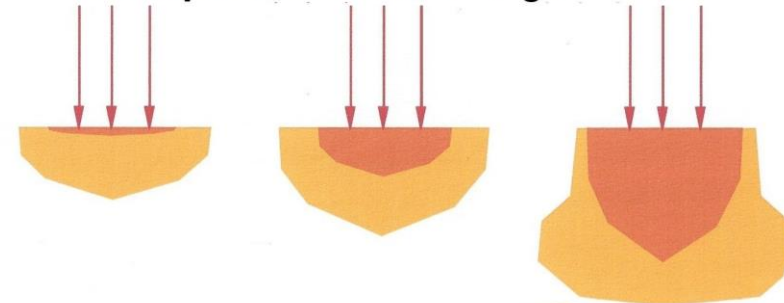


Absorption and scattering in tissue



Type of Laser

Excimer → UV
Er:YAG, CO₂ → IR
Absorption
prevailing

Argon-Ion
Dye-Laser → VIS
Absorption and
Scattering

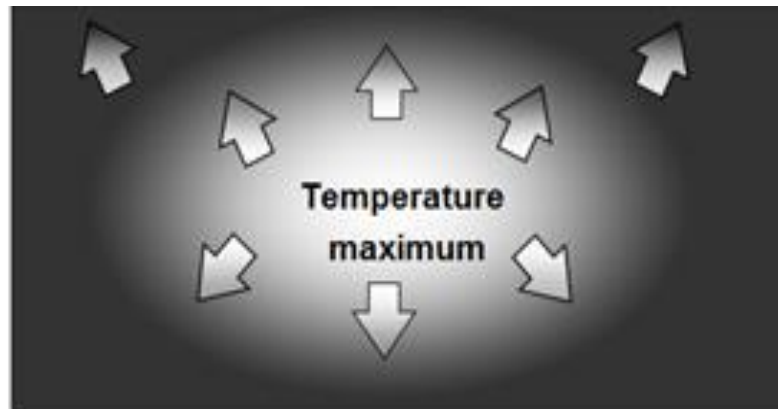
Nd:YAG, 1064 nm
Dioden → NIR
Scattering
prevailing

Penetration 1.....20 μm

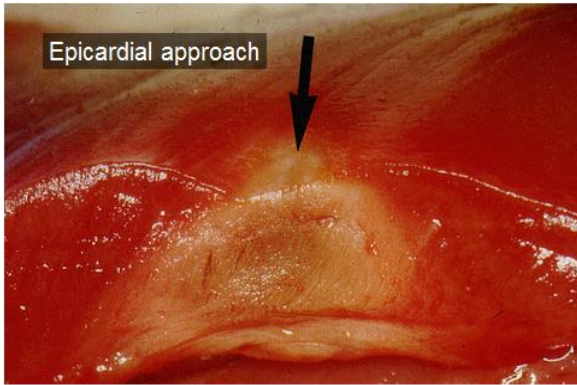
0.5.....3 mm

2.....≥ 10 mm

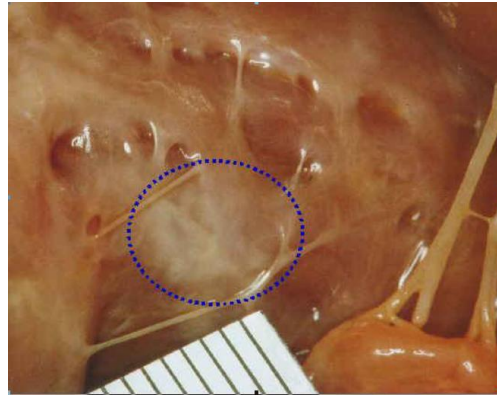
1 The 1064nm Nd:YAG-laser light has a **low absorption in water**, **scattering** in tissue is intense, and it is **selectively absorbed by the myocardium** so that **2 myocardium is gradually heated up**, however, **the catheter itself is not**. Thus, Nd:YAG laser ablation is achieved under **normothermic conditions**



