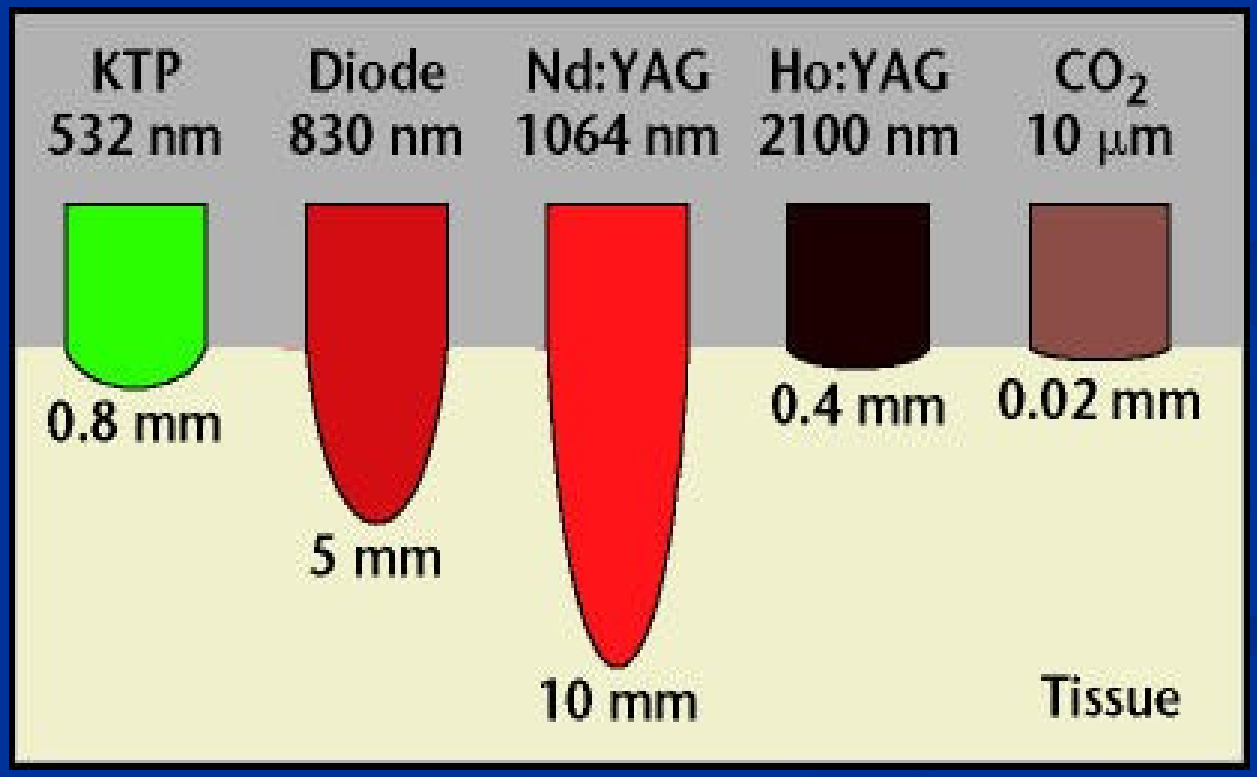
The Electromagnetic Spectrum overlayed with absorption coefficient

Laser Absorption



Optical Penetration Depth

- Optical penetration depth of each wavelength into tissue.

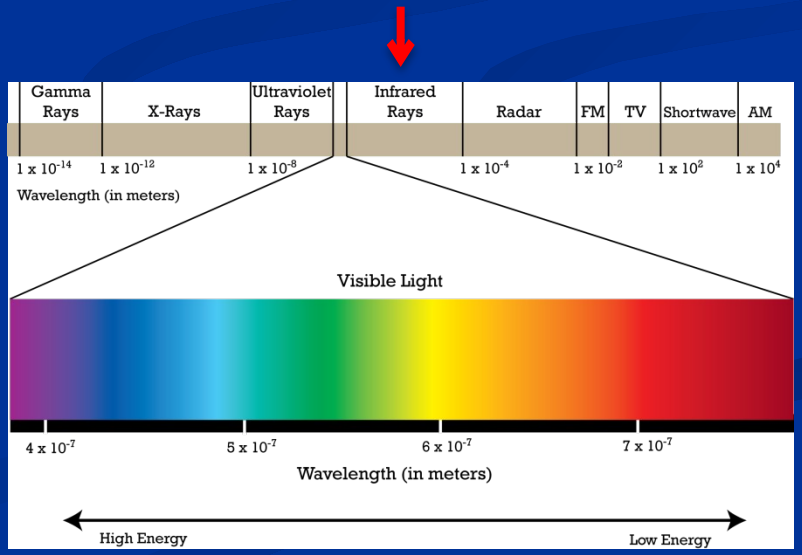


Laser Tissue Interaction

- Depends on the following parameters:
  - Tissue structure
  - Laser wavelength
  - Power / energy settings
  - Mode of laser operation
  - Pulsed vs. Continuous Wave
  - Fiber handling technique

