Laser surgery and endoscopy

EKI

_lasermed.elisabeth@pgdiakonie.de_____

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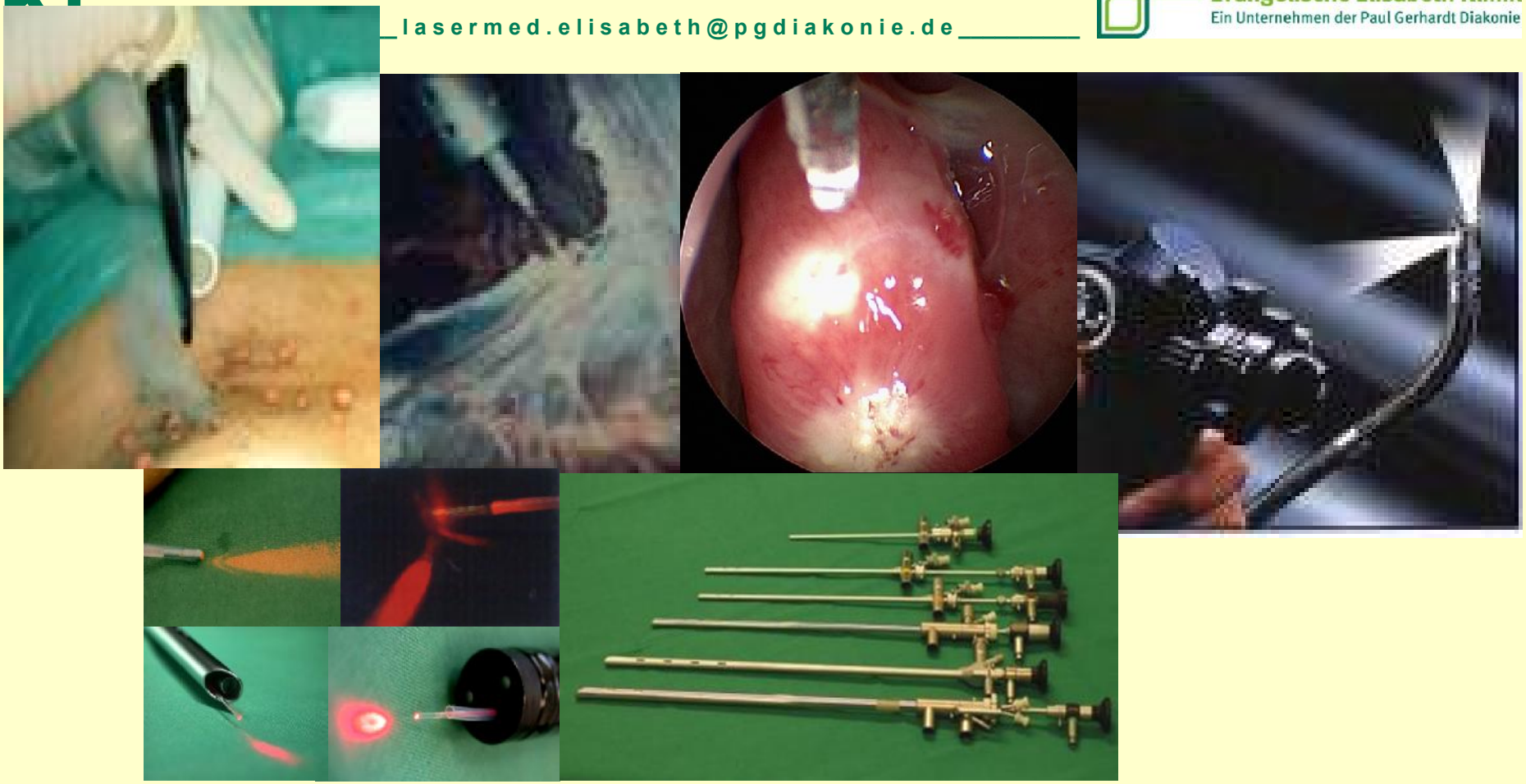

C.M. Philipp

Laserlab-Europe Foresight Workshop “Lasers for Life”
London, Royal Society, 2014

First documented Laser surgery

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1960

1963

Surgical Lasers

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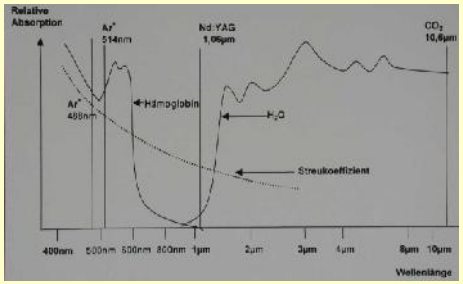
Laser	interaction	use
CO2-Laser (Erbium-, Thulium-, Holmium-, Diode-, Fiber-Lasers)	water absorption	cutting 
Nd:YAG-Laser	„YAG it down“	coagulation – cutting
VIS (KTP)	selective photocoagulation	coagulation - vaporization

Time / Power (density) ratio

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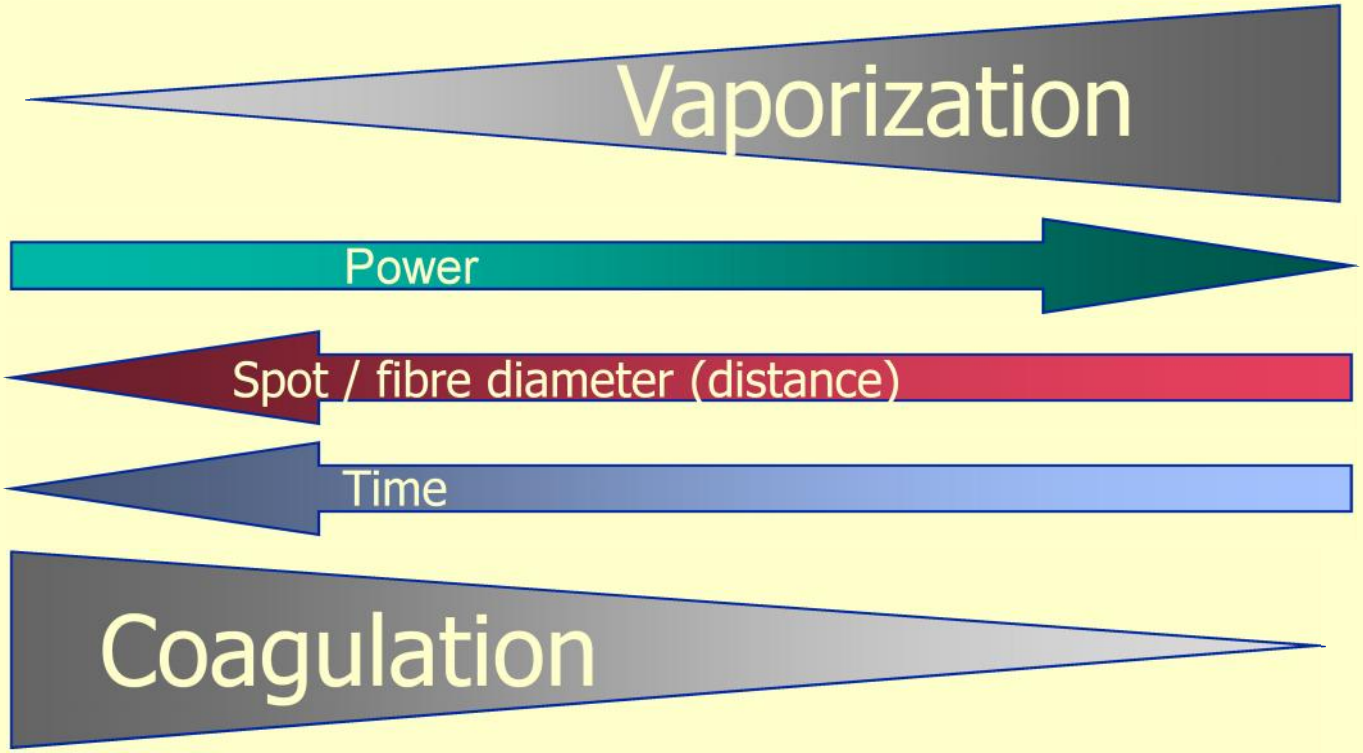

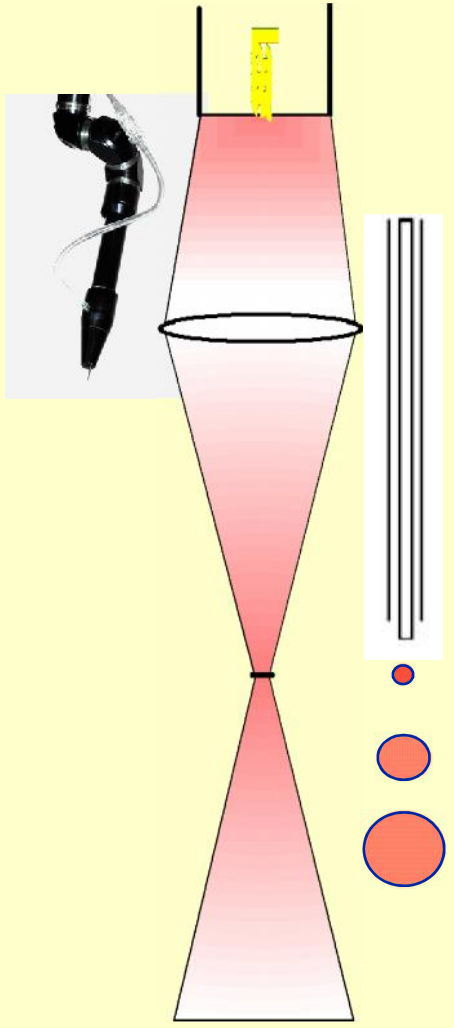

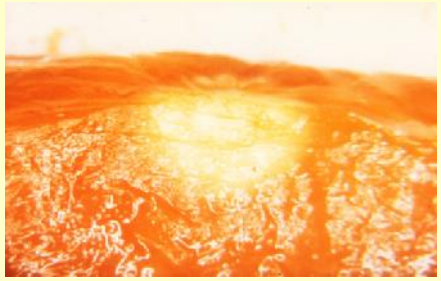

Surgery (“Chirurgia”, gr.) means “hand crafted”.