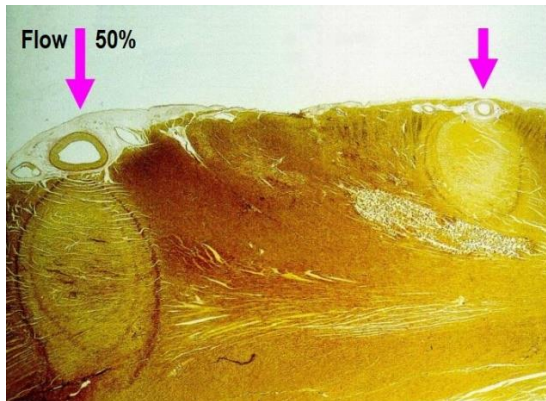
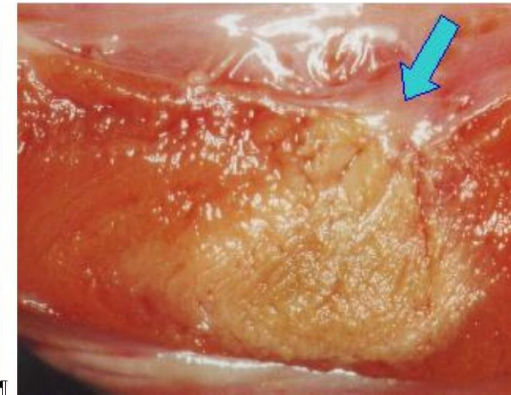
3 Heating of the myocardium **starts 2-4 mm deep intramurally** and is **spreading within a few seconds concentrically**
4 A **clear-cut homogenous lesion** of coagulation necrosis is produced **without tissue vaporization** with crater formation, **without the risk of perforation**. The induced scar is not shrinking and there is no aneurysm formation



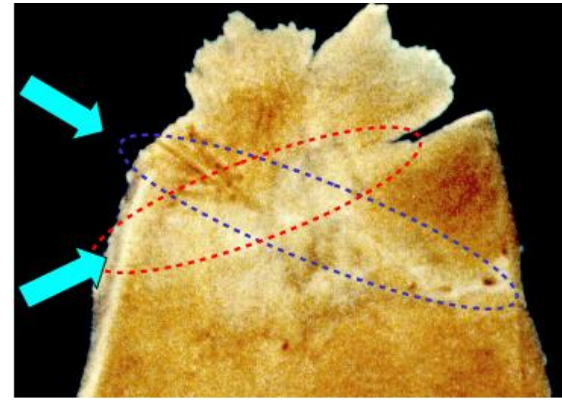
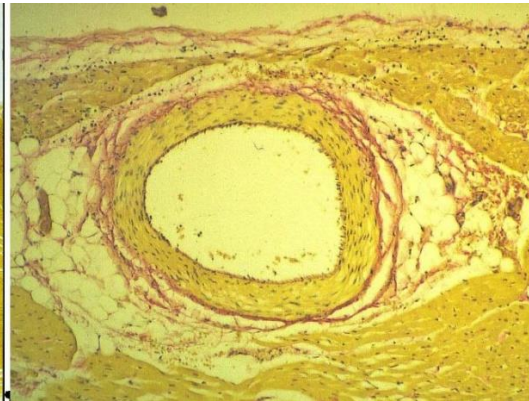
5 After epicardial laser application transmural lesions are achieved within **seconds**.