Lumenis – VersaPulse™ Holmium

- Ho:YAG 2100 nm – mid infrared (invisible)
- High absorption in water, low absorption in oxyhemoglobin
- Optical penetration 0.4 mm
- Coagulation 0.5 mm
- Pulsed laser



Laser techniques for BPH

- Ablation/vaporisation
  - Nd- Yag
  - Holmium
  - Greenlight
  - Thulium
  - Diode
- Resection/vaporesection
  - Holmium
  - Thulium
- Enucleation
  - Holmium
  - Thulium

Current lasers and their uses

	Ablation	Resection	Enucleation	TCCs	Stones
Holmium	Y	Y	Y	Y	Y
Greenlight	Y	X	X	X	X
Thulium	Y	Y	Difficult	Unproven	(Need dual 20W Holmium)

The Successful Application of the Holmium Laser for Urological Procedures –

Kooner et al USANZ 2004 and 2010

>500 prostate treatments

325 ureteric and renal stones

24 bladder stones

15 laser endopyelotomies

7 ureteric strictures

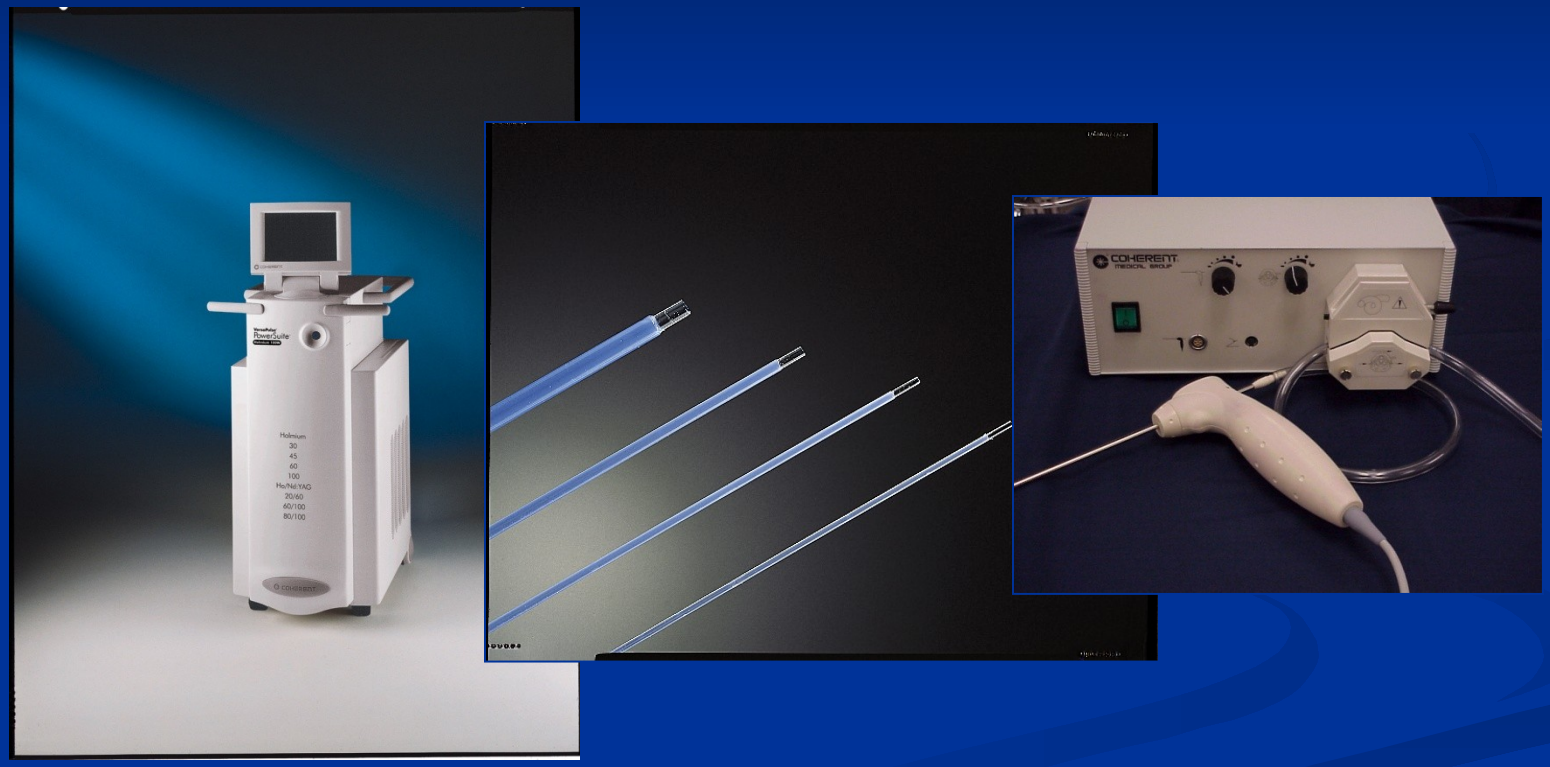
Current experience >2000 cases

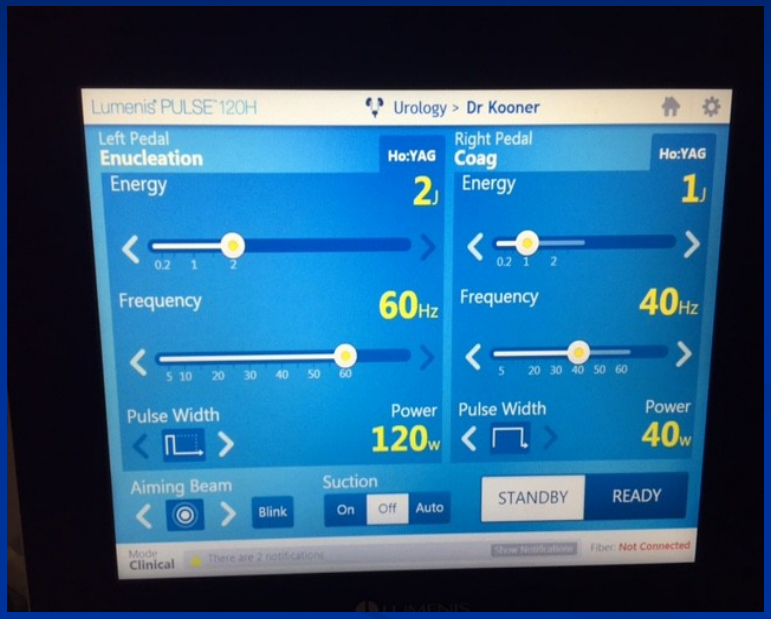
Holmium laser-tissue interactions

- Absorbed by water
  - Pulsing creates vapor bubble at fiber tip