Selective absorption

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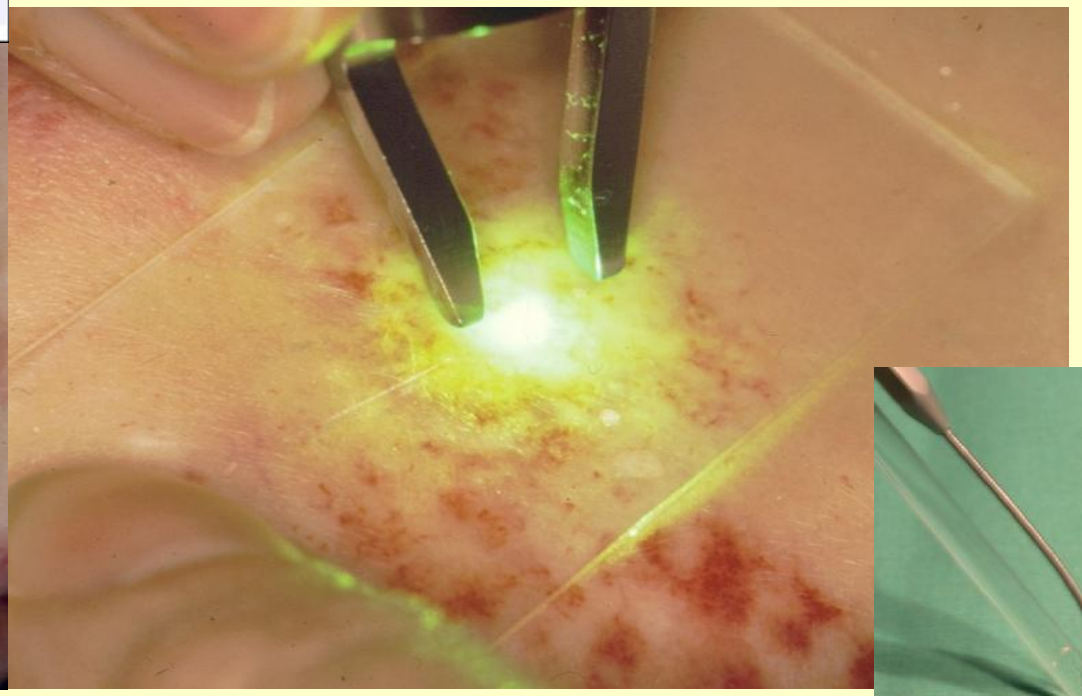
Glas plate with contact fluid (water):
- indexmatch
- compression
- cooling



Fibre Transmission

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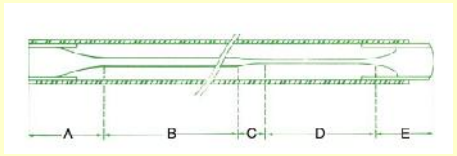
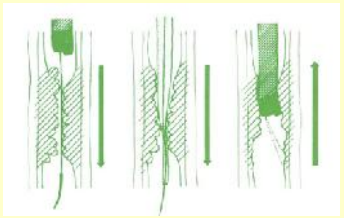
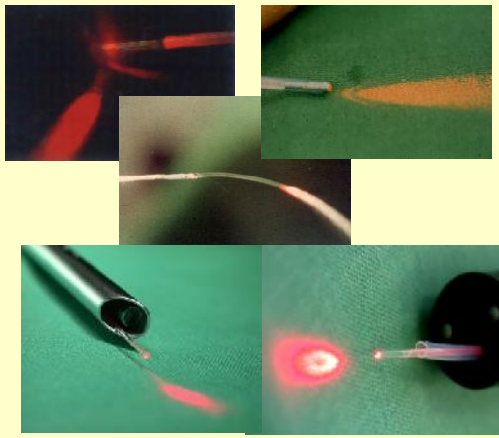
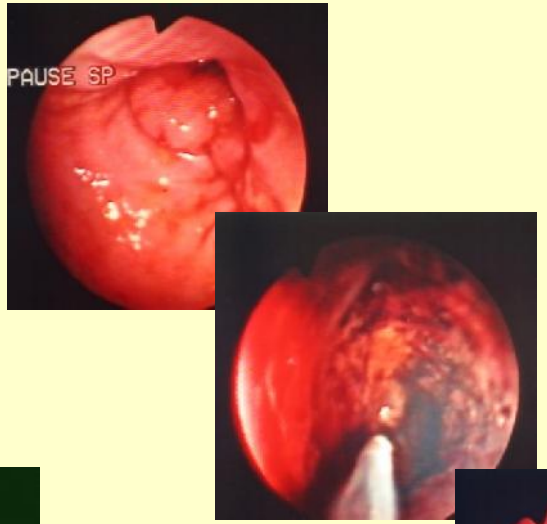
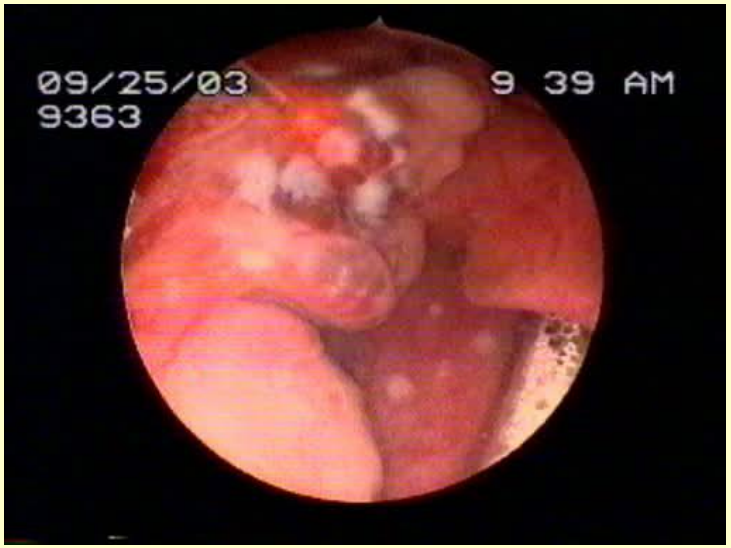


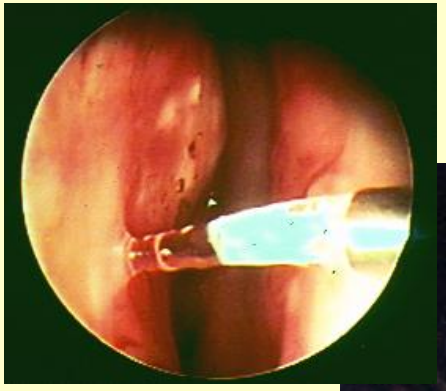
Laserbrief 1975, MLA2006(2)
Kiefhaber, Naht

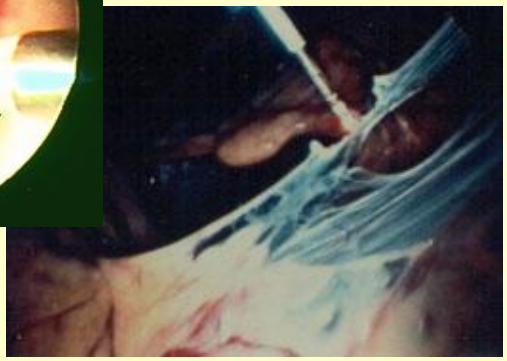


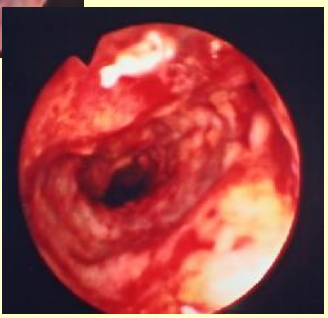












Options with fibres

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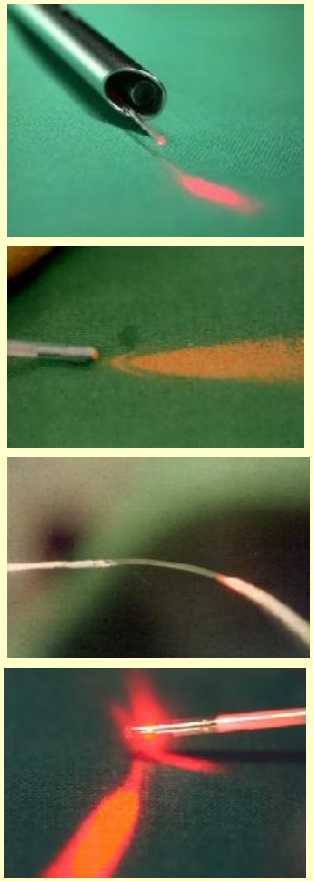

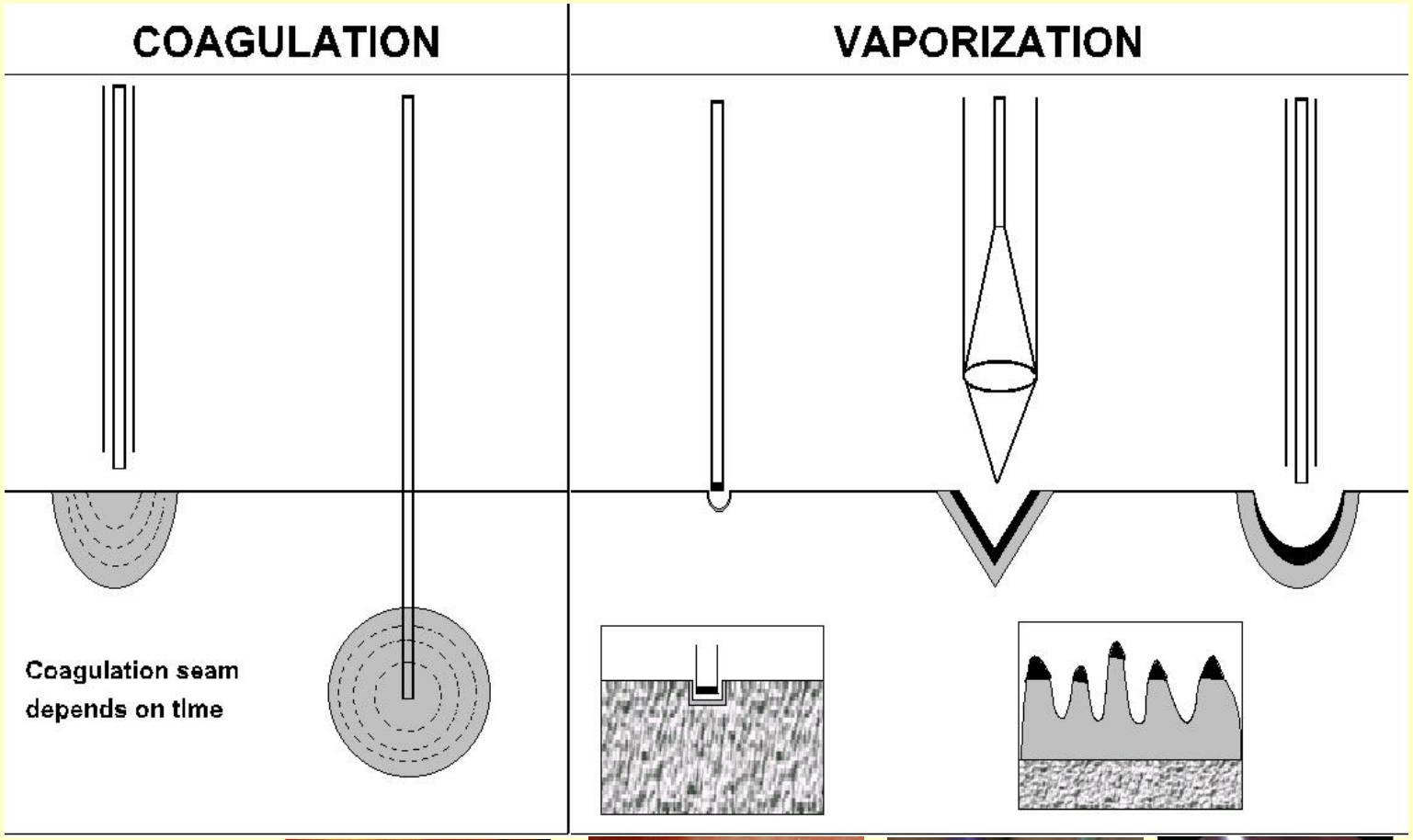

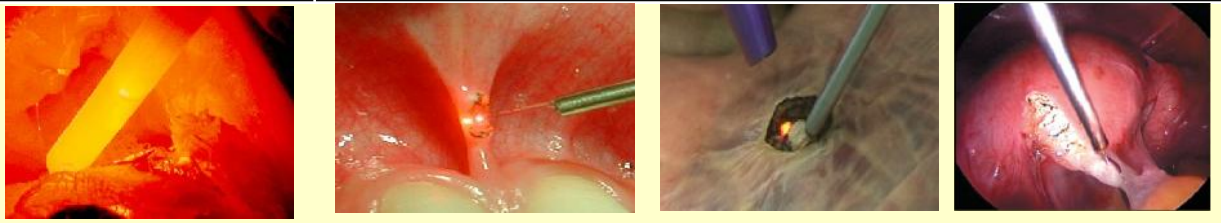

Helfmann J. "Thermal Effects" in:
Berlien HP, Müller GJ (Eds.)
"Applied Laser Medicine" Springer,
Berlin Heidelberg New York, 2003