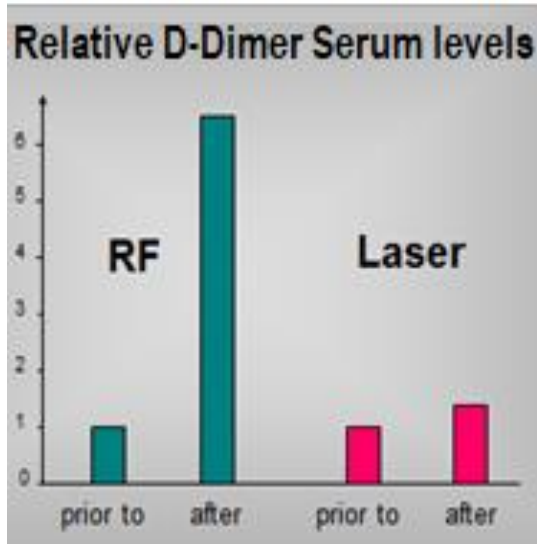
6 After endocardial laser application coagulated myocardium is visible through the normal translucent Endocardium (circle). The Lesion is homogenous, clear-cut, **transmural**



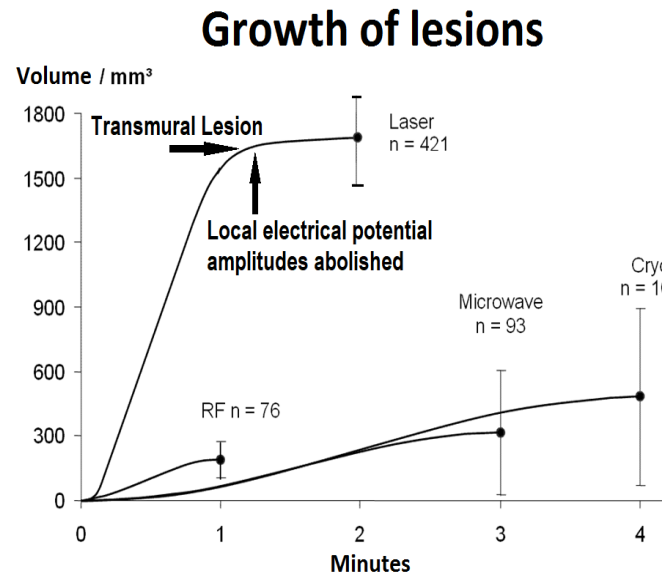
7 Epicardial laser application produces **transcoronary lesions without thermal damage to the coronaries**. Volumes of myocardial lesions produced depends on the **coronary blood flow rate**. Coronary vessel lumen is free from thrombi, intima and media layers are undamaged, however, a mild inflammation of the adventitia is present



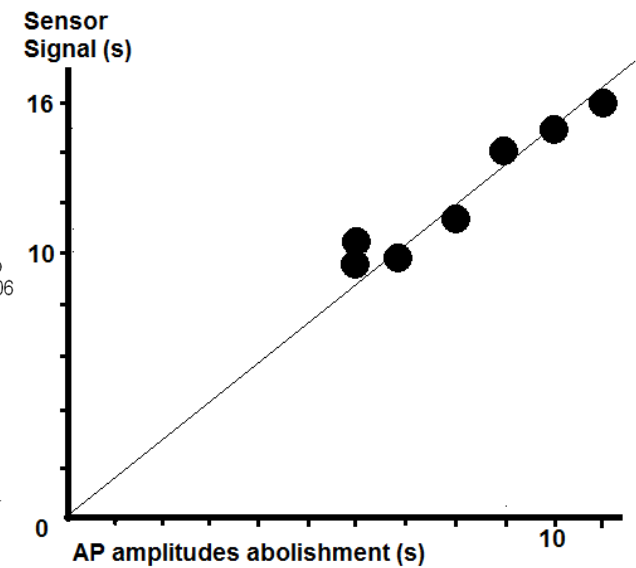
8 laser light is not absorbed but highly scattered in the bright fibrous scar and is absorbed by the remnants of viable myocardium and ablating foci of VTs. **Scars become arrhythmogenic** without shrinking and without aneurysm formation