  - Interacts with tissue resulting in a microexplosion
  - Must be used in contact or near contact (2mm)
- Penetrates <0.5 mm
  - No significant slough
  - Minimal necrotic tissue means less irritative sx
- Simultaneous vaporization and coagulation
  - Uniquely bloodless field

Holmium Laser – 100 watt

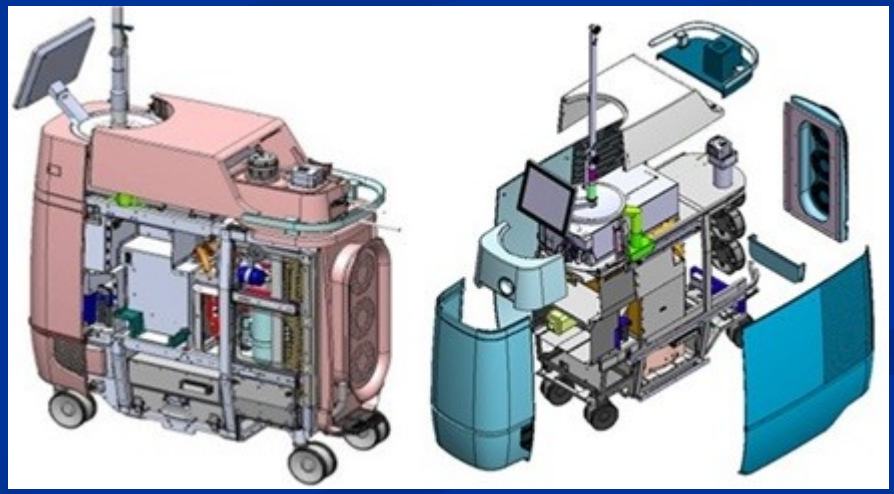
VersaPulse PowerSuite Holmium and Dual Wavelength lasers




Lumenis PULSE 120H
Urology > Dr Kooner
Left Pedal
Enucleation
Ho:YAG
Energy
2J
0.2 1 2
Frequency
60Hz
5 10 20 30 40 50 60
Pulse Width
Power
120W
Right Pedal
Coag
Ho:YAG
Energy
1J
0.2 1 2
Frequency
40Hz
5 20 30 40 50 60
Pulse Width
Power
40W
Aiming Beam
Blink
Suction
On Off Auto
STANDBY
READY
Mode
Clinical
There are 2 notifications
Show Notifications
Fiber: Not Connected

Holmium Pulse 120

- Greater power (120 watts)
- Accelerated enucleation times, shorter operating time
- Dual foot pedal (precision)
- Improved coagulation and vaporisation
- Other uses: ‘dusting’ of kidney stones, prostate vaporisation