Open surgery

Infantile hemangioma

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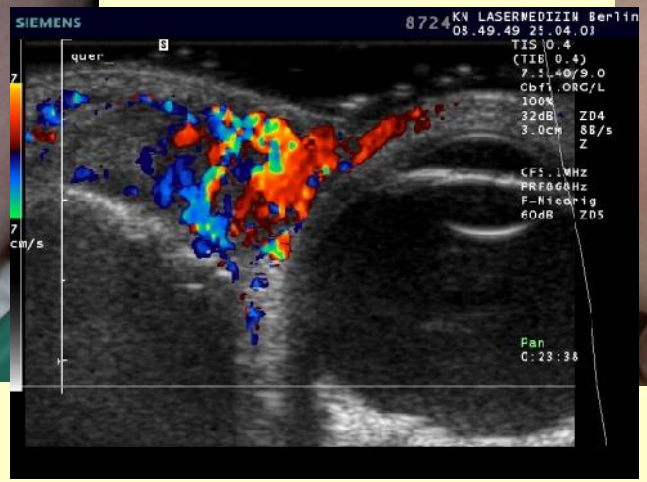
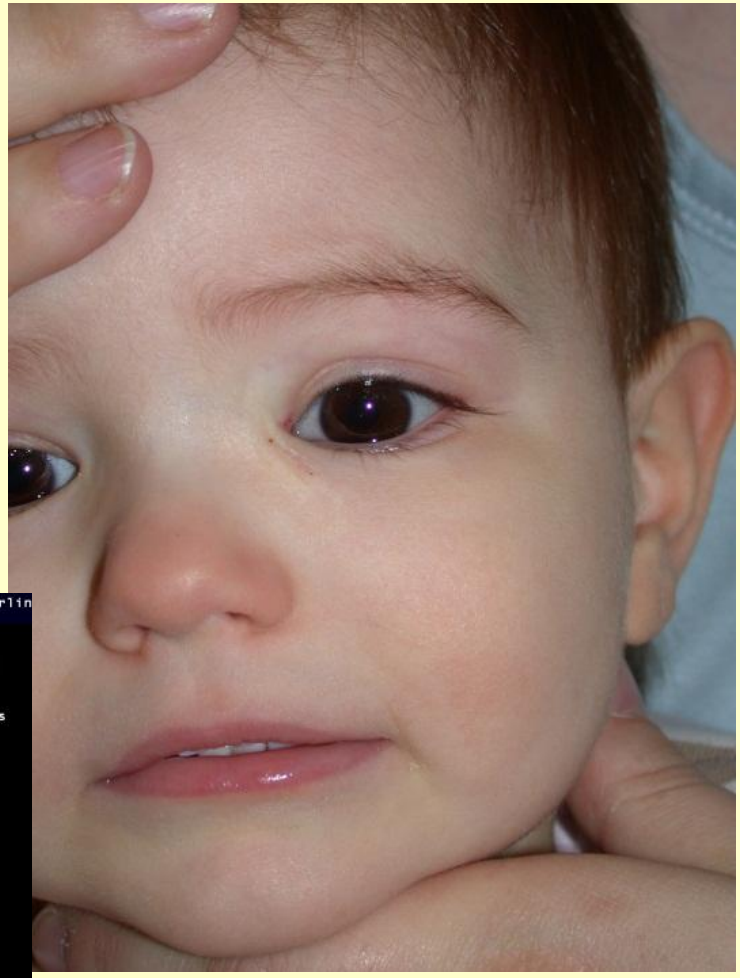
Transcutaneous with ice cube cooling,

Nd:YAG-laser, focusing handpiece

Power: 30-50 W
Pulslength: cw





Venous vascular malformation

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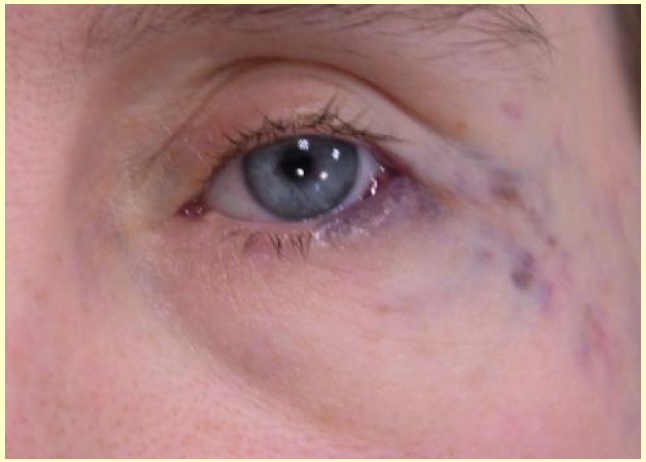
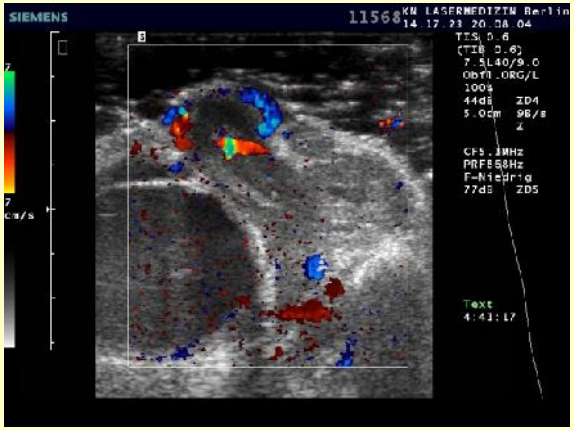
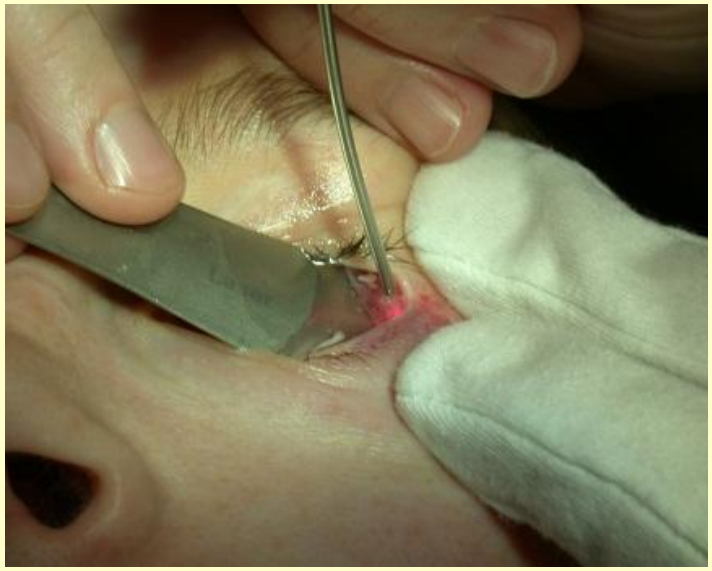
Before Treatment

Contact application:
Nd:YAG-laser
impression
600 bare fibre
Power: 3-5 W
Pulslength: cw



After 3 Sessions





Impression technique

Seborrhoic keratosis

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With KTP in situ coagulation multiple lesions may be treated at one time


No bleeding, no open wounds

<u>Laser parameters for limited findings:</u>
KTP, 532nm
5-8W, with / without cooling
0.2s, chopped with repetition
Spot acc. to needs (1-2mm)

Seborrhoic keratosis

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Laser parameters:
Pulsed Er:YAG, 2940nm
3-5J/cm2, multipass
Spot 3-5mm

Sterile dressing required
Bleeding possible

Er:YAG-Ablation

Cutaneous NF1 - CO_2-laser surgery

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Advantages:

- Quick procedure
- >300 NF/treatment
- minimized bleeding
- acceptable scars

Laser parameters:

Vaporisation:
Pulsed CO2-laser,
10600nm
20 – 50W, cw
Variable spot

Excision:
pulsed CO2-laser,
10600nm
20-30W, cw
Focussed spot

Perioperative antibiosis
PVP-iodine dressings
Tetanus vaccination

After care:
Topical steroid with antibiotic

Rhinophyma

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Laser parameters:
Ultrapulsed CO2-laser, 10600nm
20 - 40J/cm2
ms
Spot 3mm

4 weeks after single treatment

Lung resection (atypical vs. Laser)

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→ Laser surgery saves parenchyma

Interstitial Laser Coagulation (vascular), LITT

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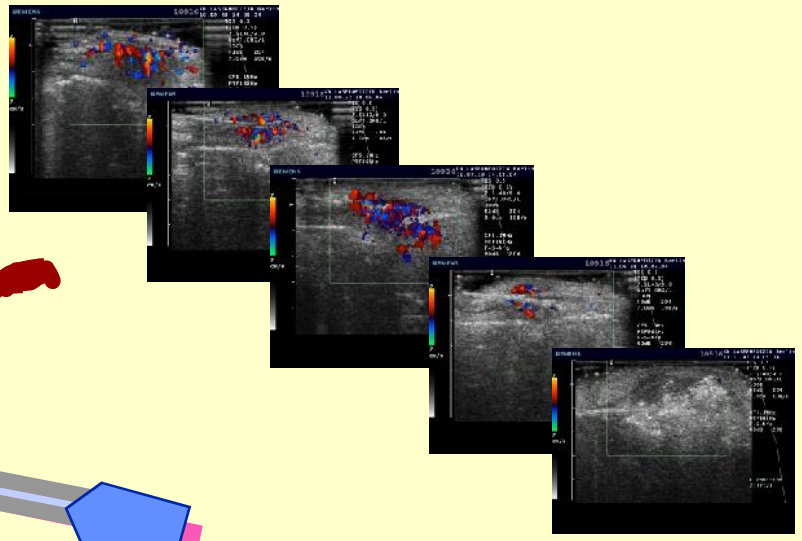
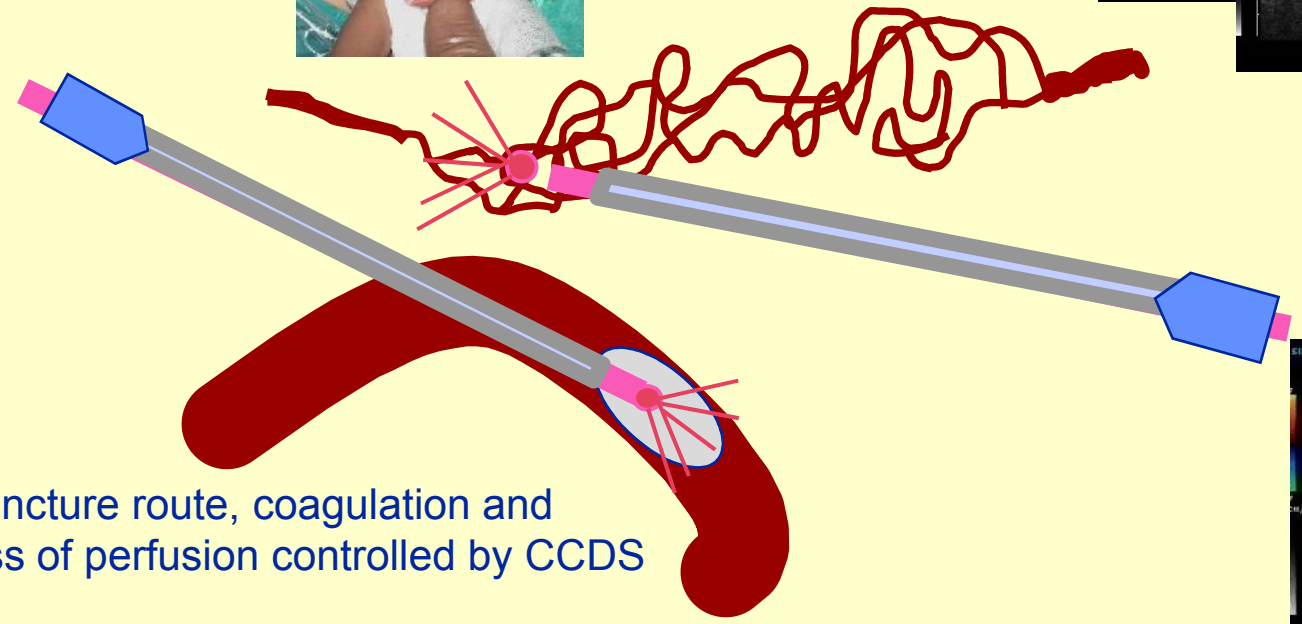
Wavelength:	1064 nm
Pulslength:	cw
Power:	5 W, without rinsing (interstitial)
Power:	8-10 W, with rinsing (intravascular)