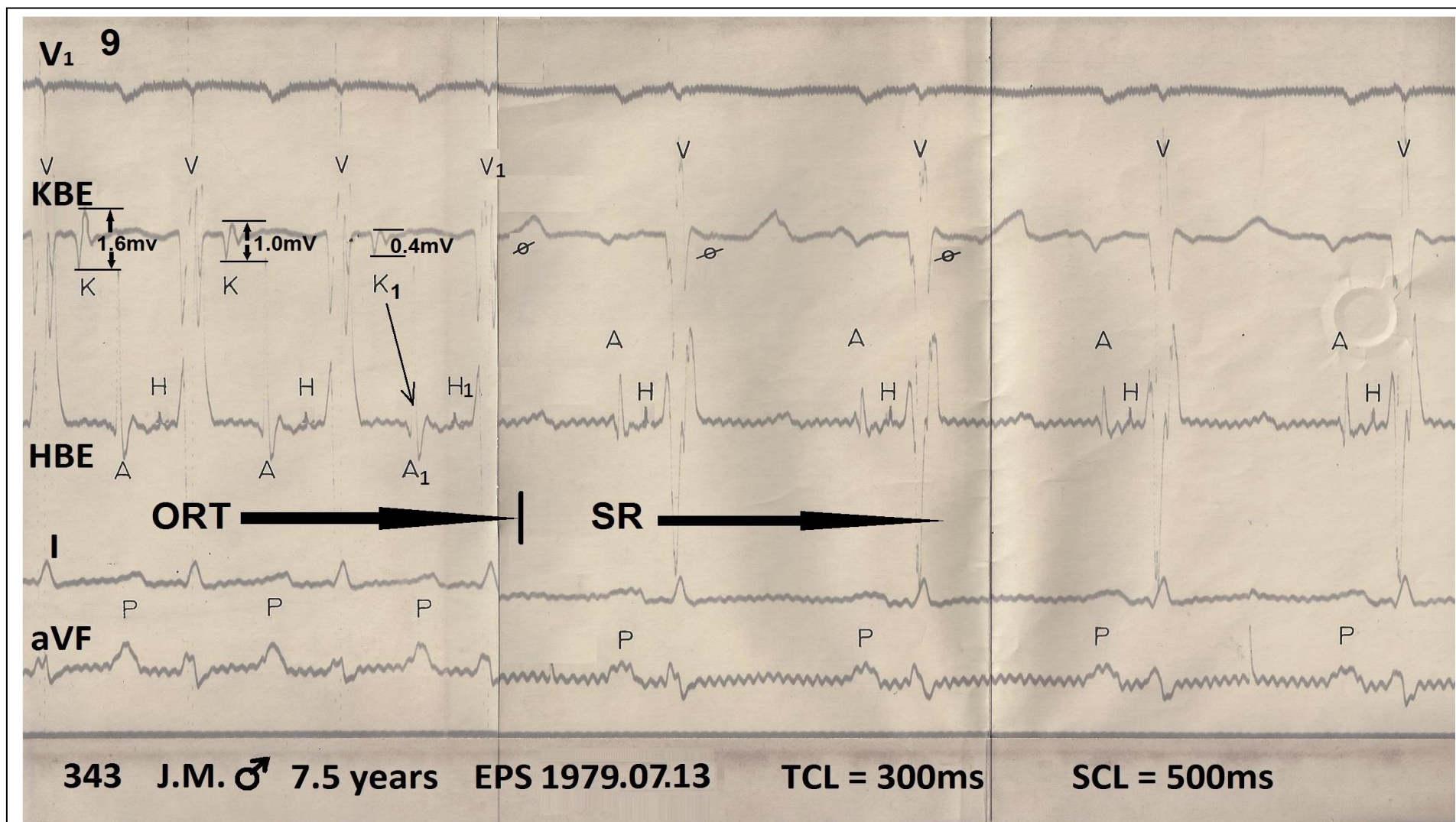
9 The laser method is **not arrhythmogenic or thrombogenic**. In contrast to RF laser treatment does **not increase D-Dimer Serum levels**



10 Regardless of myocardial wall thickness ≥ 20 mm after laser radiation at **15 Watts/ ≤ 60 ventricular lesions are allways transmural, and**

