Investigation of selective retina treatment (SRT) by means of 8 ns laser pulses in a rabbit model.

BACKGROUND: It has been shown that selective retina treatment (SRT) using a train of 1.7 microseconds laser pulses allows selective damage of the retinal pigment epithelium (RPE) while sparing the adjacent photoreceptors and thus avoiding laser scotoma. It was the purpose of this work to investigate SRT laser effects with Q-switched pulses of only 8 nanoseconds in duration by evaluating the angiographic and ophthalmoscopic damage thresholds and the damage range by histology in a rabbit model.

MATERIALS AND METHODS: A flash lamp pumped frequency doubled (532 nm) Nd:YAG laser with 8 nanoseconds pulse duration was used. In total 210 laser lesions, each calculated to be 102 microm in diameter on retina, were applied through a slit lamp onto the fundus of six eyes of Chinchilla Bastard rabbits. The rabbits were irradiated with increasing energies with single pulses and a train of 10 laser pulses at 10 Hz. After treatment fundus photography and angiography were performed to determine the damage thresholds (ED(50)-probability of RPE cell damage and neurosensory retinal damage) as well as the safety range between both thresholds (ratio of angiographic ED(86) vs. ophthalmoscopic ED(14)). Selected histology was taken for single and repetitive pulse lesions after treatment. RESULTS: Angiographic and ophthalmoscopic ED(50)-thresholds decreased with
increasing number of pulses. For single pulse application ophthalmoscopic and angiographic ED(50) were determined to 365 and 144 mJ/cm(2), respectively. Regarding 10 pulses 266 and 72 mJ/cm(2) were found. No retinal hemorrhages or disruptions were observed for both sets of parameters. The therapeutic window between angiographic and ophthalmoscopic threshold revealed a factor of 3.1 for single pulses and 2.3 for repetitive pulse irradiation. The safety range respectively had a factor of 0.8 (single pulses) and 1.7 (10 pulses). Histologic examination of laser lesions with single and repetitive pulses at radiant exposures within the therapeutic window-292 and 213 mJ/cm(2) respectively-revealed damaged RPE, intact Bruch's membrane and choriocapillaries. Photoreceptors were partly spared but also damaged to various extents. CONCLUSIONS: Short laser pulses of 8 nanoseconds pulse duration can damage the RPE without retinal hemorrhage or disruption. Selective damage of the RPE without affecting the photoreceptors can only rarely be achieved due to the small safety range. Thus, so far microsecond laser pulses for SRT seems favorable compared to nanosecond pulses in order to prevent unintentional photoreceptor damage.