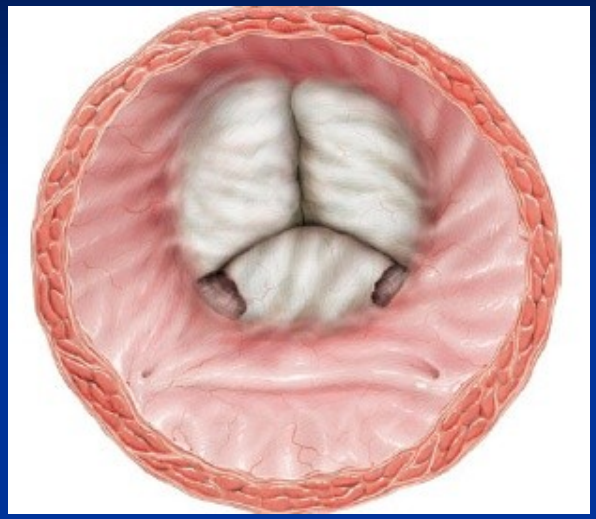
Holmium Pulse 120: Initial Experience

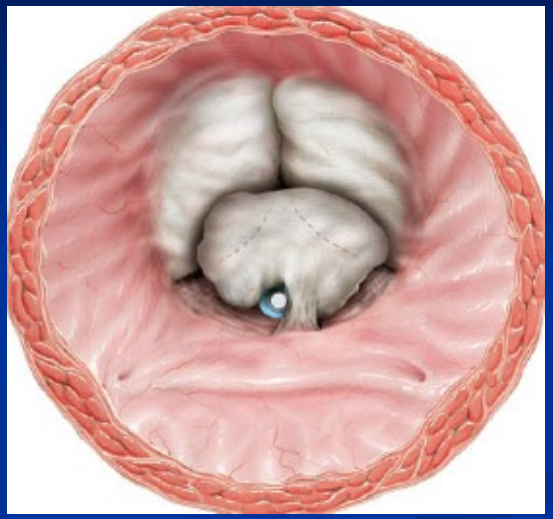
- Prior experience of >2000 HoLEPs (100W)
- >80 Cases to date with Pulse 120

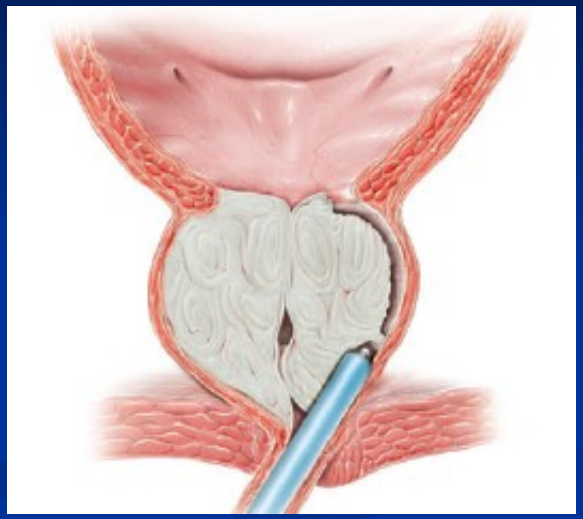
Pulse 120 Case Series (n=>80)	
Mean Age	73.1 years (61-89yr)
Mean Catherisation Time	1.5 days
Temporary Post Operative Retention	n=3
Transfusion rate	0%
Mean Laser Time	28.7min (31-90min)
Mean Energy Delivered	145.4J (14.8-263.4J)

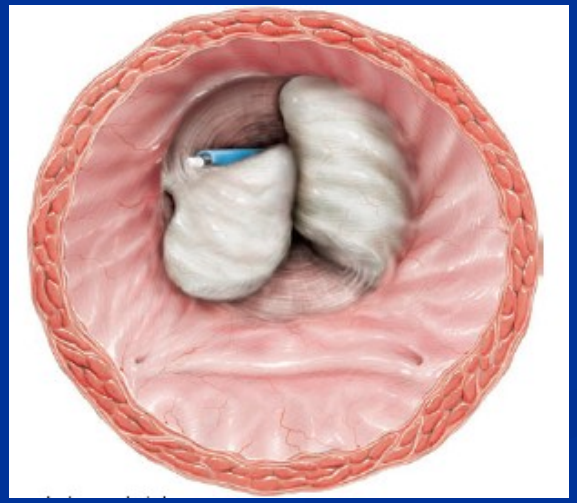
HoLEP Technique

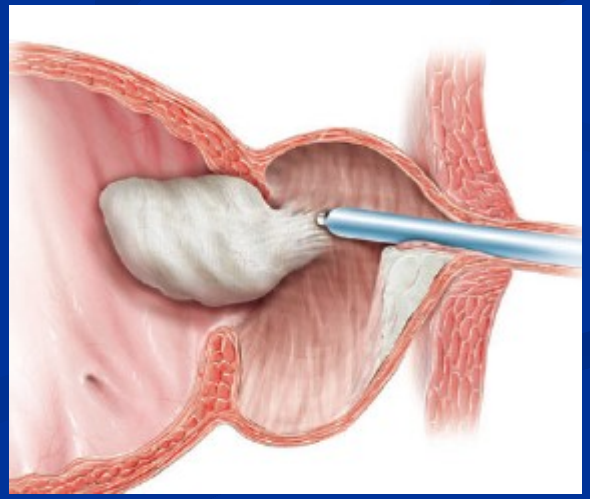
(*BJUI (2008) 101:131-142*)