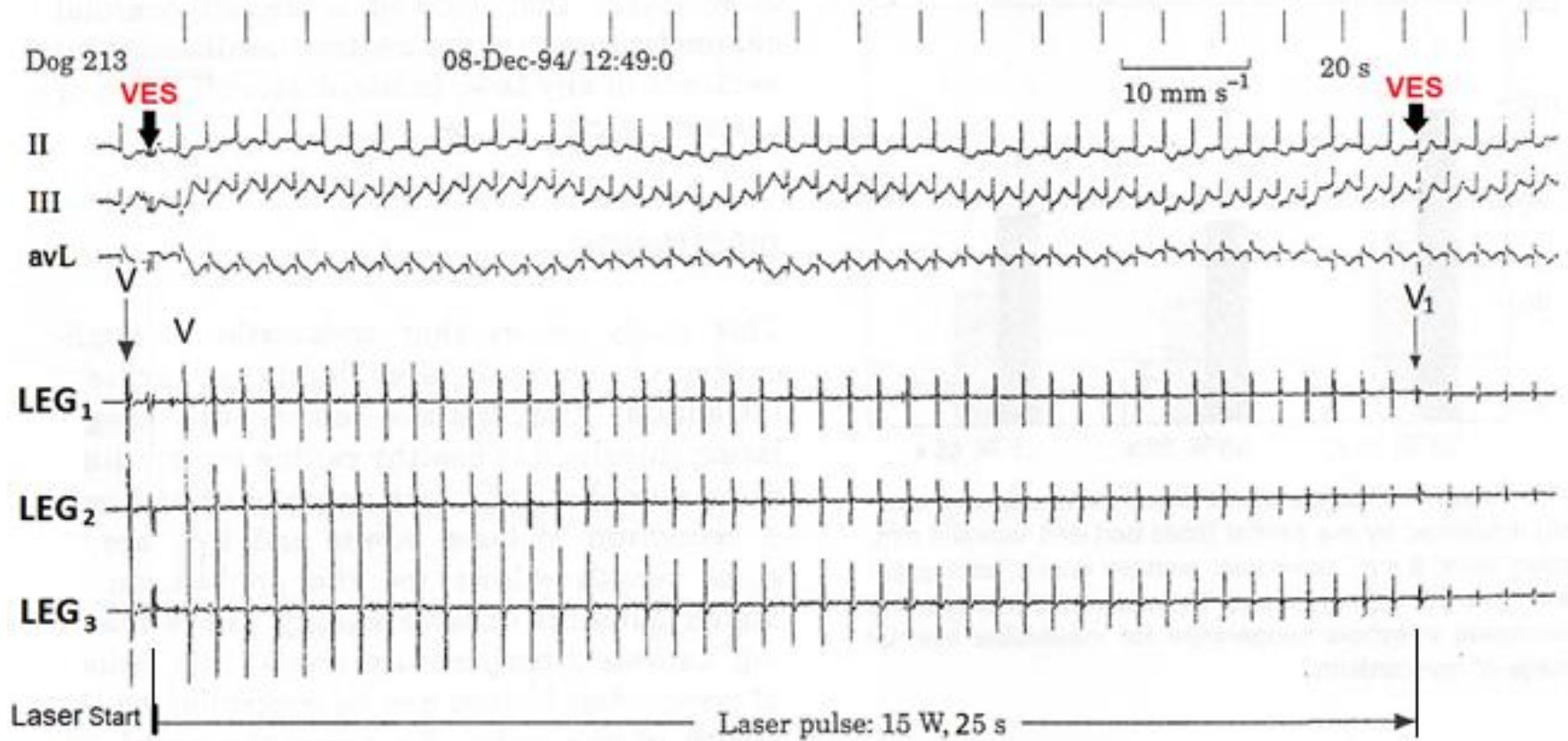


11 simultaneously the local electrical potentials in the **HD local mapping electrograms are abolished, Correlation Coefficient = 0.9**