Puncture route, coagulation and
loss of perfusion controlled by CCDS

AVM – interstitial treatment

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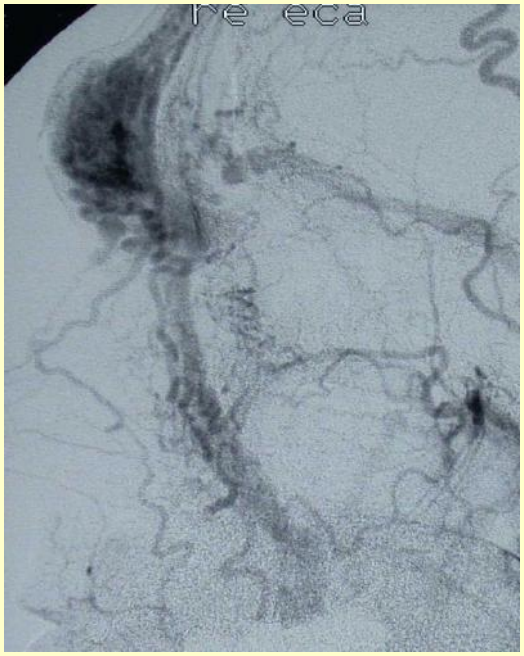
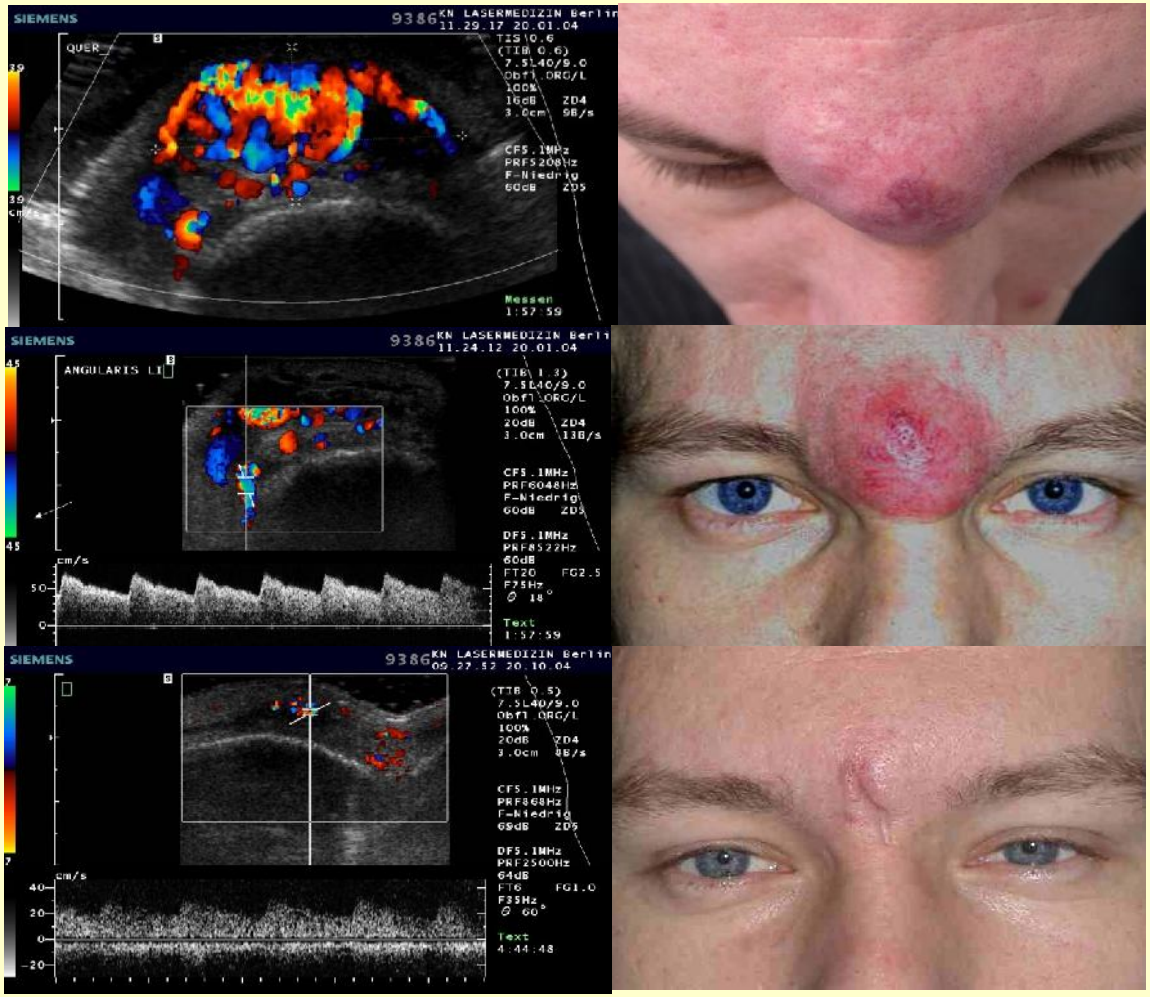
Laser parameters:

Nd:YAG-laser, 1064nm
cw
5W, interstitial/intraluminal
Bare fibre via Abbocath





2004, 3 interstitial & 1 transcutaneous treatments

MRI – controlled in situ interstitial coagulation of hepatic metastasis (Colon carcinoma)

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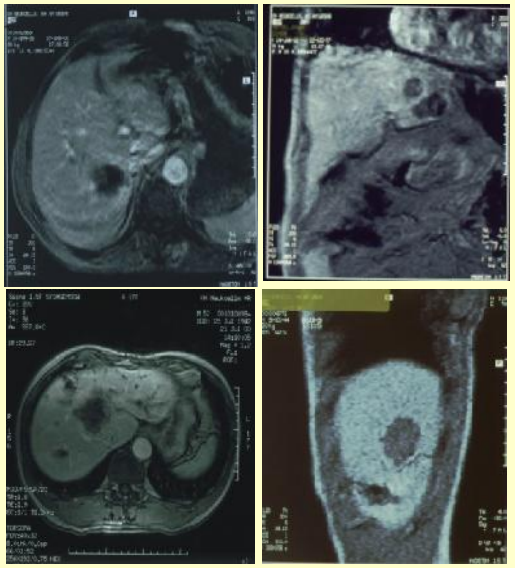
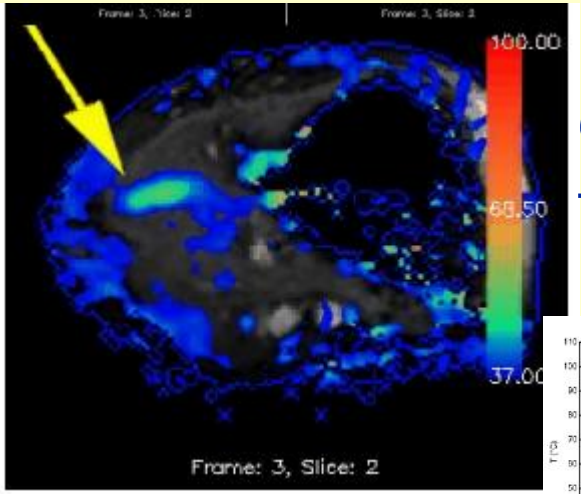
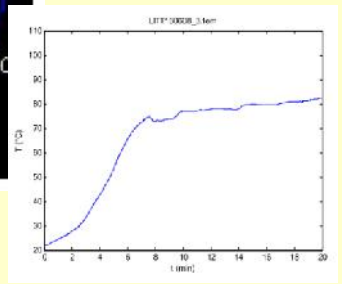
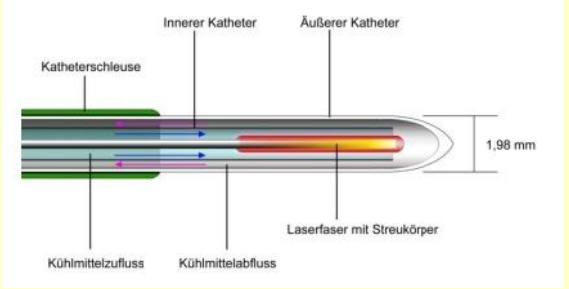


MRI with Gadolinium®
48h after LITT



Online thermometry





Endoscopic surgery – from head to toe

(ENT, PULM, LAP, GYN, GI, URO, ARTHRO, …)

CO2-Laser micromanipulator (ENT & GYN)

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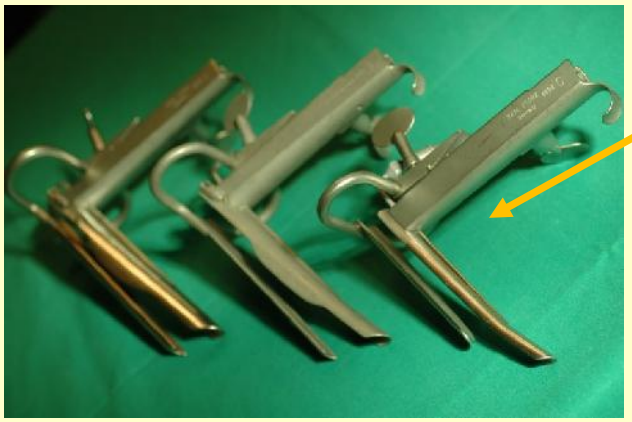
By changing of mirrors every wavelength may be transmitted.