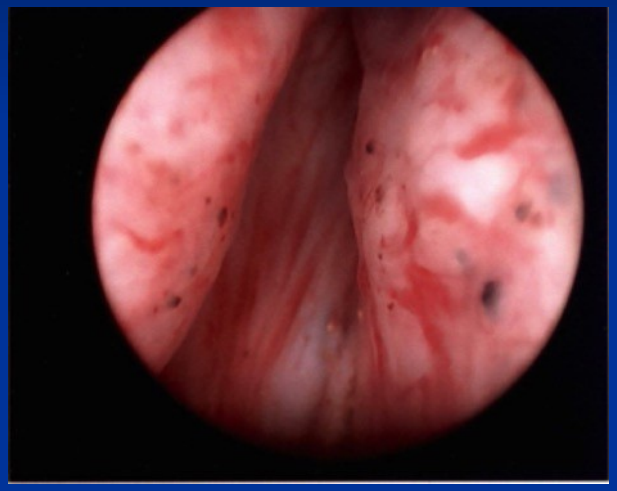
Courtesy of
Peter Gilling

Tissue Retrieval - Morcellation

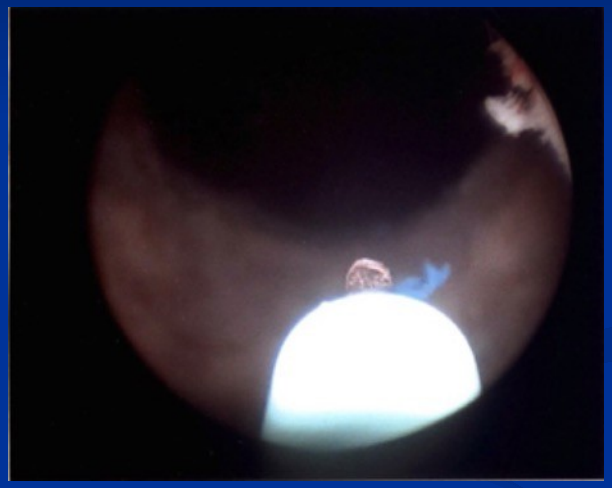
BJUI (2008) 101:131-142

Courtesy of Peter Gilling

Holmium Pulse 120



Before HoLEP

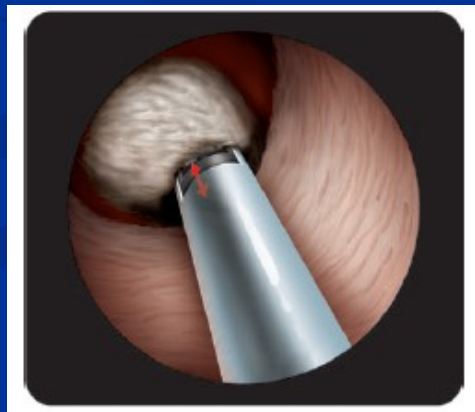


During HoLEP

After HoLEP

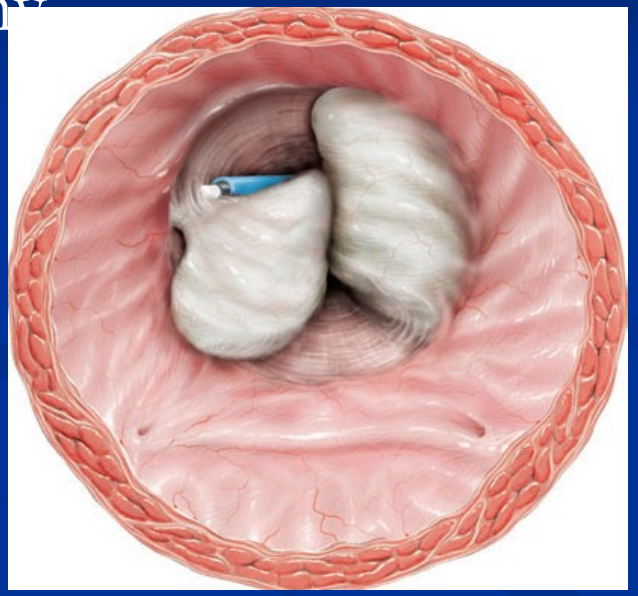
Holmium Prostatectomy

- '…transurethral holmium laser resection is an option for patients seeking an alternative method of resection/enucleation' – AUA BPH Guidelines (2003)
- "HoLep is a an appropriate and effective treatment alternative to TURP and OP" AUA Guidelines (2010)
- 'HoLEP is the gold standard for patients with prostates >80mL' – EAU Guidelines (2010)
- NICE, ASERNiPS, WHO(2005)



Efficacy -HoLEP Randomized Trials

- 7 HoLEP vs TURP
- 3 HoLEP vs Open Prostatectomy
- 1 HoLEP vs PKEP
- 1 HoLEP vs PVP 120W



- 12 month data x 4
- 24 month data x 2
- 3 year data x 1
- 5 year data x 1
- 8 year data x 1