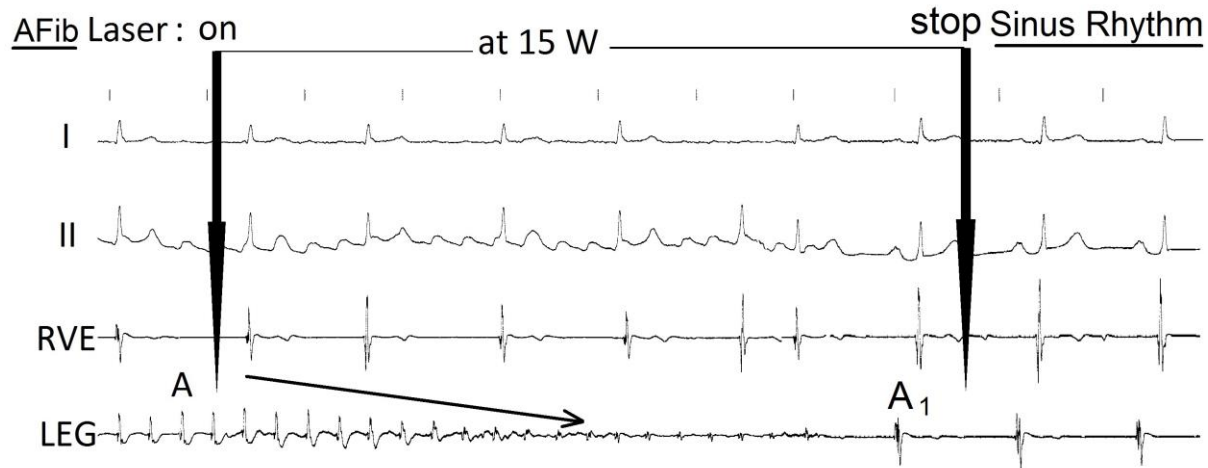


12 Interelectrode distances of $\leq 2\text{mm}$ allow for **high-density endocardial mapping (KBE)** and **localization of arrhythmogenic areas** in the heart

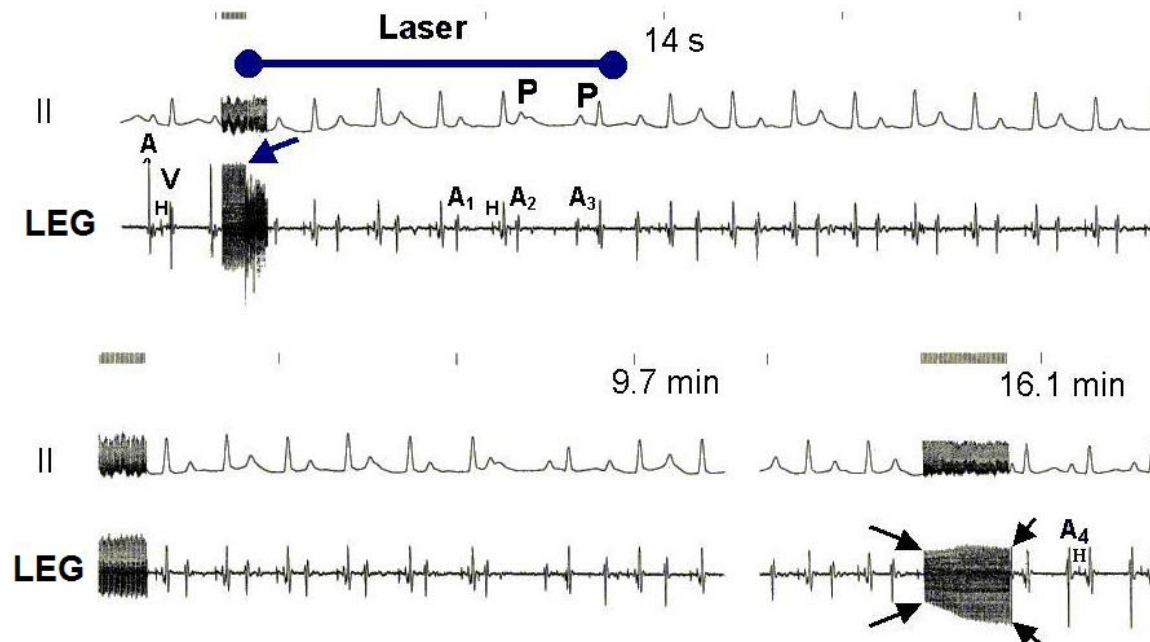
13 Here dwindling of the specific AP (K) potential amplitudes during **ORT** and recurrence to sinus rhythm (**SR**) simultaneously with their abolishment of K potential ∞ is shown. **Note:** prerequisite for high-density endocardial mapping, for localization of arrhythmogenic structures in the heart, is a detailed and complete manual, robotic or by magnetic navigation guided electrode catheter exploration of the heart chambers, during continuous monitoring of electrical potentials.