Laser-laryngoscopes for ENT

CO_2 – Laser vaporization / excision ENT

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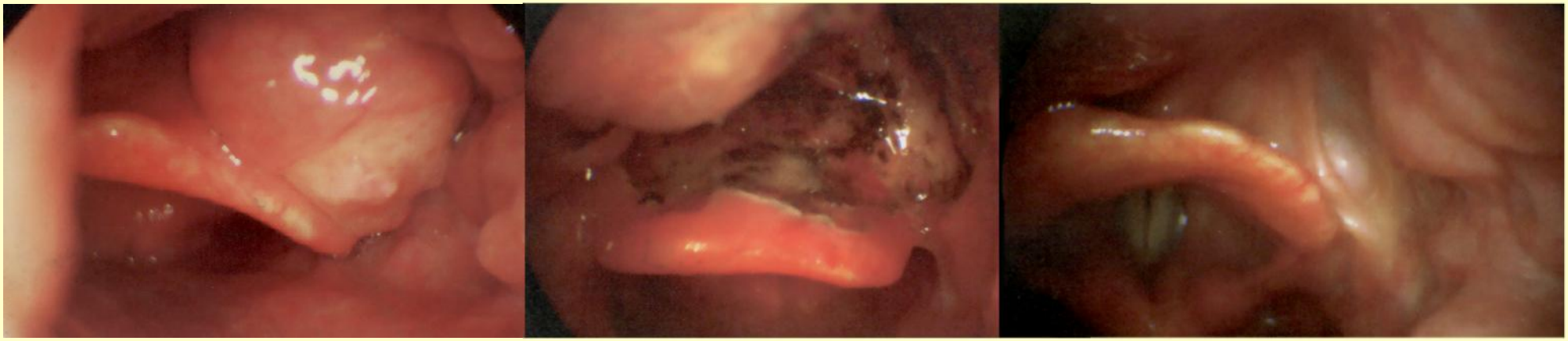
Laryngeal Papillomatosis (vaporization)



Epiglottic vallecula carcinoma (excision)

Images courtesy of PD Schilling, ENT KNL

CO2-Laser in laparoscopy

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Archives of gynecology
September 1985, Volume 238,

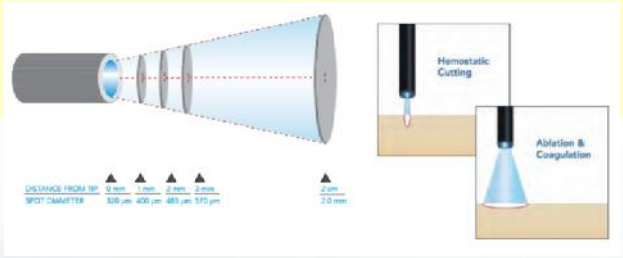
rchives of gynecology
ptember 1985, Volume 238, Issue 1-4, pp 528-529

Rekonstruktive Mikrochirurgie und laparoskopische Adhäsiolyse an der Adnexe mit dem CO_2-Laser

E. Dreher, M. Meandzija, A. Carasso, A. Friedmann

Courtesy of Martin Gallo Dupage Medcical Group for Omniguide, 2012, yuotube

Nezhat Laparoscope Coupler & Adapter



Choice of rigid vs. flexible

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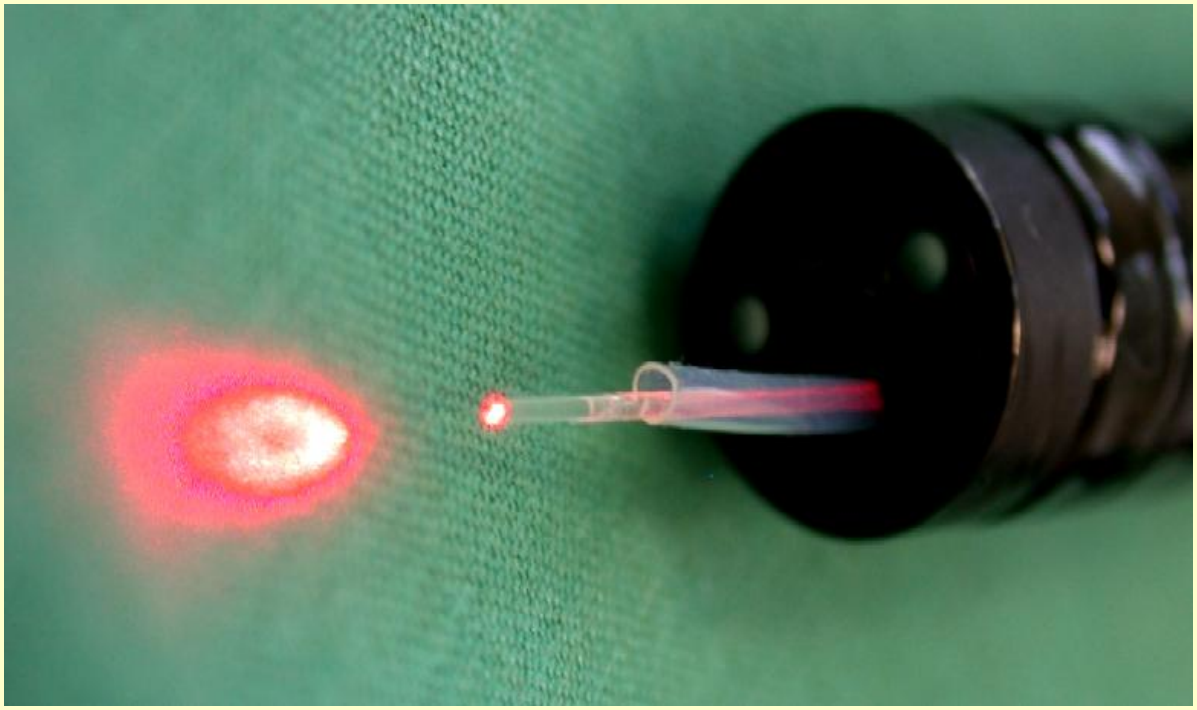
Rectoscope,
with combined inflation,
suction and fibre holder



flexible Coloskope
With bare fibre 600µm and protection tubing

Laser for vascular findings in ENT (HHT)

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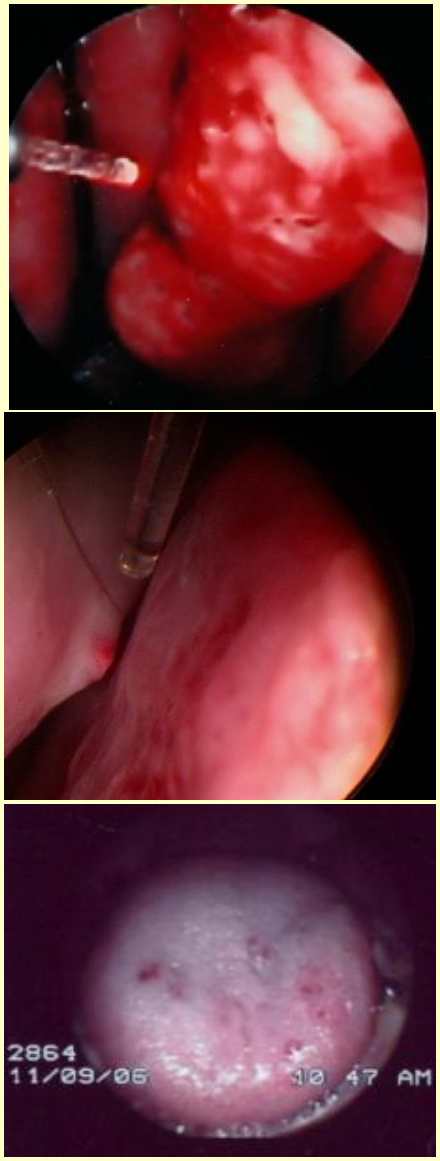
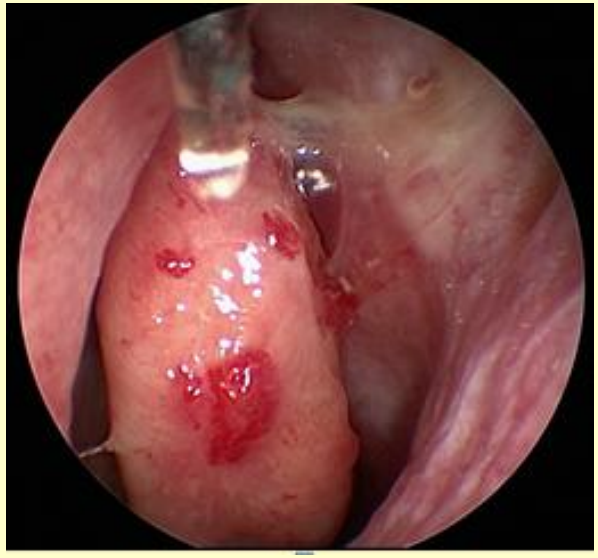
cw-Nd:YAG-Laser

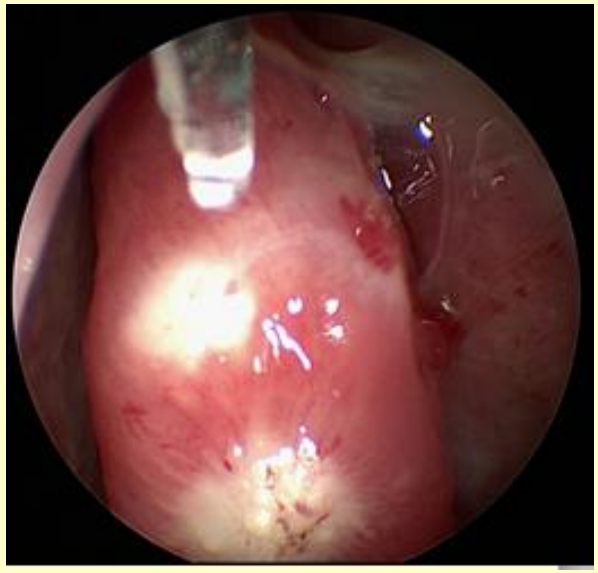
Wavelenght: 1064nm (IR)
Penetration depth: up to 10mm
-Large Volume
-Larger vessels

cw-Diode-Laser

Wavelenght: 980nm (IR)
Penetration depth: up to 6 mm
- Medium volume
- Medium vessels







HHT – endoscopically controlled treatment

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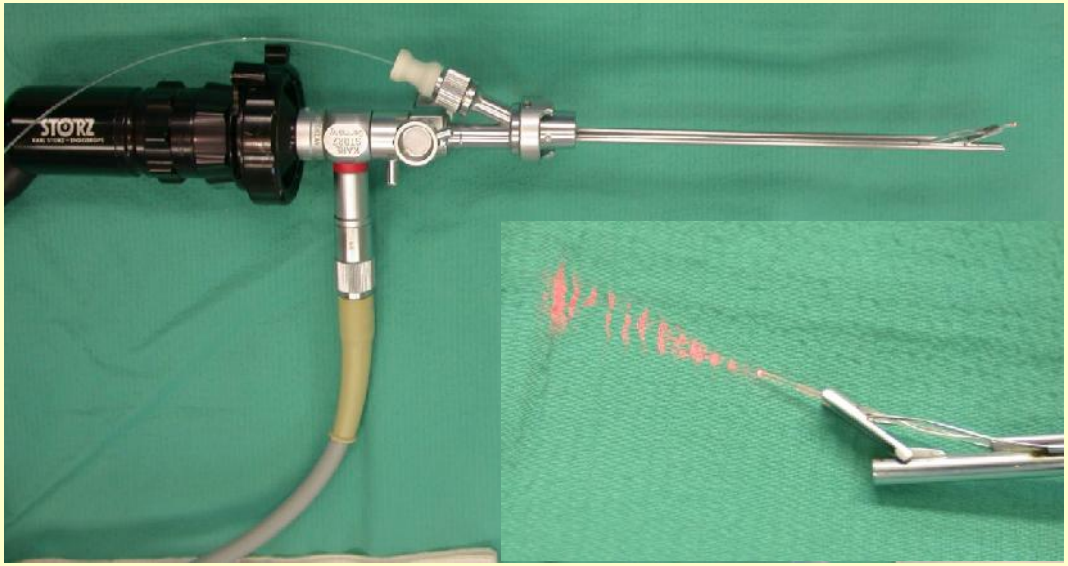
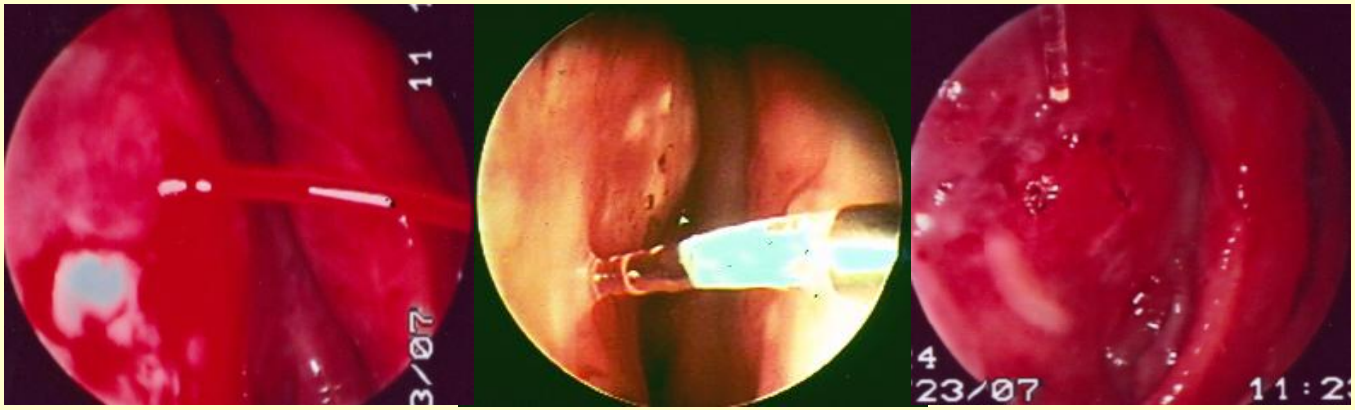


