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Review of Grant for Research on Laser Damage to Monkey Retinas

"The effect of single and repetitive neodymium and frequency-doubled neodymium laser irradiations on cumulative prior light- and dark-adapted monkey retinas (especially the macula)" by Bessie Borwein and Martin J. Hollenberg.

Nedim C. Buyukmihci

I am glad to provide a critique of the above grant application. I am a vision scientist with considerable experience with retinal disease, as my publications document.

In general, the proposal is fragmented and disjointed. The introduction is long and confusing. It reads like an attempt to show how well-read the investigators are, but it does not bear succinctly on the proposed work. This appears to be a militarily-based project, because the authors state, "These experiments simulate the exposures of combat personnel to e.g. neodymium laser rangefinders on tanks, in day-time and night-time conditions."

The investigators plan to expose the maculas and peripheral retinas of cynomolgus macaques to laser light, and then the animals will be killed 1 hour and 24 hours later. Borwein and Hollenberg claim that this study will reflect the disturbance in retinal *function* by the laser. The study, however, is only *morphological* and there can be *no* determination of what effects the exposures may have on function. In addition, the study will look only at the *short-term* effects of the exposure. There will be no evaluation of changes over a long period of time. It will not be possible to determine if any induced microscopic changes persist for any length of time.

It is well established in many species, including humans, that lasers damage the retina. Given the known hazard of lasers, the most important questions involve means of laser light *attenuation*. This study does not address this issue.

The originality and applicability of this research are questionable. The investigators note that Zwick et al. have shown that laser light can cause major retinal damage. In addition, they cite references which indicate that the human retina is much *less susceptible* than monkeys to the effects of lasers. What relevance, then, will data collected from this study have for the human situation? Finally, although the investigators claim that these experiments have not been done before, there have been similar experiments with rhesus monkeys, and there is little difference between rhesus and cynomolgus retinas. I could see no substantial differences that suggested this study would provide important new information.

There are some specific methodological problems. The exposure of the monkeys does not approximate what would happen in humans. The monkey eyes will be stationary in order to receive constant laser irradiation. In contrast, human eyes move, changing the exposed area of the retina. In addition, humans periodically blink, and it is not stated in the protocol whether the monkeys will be allowed or be able to blink. Finally, after the monkeys are dark-adapted, there may be five minutes or more of light adaptation in order to focus the laser. This may cause *major* changes in the effects of the laser under the subsequent dark-adapted conditions. There is no control for this - a potentially serious omission.

In summary, I do not believe this project is worthwhile from a scientific viewpoint. It will not produce substantially new information. It will not measure the *functional* deficits caused by laser exposure, these deficits being of primary importance to humans who may be exposed to lasers. It will examine only the very short-term effects of laser exposure; long-term effects, which are of major concern to humans exposed to lasers, will not be examined. Consequently, this study cannot account for regeneration of photoreceptors of the retina, which can be considerable under certain circumstances. Because there is a very large body of knowledge on the effects of various lasers on the retinas of *humans*, this study is most unlikely to contribute to that literature. This study, therefore, appears to be a waste of nonhuman primate lives, resources, and money.

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