Cornu et al, 2015

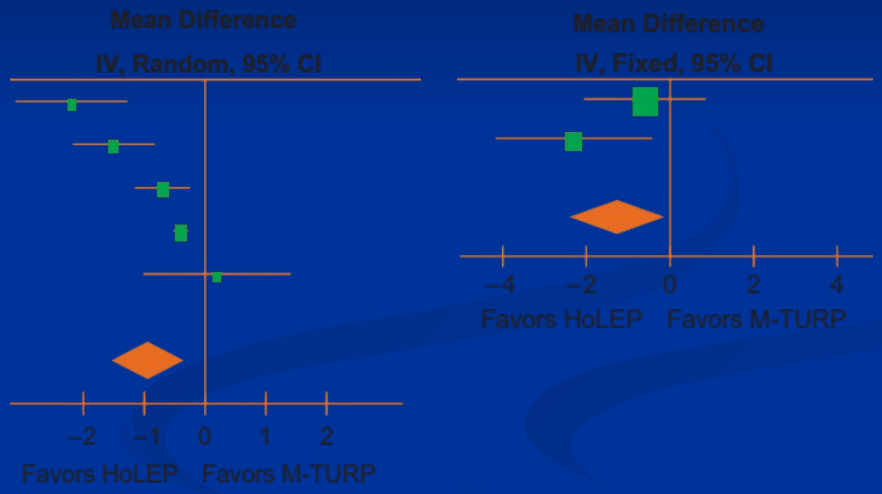
HoLEP vs TURP: Meta-analysis

- 6 studies, n=570
- HoLEP associated with longer operating time (14.9min)
- Fewer immediate complications with HoLEP
  - 0% transfusion rate
  - 3.4% with TURP
- Standard complications comparible
- HoLEP associated with shorter duration of catheter (22.2hr) and shorter length of hospital stay (1.4d)

Cornu et al. 2015

HoLEP vs TURP: Meta-Analysis 1 year Follow Up

- Results favour HoLEP
- Lower IPSS (mean difference 0.92, p=0.003)
- Higher Qmax (mean difference 1.59ml/s, p=0.02)
- Lower PVR (mean difference 18.69ml p<0.00001)



IPSS Score meta-analysis at 1 year (L) and for longer term (3-8yrs) (R)

Cornu et al. 2015

HoLEP randomized trials
HoLEP vs TURP (x4)

- *Tan et al J.Urol (2003) 170:1270*
  - Prostates 40g< >200g
  - Urodynamically superior to TURP
  - Less morbidity
  - More tissue removed with HoLEP
  - Similar efficiency (g/min)
  - Clinically similar at 12 months

- *Montorsi et al J.Urol (2004) 172:1926*
  - Multicenter
  - Adenoma < 100g
  - Less morbidity
  - Similar efficacy
  - Similar sexual function

HoLEP randomized trials
HoLEP vs TURP (x4)

- *Kuntz et al J Urol (2004) 172:1012*
  - 200 patients
  - Less morbidity
  - AUA scores and PVR better with HoLEP
  - Similar efficacy at 12 months
- *Gupta et al BJUInt (2006) 97:85*
  - 150 patients
  - TURP, HoLEP, TUVRP
  - HoLEP took longer
  - Less morbidity
  - Similar efficacy

HoLEP randomized trials
HoLEP vs Open Prostatectomy (x2)

- *Kuntz et al J Urol (2002) 168:1465*
  - 120 patients randomized
  - Prostates >100g
  - Operating time longer for HoLEP
  - Similar amounts of tissue retrieved
  - Less morbidity
  - Outcomes similar out to 1 year
- *Naspro et al Eur Urol (2006) 50: 563*
  - 80 patients randomized
  - 24 month follow-up
  - Urodynamics equivalent-12 months
  - IIEF scores equivalent

	Baseline	12 mo	*p* value
Mean detrusor pressure at maximum flow rate ($P_{det,qmax}$) cm H_2O			
HoLEP group	80.6 (44–130)	30.6 (22–80)	<0.001
OP group	83.1 (41–147)	34.8 (18–88)	<0.001
p value	$p = 0.94$	$p = 0.66$	
Schäfer grade (LinPURR)			
HoLEP group	3.8 (2–6)	0.7 (0–4)	<0.001
OP group	3.1 (2–6)	0.8 (0–4)	<0.001
p value	$p = 0.33$	$p = 0.18$	

HoLEP = holmium laser enucleation of the prostate; OP = open prostatectomy; LinPURR = linear passive urethral resistance relation.

HoLEP vs Open Prostatectomy
5 year Results

Kuntz et al Eur Urol (2008) 53: 160-168

- 120 patients randomized
- AUA scores, Qmax values (24.4 ml/s in both groups) PVR similar in both groups at 5 years
- Re-operation rates similar (5% vs 6.7%)
- *No re-operations in either group for recurrent*

	HoLEP *n* (%)	OP *n* (%)	*p* value
Stricture–visual urethrotomy	2 (3.3)	1 (1.7)	0.61
BNC–holmium laser incision	1 (1.7)	3 (5.0)	0.60
Total	3 (5)	4 (6.7)	1.0

HoLEP, holmium laser enucleation of the prostate; OP, open prostatectomy; BNC, bladder-neck contracture.