Instrumentation



Arthroscopic Coagulation

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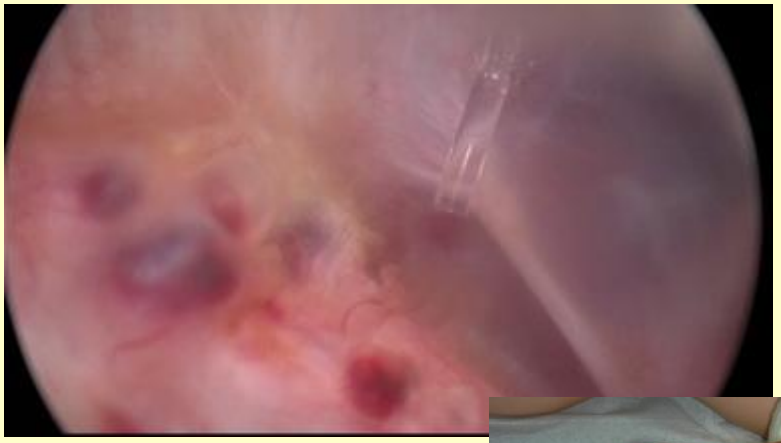



VVM (KTS with intraarticular finfings)

HHT in Larynx & Trachea

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Nd:YAG-Laser
12W, 0,2s, chopped

Tracheoscope with
Hopkins lenses
and Nd:YAG bare fibre

Selective in situ coagulation of vascular tissues

Laryngeal lymphatic malformation

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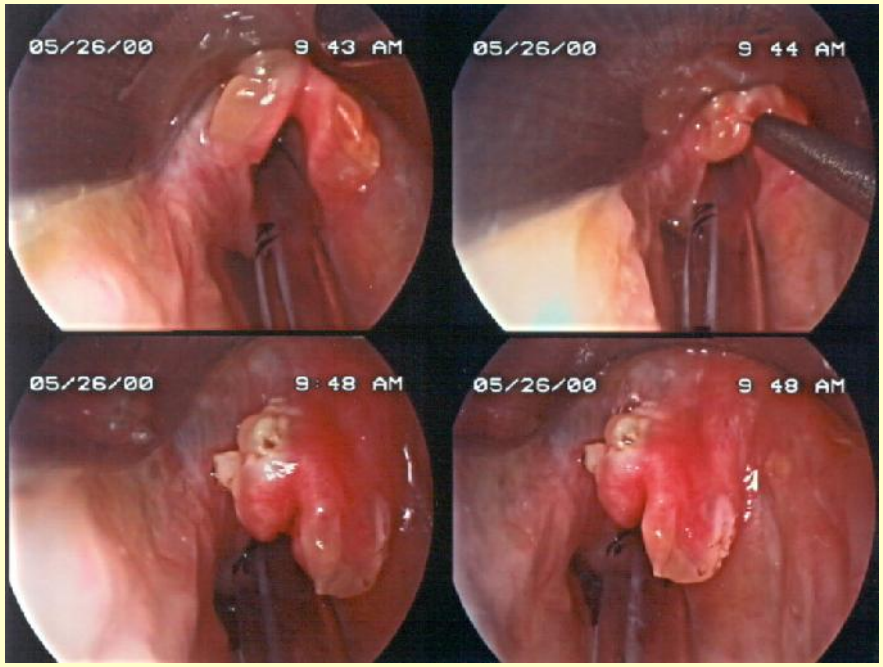
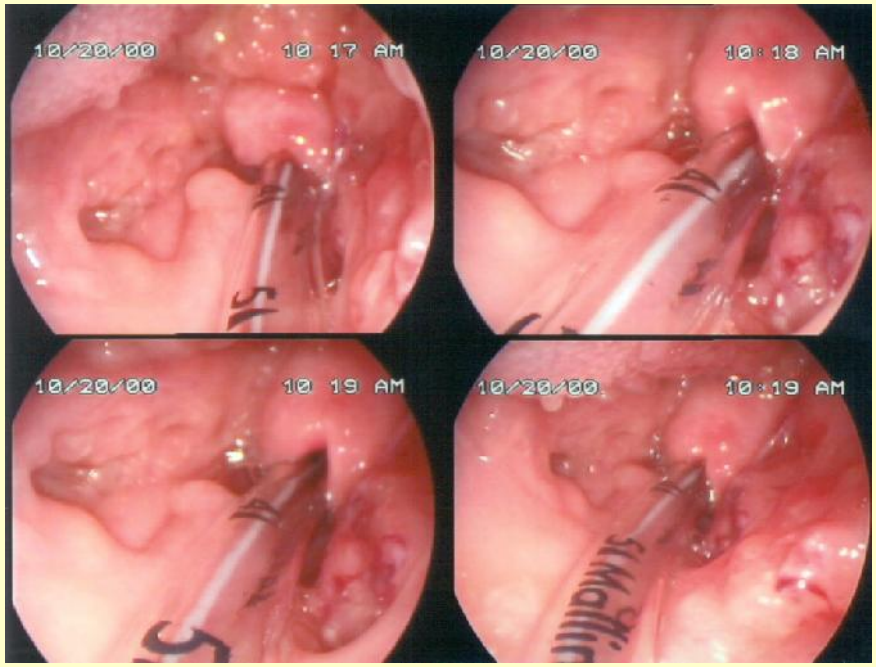


Prior to treatment



After two treatments

Tracheal/Subglottic Granuloma

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contact vaporisation
conditioned fibre tip
20-30W/0.1:0.1sec

Pellicular Tracheal Stenosis

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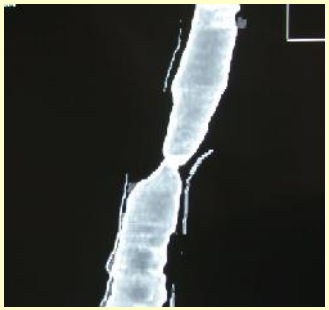
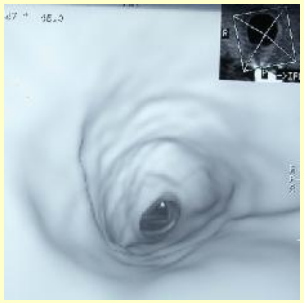
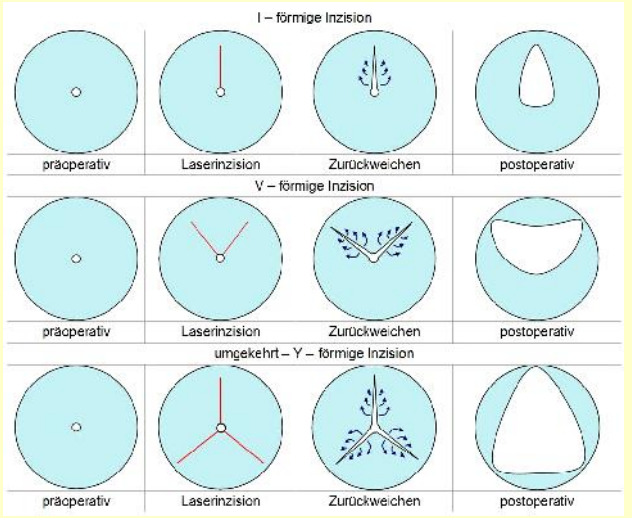
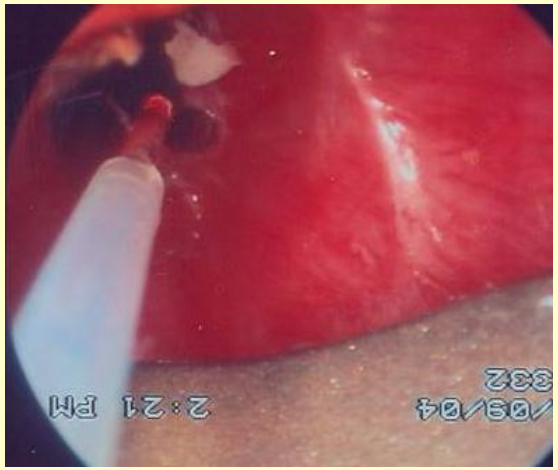


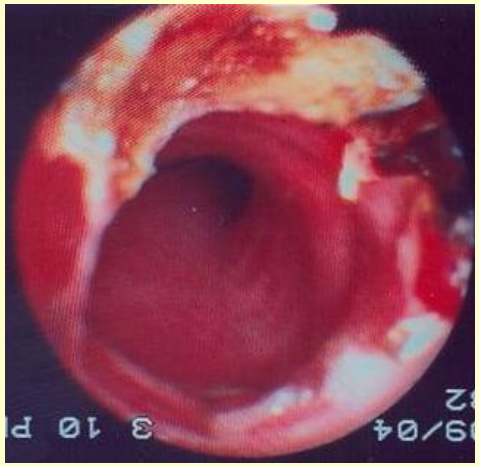
CT reconstruction



view from the distal trachea







Nd:YAG bare fibre vaporization, contact; 30W / 0.1:0.1sec

control after 3 days

Recanalization in obstructive colon carcinoma

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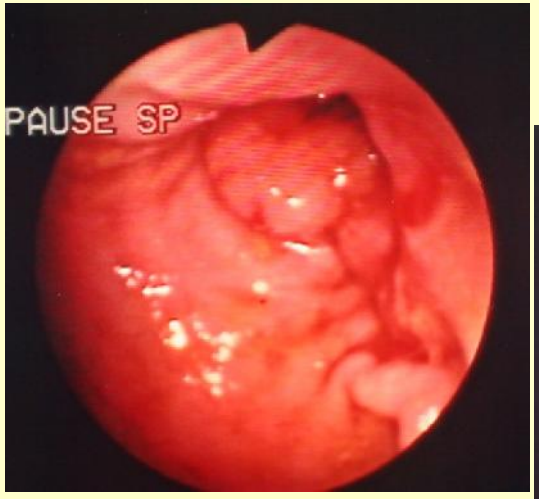
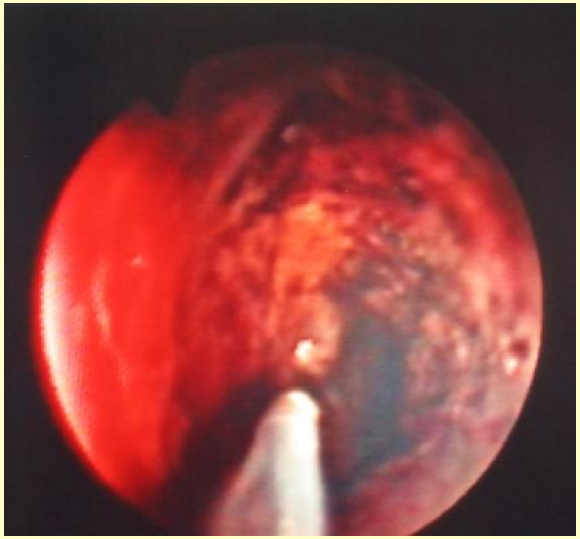
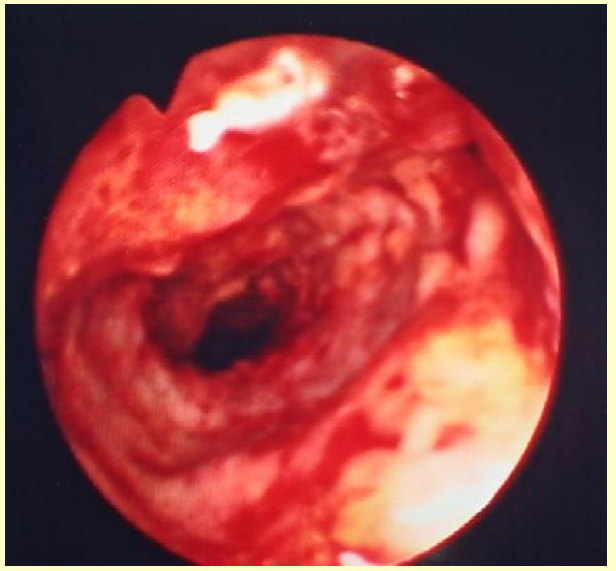


