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Lasers in medicine

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In the late 1950s Gordon Gould, an American physicist, then at Columbia University, worked on the development of an apparatus to emit intense, narrow beams of light. The heading he gave to the respective pages in his research notebook read 'Some rough calculations on the feasibility of a LASER: Light Amplification of Stimulated Emission of Radiation'.[1] He thereby not only initiated the development of a continuously increasing armamentarium of devices emitting monochromatic, coherent light, essential today to almost all aspects of research and technology and integral to everyday life but also coined the acronym for these machines – lasers, that is now present in (presumably) the dictionaries of all languages and has become part of everyone's vocabulary. In everyday speech it has even lost its acronymic origin, becoming a generic term for a technology presumed to be advanced, versatile, powerful, and fashionable. The fame of firing off the first laser beam belongs to Theodore H. Maiman, who at Hughes Research Laboratories in 1960 built, presented to the public, and published the first working laser using ruby as a medium.[2] Hazards and potential use of lasers in medicine were immediately recognized and already in 1961 the Gould group envisioned their biomedical application in ophthalmology in their work entitled 'Physiologic implications of laser beams'.[3]

Eyes and skin, the two naturally light exposed mammalian organs, became the primary targets of research on the harmful and beneficial effects of high-intensity, monochromatic optical radiation. Starting with using laser beams as 'light-knives' already in the 1960s, technological progress enabled the development of selective photothermolysis, allowing for the specific thermal destruction of unwanted tissue components leaving minimal collateral damage.[4,5] 60 years after its invention, almost all fields of clinical and experimental medicine take advantage of the unique physical properties of lasers, which can now provide light of almost any colour (extending even into the ultraviolet and infrared regions), spot size, and intensity. In some specialties laser applications have become an indispensable standard (*e.g.* ophthalmology and dermatology). Other uses still under investigation include low intensity lasers of various colours for the treatment of almost all kinds of ailments (photobiomodulation, low level laser therapy, LLLT).

This web collection entitled 'Lasers in medicine' aims to provide a selection of papers directed towards clinicians and interested researchers alike to highlight some current developments of laser applications in different medical areas.

The question of evidence in photobiomodulation is tackled by Heiskanen and Hamblin (DOI: 10.1039/C8PP00176F), who address the requirement for light coherence to achieve biological response, and by Silveira *et al.* (DOI: 10.1039/C9PP00120D), who carried out a systematic literature review on benefits and risks of photobiomodulation applied as a supportive care measure in head and neck cancer patients. Novel aspects of laser removal of vascular lesions and unwanted tattoos are discussed and impressively illustrated in the papers by Just *et al.* (DOI: 10.1039/C8PP00264A), Zutt (DOI: 10.1039/C9PP00079H), and Bäumler and Weiß (DOI: 10.1039/C8PP00416A). Lasers are not only used for skin surgery but increasingly also for high-resolution skin imaging. Novel avenues to enhance the information gained with these non-invasive techniques are described in the papers by Liu and Drexler (DOI: 10.1039/C8PP00471D) and Andreana *et al.* (DOI: 10.1039/C8PP00410B). The state of the art of *in vivo* confocal microscopy for the differentiation of innocent *versus* malignant pigmented lesions of the face is provided in a perspective by Farnetani *et al.* (DOI: 10.1039/C8PP00525G). As mentioned, ophthalmologists were the first to apply therapeutic lasers in the clinic and the perspective by Moussa *et al.* (DOI: 10.1039/C9PP00039A) shows using the example of ultrashort pulse lasers in corneal surgery that progress is still ongoing. Finally, demonstrating that laser surgery is not only useful and advantageous at the body surface, Fajkovic *et al.* (DOI: 10.1039/C8PP00409A) provide a perspective on the advances of laser surgery in urology.

I feel privileged to have been given the opportunity to coordinate this

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themed collection and I am grateful to the authors for their fine contributions and for the efforts, diligence, and expertise they have put into their work, to the referees for their indispensable and highly competent (although invisible) input, and to the Editor-in-Chief for his always helpful and supportive advice.

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