Nanotechnology in Plastic Surgery

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Background: Nanotechnology has made inroads over time within surgery and medicine. Translational medical devices and therapies based on nanotechnology are being developed and put into practice. In plastic surgery, it is anticipated that this new technology may be instrumental in the future. Microelectromechanical systems are one form of nanotechnology that offers the ability to develop miniaturized implants for use in the treatment of numerous clinical conditions. The authors summarize their published preliminary findings regarding a microelectromechanical systems–based electrochemical stimulation method through modulation of ions around the nerve that is potentially implantable and clinically efficacious, and expand upon current and potential usages of nanotechnology in plastic surgery.

Methods: Sciatic nerves ($n = 100$) of 50 American bullfrogs were placed on a microfabricated planar gold electrode array and stimulated electrically. Using Ca^{2+}-selective membranes, ion concentrations were modulated around the nerve environment in situ. In addition, a comprehensive review of the literature was performed to identify all available data pertaining to the use of nanotechnology in medicine.

Results: A 40 percent reduction of the electrical threshold value was observed using the Ca^{2+} ion–selective membrane. The uses of nanotechnology specifically applicable to plastic surgery are detailed.

Conclusions: Nanotechnology may likely lead to advancements in the art and science of plastic surgery. Using microelectromechanical systems nanotechnology, the authors have demonstrated a novel means of modulating the activation of nerve impulses. These findings have potentially significant implications for the design of special nano-enhanced materials that can be used to promote healing, control infection, restore function, and aid nerve regeneration and rehabilitation. (*Plast. Reconstr. Surg.* 130: 879e, 2012.)

Microelectromechanical systems technology focuses on creating functional implants that function on the nanoscale and utilize electromechanical elements constructed using microfabrication techniques. These devices can range from a few millimeters to the submicron level (Fig. 1).[1] This technology involves the integration of several microcomponents on a single chip to create a microsystem that can both sense and affect the environment. Nanotechnology takes advantage of the fact that the properties of materials change at the nanoscale. Combining the two in a process called heterogeneous integration enables microelectromechanical system devices to have broad applications in other industries, including biomedicine (detecting and curing diseases), energy systems (stretching the world's resources and reducing pollution), security systems, and consumer applications (televisions, mobile devices) (Table 1).[1,2] The term nanomedicine is used to describe the current applications of nanotechnology in the screening, diagnosis, and treatment of disease.[3] It has been estimated that the U.S. market for nanotechnology medical products will increase to $53 billion by year's end, doubling over the course of the next 5 years.[4] A leading international business research company, the

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