subtotale stenosis



Nd:YAG coagulation
and vaporization

Passage achieved



Dont go to far,
remember, the 30% plus effect!

Condylomata male / female

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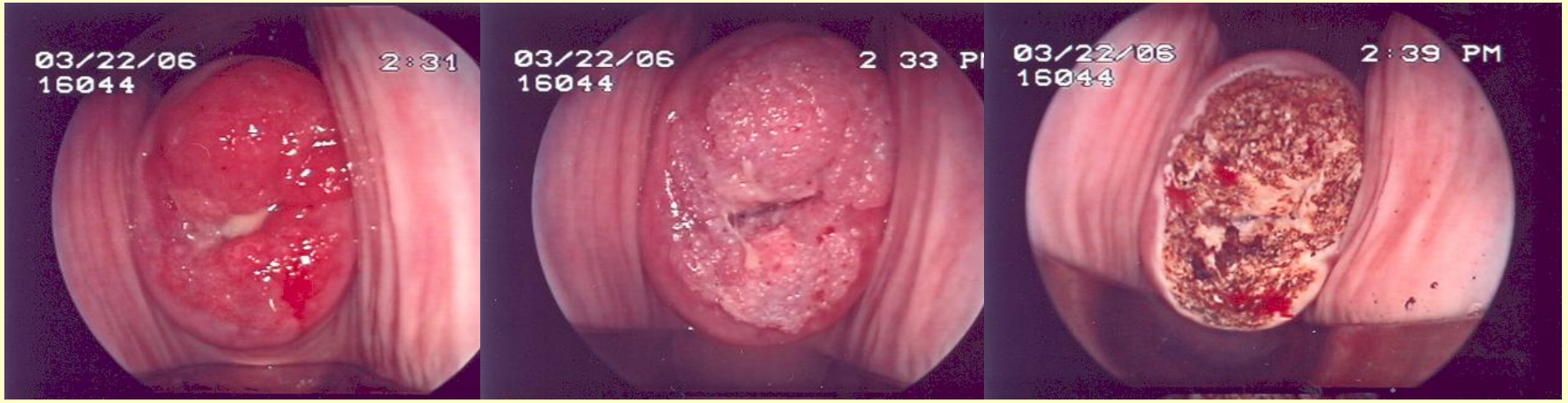
Nd:YAG coagulation



nativ | Essigprobe | nach Co2-Vaporisation

Condylomata – IEN III

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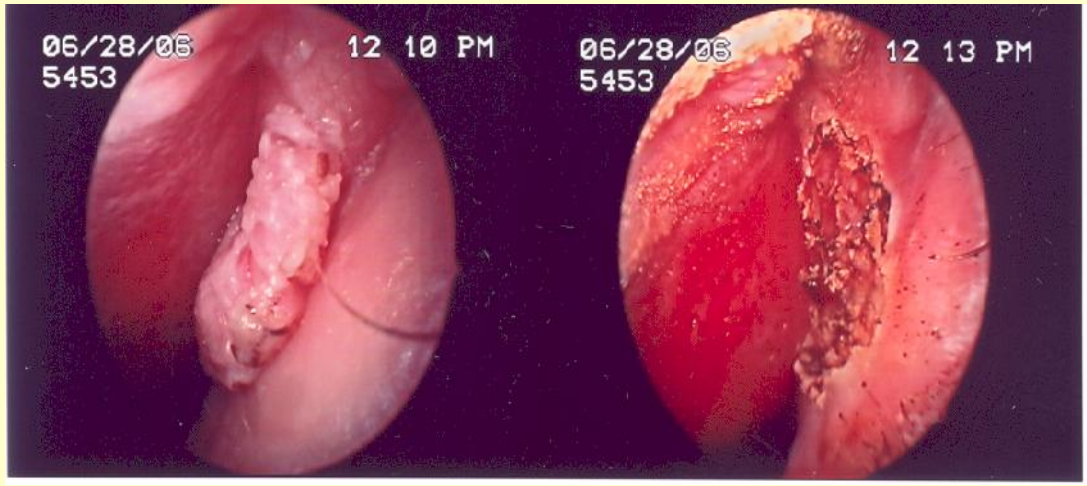
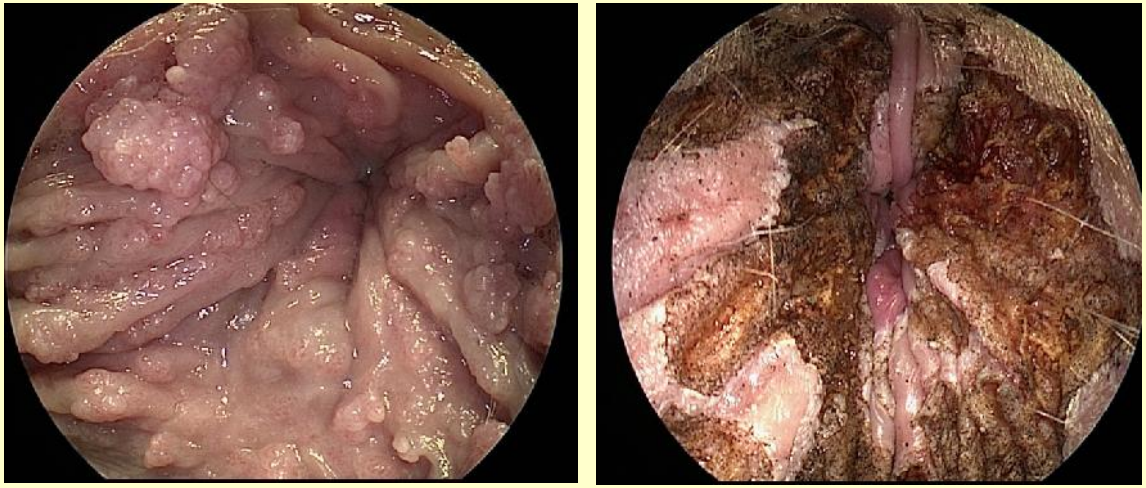


- local, regional or general anaesthesia
- fluorescence-guided (PDD),
  optionally in IEN

<u>1.) Vaporization</u>
- CO2-laser 10.600nm, cw
  20-50 W
  Spot size 2-5mm
- Shallow vaporization (epithelial)
- Deep vaporization in IEN II-III (3mm)

<u>2.) Excision</u>
- CO2-laser 10.600nm, cw,
- 20-30 W
- Spot minimized



AIN in HIV+ patients

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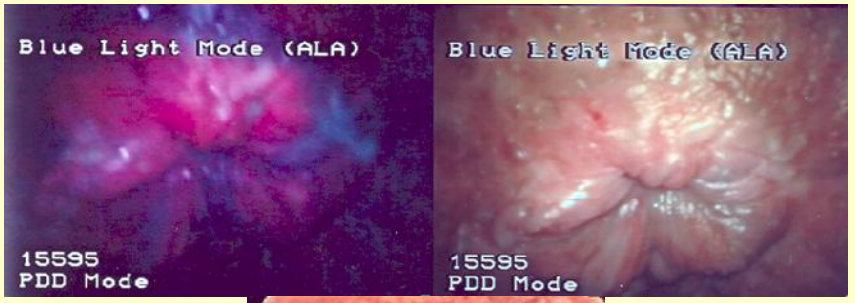
Late sequaele of HPV: AIN



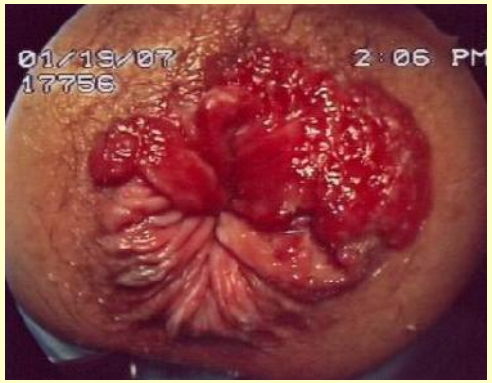
HPV assoc. in 100% (87% HPV 16)
(Varnai, Int J Colorectal Dis 2006)

Incidence 0.8/100.000 in general, m/f = 1/2,
increases to 24/100.000 in HIV+ males.

Immunosuppression increases risk 100 fold
(hivinsite.ucsf.edu)

High prevalence of HPV ind HIV+-patients
(Chin-Hong, Clinical Infectious Diseases 2002)

Skin appendage tissues (hair, glands) involved in 60%, thickened epithelium, depth of 2,2mm below basal membrane for CR required (Skinner, Brit. J Surg 1997)



progression into
invasive carcinoma if untreated

→ CO2-Laser ablation + radiotherapy
(+chemotherapy)

Stent occlusion left main bronchus (SCC)

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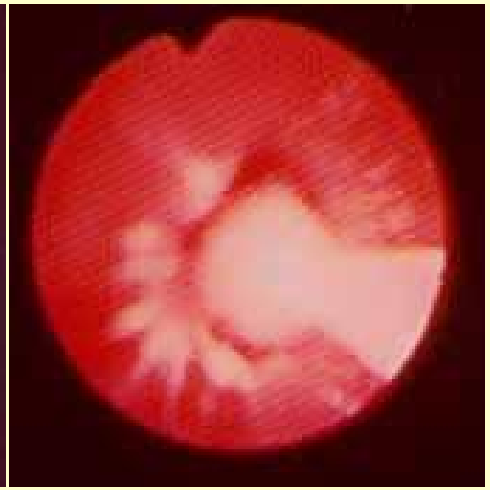
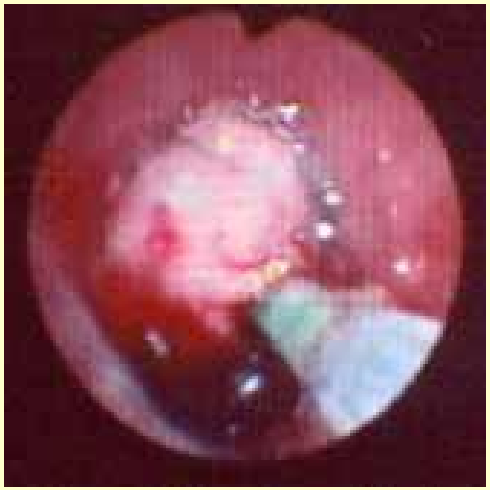
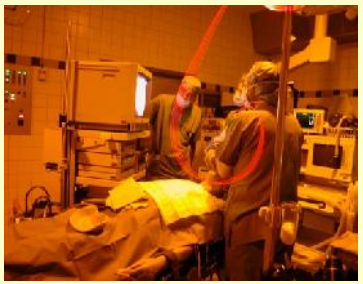
Left main bronchus