14 With the laser start electrical potential amplitudes in the high-density mapping electrogram **dwindle gradually**. With the laser stop the ventricular lesion is transmural (V₁). Simultaneously with the start and the stop of laser applications a **ventricular extrasystole** is induced (VES)



15 Laser applications at 15W aimed at the left atrial posterior wall can achieve transmural lesions in less than 5 s and ablation of chronic persistent long-lasting atrial fibrillation. The laser method is a low power short duration – a **low energy ablation method**. The electrophysiologically guided ablation allows for a **systematic approach** with simultaneous **validation of initial success**.



16 After the abolishment of local potential amplitudes in the high-density mapping electrograms **ablation result is permanent**. However, if radiation is **stopped prior to permanent potential abolishment**, amplitudes will recover and the lesion produced is completely **reversible**. This is shown here with an example of AV-nodal laser application.

The novel Laser Catheter Ablation System is an unmet medical technology based on a key technology: the **laser**
Special claims of the open-irrigated Electrode-Laser Mapping and Ablation (ELMA) catheter System **RytmoLas®**:

1. It is an **open-irrigated, non-contact** method of transcatheter laser application.
2. Inter-electrode distances of ≤ 2.0 mm allow for **High-density-mapping**,
3. thereby side-selective **localization of arrhythmogenic substrates** such as reentry pathways or arrhythmogenic foci is achieved
4. Ablation is performed under **normothermic conditions** while avoiding interfering with the electrophysiologic monitoring principles
5. Lesions are produced by **selective absorption of the laser light** in myocardium, the **catheter itself is not heated up**
6. Online monitoring of the abatement of **electrical potential amplitudes** during laser application represent an immediate and real-time verification of the **success of treatment**.
7. With the **permanent abolishment** of potential amplitudes laser **lesions are transmural** (correlation coefficient 0.9),
8. Transmural lesions are achieved regardless of **position of the catheter** upon the endocardial surface, perpendicular or flat
9. Transmural lesions can be achieved by laser applications at powers of 10-15 Watts within 5-30 seconds. The laser method is a Low Power - Short Duration (**LPSD**) ablation method
10. Lesions are achieved **without pressure** upon the endocardial surface, even without intimate catheter-endocardial contact
11. Homogenous distribution of the photon energy in myocardium produces **clear-cut homogenous lesions** of coagulation necrosis
12. **without** shrinking or aneurysm formation of the myocardial wall.
13. Unhindered photon penetration through fibrous tissue allows for **ablation of remnant viable myocardium** within scars.
14. Premature stop of laser application, prior to the abolishment of potential amplitudes, results in transitory **reversible lesions**, and.
15. potential amplitudes as well as histological tissue changes can **recover completely** within minutes.
16. Laser lesions are **not arrhythmogenic**, are **not thrombogenic**, and **do not** jeopardize irradiated vessels
17. The laser catheter is MRI compatible

The special claims of the Laser Catheter Ablation System are published in peer reviewed scientific journals and book contributions.

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