Durability - 24 month data

Wilson et al HoLEP vs. TURP Eur Urol (2006); 50:569-73

- 61 patients randomized
- 40-200g
- Urodynamic outcomes superior at 6 months
- At 24 months 2 re-operations in TURP group *0% in the HoLEP group*
- AUA, QoL score and Qmax similar

Naspro et al HoLEP vs. Open Prostatectomy Eur Urol (2006);50:563-8

- 80 patients randomized
- Shorter OR time for OP
- Urodynamics equivalent at 12 months
- No change in potency at 24 months – no difference
- Qmax, QoL and IPSS score similar at 2 years

Durability
Holmium Laser Enucleation of the Prostate: Results at 6 Years
Gilling et al European Urology 2008

- Mean follow-up 6.1 yrs, mean age 75.7 yrs
- 38 of 71 avalable(14 deceased,19 lost)
- Mean IPPS 8.5, Qmax 19 ml/s, QOL score 1.8
- 1 reoperation
- 92% satisfied or extremely satisfied with their outcome

J Urol 2008:Supp .1954A
HoLEP vs TURP at 7 years

- Original cohort 61 patients (*Tan et al J Urol (2003) 170:1270-74)*
- 31 patients screened at 7.6 years (12 deceased, 18 LTF incl re-ops.)
- Mean age 79.8 years at follow-up (14 HoLEP vs. 17 TURP)
- *Re-operations - 0% HoLEP 18% TURP*

	AUA	QoL	Qmax	BPH II	IIEF-EF	ICS V1-5	ICS I1-6
HoLEP	8	1.5	22.1	1.5	11.6	4.2	3.1
TURP	10.3	1.3	17.8	0.6	9.2	3	1.2

No significant differences between HoLEP and TURP at 7 years except re-operation rate

Consistent RCT findings vs TURP

- Less blood loss
- No TUR syndrome
- Longer operating time
- More efficient prostate volume reduction
- Less catheter time
- Less nursing contact
- Shorter hospital stay
- At least equivalent subjective and objective measures of success

Symptom improvement: HoLEP

Procedure	Author	Number	Volume	IPSS Improvement (%)	QOL Improvement (%)
80-100W HoLEP	Kuntz et al 2004	100	53.5 ± 20.0	**92 %** 12 months	
80-100W HoLEP	Gupta et al 2006	50	57.9 + 5.1	**78 %** 12 months	
80-100W HoLEP	Kuntz et al 2002	60	114.6 ± 21.6	**90 %** 12 months	
80W PVP	Elzayat et al 2006	225	126 ± 45	**79 %** 12 months	**78 %** 12 months

Objective improvement: HoLEP

Procedure	Author	Number	TRUS Volume	Change in Qmax ml/s (%)	Change in PVR ml (%)
80-100W HoLEP	Kuntz et al 2004	100	53.5 ± 20.0	**469 %** 12 months	**98 %** 12 months
80-100W HoLEP	Gupta et al 2006	50	57.9 + 5.1	**388 %** 12 months	**82 %** 12 months
80-100W HoLEP	Kuntz et al 2002	60	114.6 ± 21.6	**621 %** 12 months	**98 %** 12 months
80W PVP	Elzayat et al 2006	225	126 ± 45	**224 %** 12 months	**91 %** 12 months

Amount of tissue removed: PSA & TRUS

- PSA
  HoLEP 82-91% reduction

- TRUS volumes pre- and post-op
  HoLEP: 67-86%

Complications after HoLEP Rieken et al World J Urol 2010

- Capsular perforation .3-10%
- Incomplete morcellation/morcellator malfunction 2%
- Superficial bladder mucosal injury 2-4%
- Injury to UO 2%
- Blood transfusion 1%
- Bleeding with clot retention 1-3%
- Urethral stricture 2-5%
- Bladder neck contractures .5-4%
- Re-catheterization 4-8%
- UTI/Epididymitis 4%
- Reoperation 2.9%
- Early incontinence 2%(equal to TURP)
- Retrograde ejaculation 75%

Learning Curve and Training

- Seki et al 2003 – based on volume of tissue suggested at least 50 cases
- El-Hakim et al 2002- resident adept at 20 cases. HoLEP require more training than TURP
- Suggest start with BNI, then small prostates and gradually increase size criteria

BJUI 2016; 117(3)
Multicenter prospective evaluation of the learning curve of HoLEP

- Even in a prospective training structure, HoLEP has a steep learning curve exceeding 20 cases
- A more intensely mentored and structured mentorship programme may allow safer adoption of the procedure

EAU Guidelines - 2018

Summary of the evidence

- HoLEP demonstrates high intra-operative safety when compared to TURP. Peri-operative parameters e.g. catheterization time, hospital stay and blood loss are in favor of HoLEP
- HoLEP demonstrates higher hemostasis and intra-operative safety when compared to TURP and open prostatectomy
- HoLEP did not negatively effect ejaculatory function
- Long term functional results are comparable to open prostatectomy

EAU Guidelines - 2018

Recommendations

- Offer HoLEP of the prostate to men with moderate to sever LUTS as a alternative to TURP or open prostatectomy