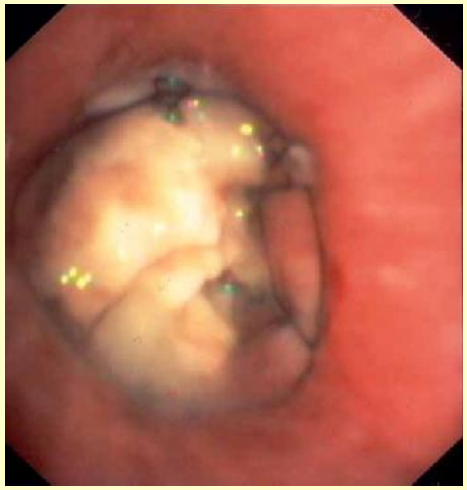


during **PDT**



endpoint of irradiation





4 d post PDT, isolated necrosis of TM

after debridement

Summary

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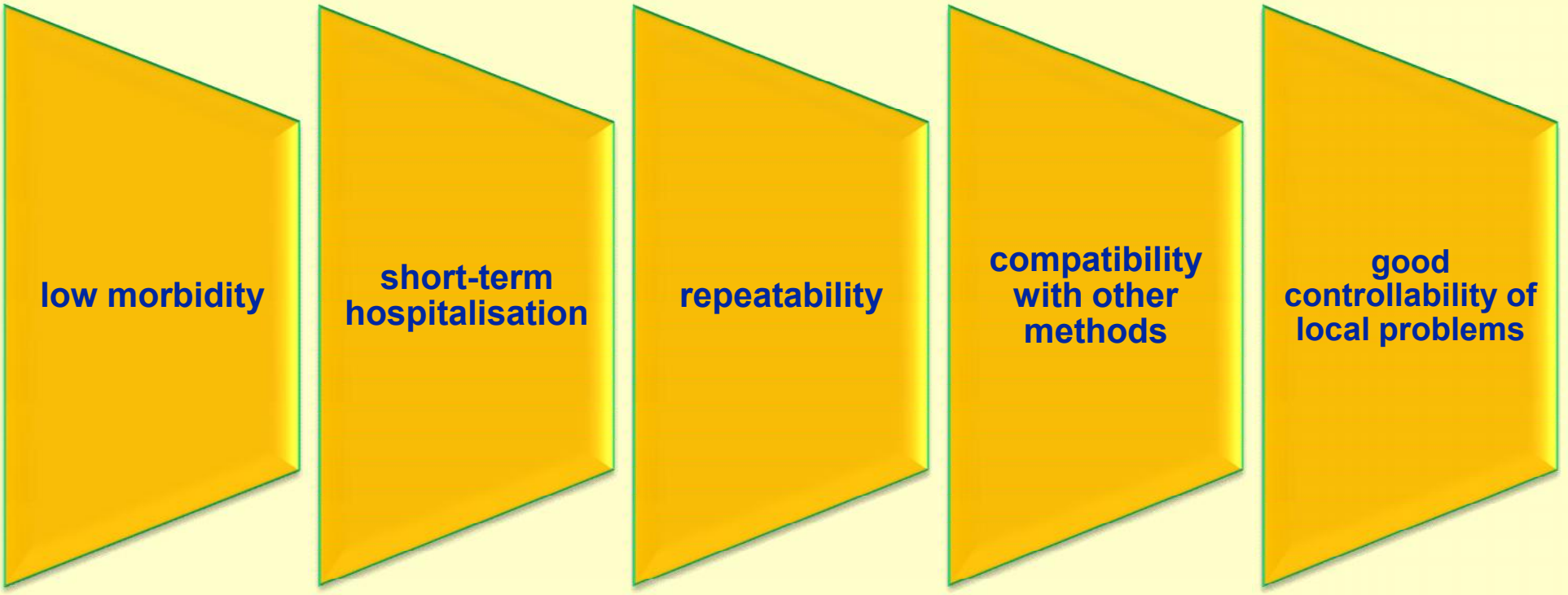
Benefits of laser treatment



But why does not every surgeon uses lasers?


Laser & Biophotonics in clinical use
How can we gain better
therapies for tomorrow ?

Aim

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Patient comfort, ease and safety of application

Options (a surgeons wishlist)

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- Combining diagnostics and therapy
  - integrated diagnostic tools
  -- fluorescence, Raman, backscattering, temperature, elasticity,…
  -- discrimination between healthy and diseased tissues

  - combination with imaging techniques
  - feedback systems
  - adopted (flexible) parameters
  - aid for the surgeon

Options (a biophonics nerd wishlist)

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- New technologies
  - photonic implants
  - light driven microrobots

- Higher availablity
  - smaller
  - cheaper
  - easy to use, „fail safe“ (specialized systems)
  - education and training (generalized systems)
  - demystification

In therapy generally only destructive effects of light are used.

Photobiomodulation shows some initial positive results in wound healing and pain magement, (hair growth?)

EKL Learning from biology

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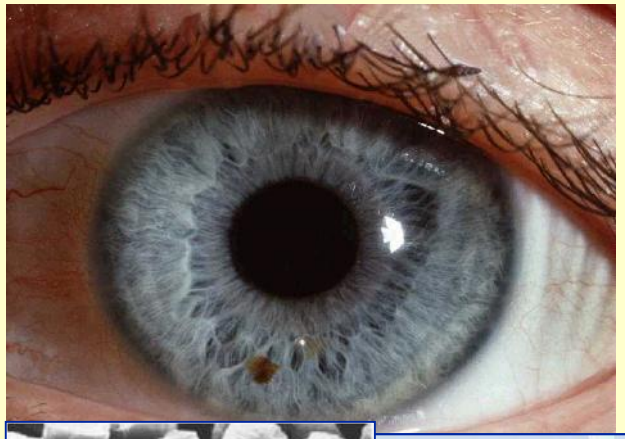

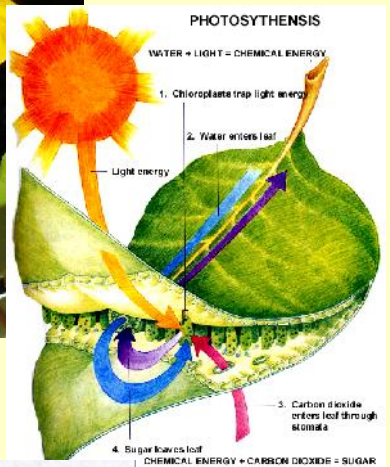

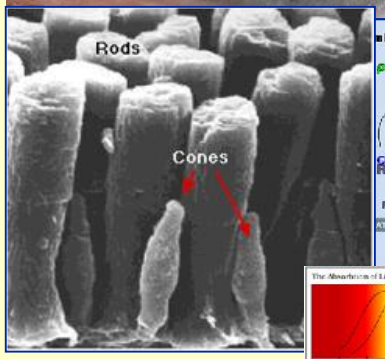

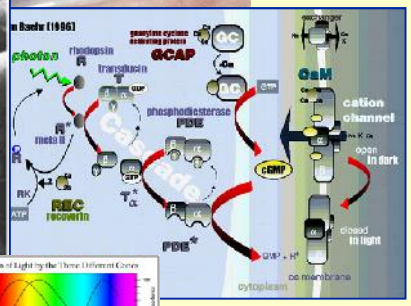

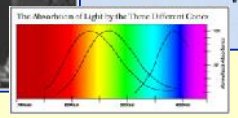

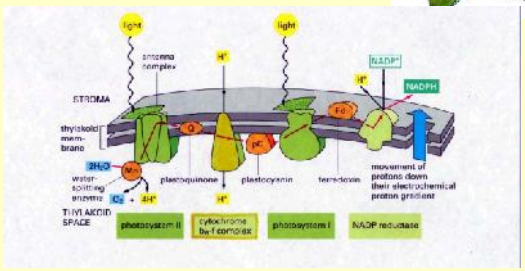

Nature uses light for signal transmission and building up materia.

Tissue fusion ?

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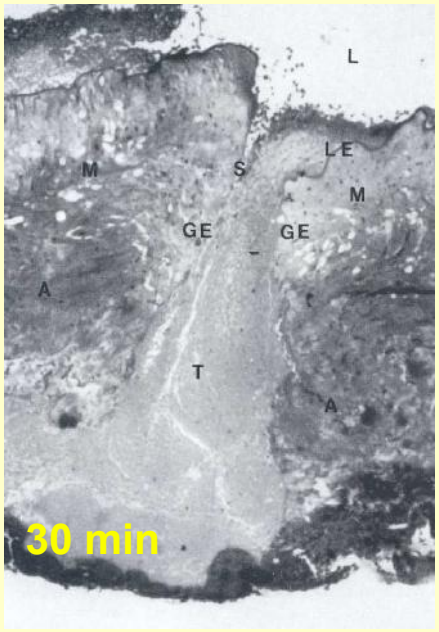

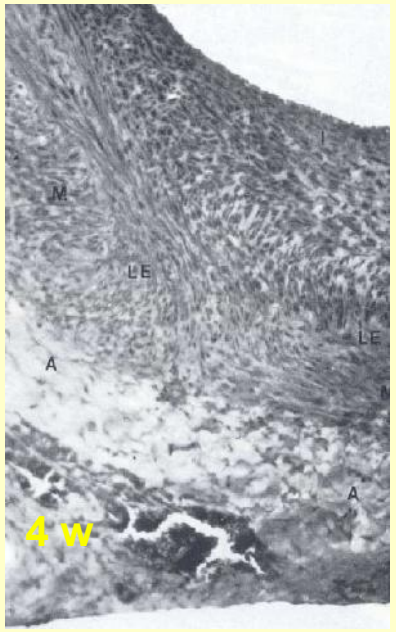

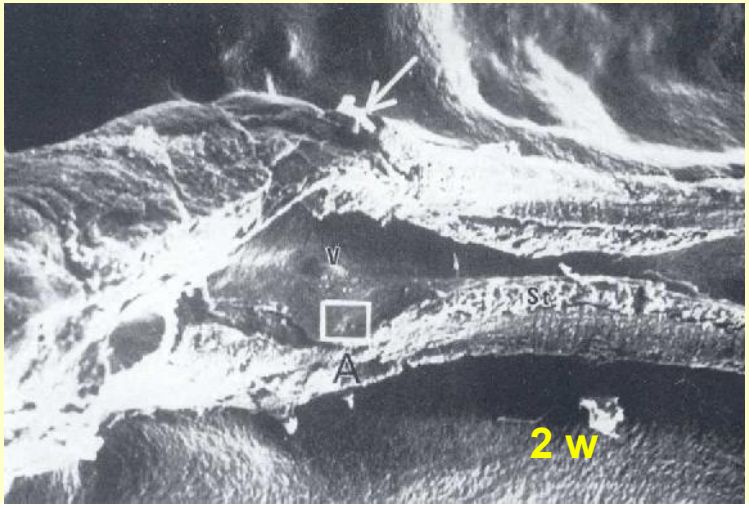

Dept. Lasermedicine

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A great thanks to the team !