AUA Guidelines

- Symptomatic improvement comparable to that obtained by TURP
- Decreased blood loss, decreased catheterization
- Useful as option in men with very large prostates (> 100 g)

SUMMARY

- Various laser techniques
- Understanding physics
- Evolving field
- Extensive data on holmium- alternative to TURP and open prostatectomy (proven superiority), highest level of evidence
- Pulse 120 Holmium Laser represents a significant advance

SUMMARY

- Understanding of the Learning curve.
- Laser therapy of the prostate will probably replace TURP as the "Gold Standard"
- Suggest surgeons consider utilising laser therapy
- Visiting centres utilising laser technology

THANK YOU

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Prostatesurgery.com.au

ST VINCENT'S HEALTH AUSTRALIA

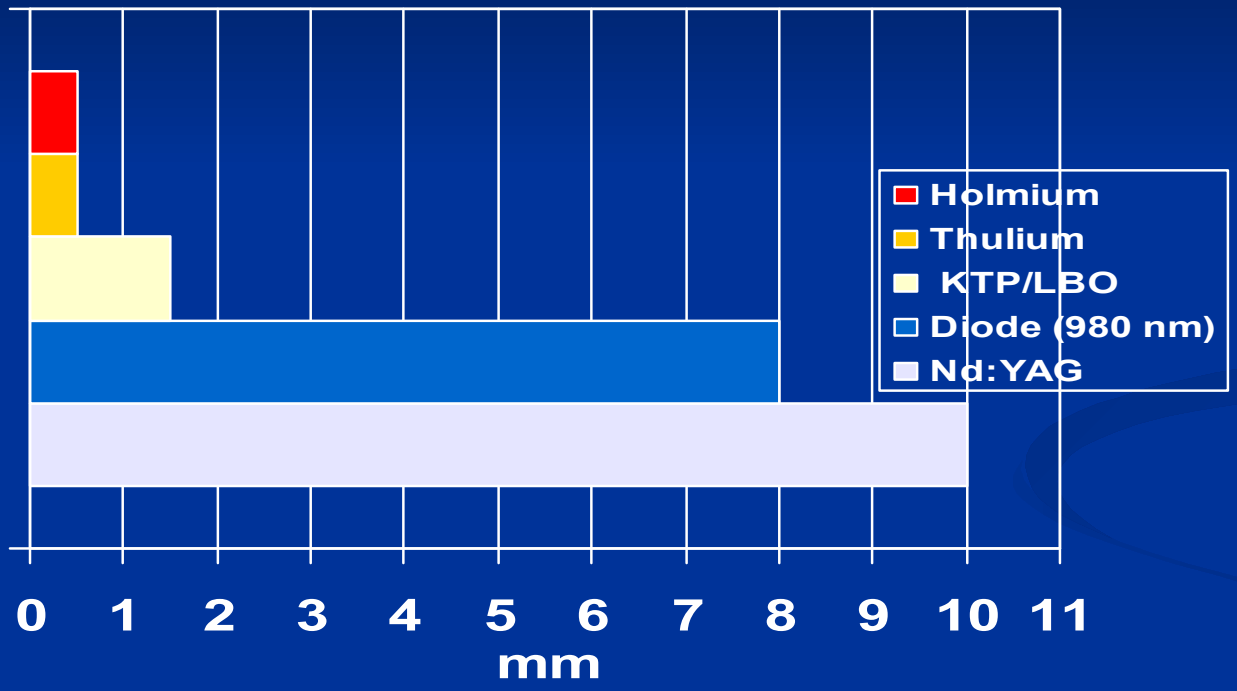
Meta-analysis of functional outcomes and complications following transurethral procedures for lower urinary tract symptoms resulting from benign prostatic enlargement
Ahyai et al European Urology 2010

- "The reduction in IPSS and the increase in Qmax are significantly more pronounced after HoLEP than after TURP"
- "HoLEP is least as effective as TURP. Complications are less frequent after HoLEP compared to TURP"
- "Long-term follow up of HoLEP shows durability of the excellent postoperative results"
- HoLEP is "a strong competitor for the new reference standard in transurethral surgery for symptomatic BPE"

Review Article- Critical review of lasers in benign prostate hyperplasia Stavos et al BJUI 2011

- "Current evidence supports the conclusion that HoLEP offers favourable and durable outcomes for any prostate size with low early and late morbidity"
- "HoLEP is the most rigorously analysed laser techinique"

Effect of Laser Energy on Prostatic Tissue



Coagulation Zone: Deep coagulation may lead to increased dysuria/irritative symptoms

1. Lumenis Corporate Wesbite:http://www.surgical.lumenis.com/wt/content/bph
2. Healthtronics2007_RevolixDuo Brochure
3. Recent Advances in Endourology: Interventional Management of Urological Diseases. 2006:8;103-122
4. Seitz M, Reich O, Gratzke C, Schlenker B, Karl A, Bader M, Khoder W, Fischer F, Stief C, Sroka R. High-power diode laser at 980 nm for the treatment of benign prostatic hyperplasia: ex vivo investigations on porcine kidneys and human cadaver prostates.Lasers Med Sci. 2008 Feb 13.