CRISPR gene editing will find applications in plastic and reconstructive surgery

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The CRISPR genome editing technique promises to be a "transformative leap" in genetic engineering and therapy, affecting almost every area of medicine. That includes plastic surgery, with potential advances ranging from prevention of craniofacial malformations, to therapeutic skin grafts, to new types of rejection-free transplants, according to a paper in the November issue of *Plastic and Reconstructive Surgery*, the official medical journal of the American Society of Plastic Surgeons (ASPS).

"CRISPR's potential impact on treating human disease includes several areas important to the plastic surgeon such as oncology, wound healing, immunology, and craniofacial malformations," comments ASPS Member Surgeon Eric Chien-Wei Liao, MD, Ph.D., Director of the Cleft and Craniofacial Program, Laurie and Mason Tenaglia MGH Research Scholar, Massachusetts General Hospital, Harvard Medical School. In a special regenerative medicine article, Dr. Liao and coauthors review the history and mechanisms of CRISPR genome editing, highlighting its potential uses and impact in plastic and reconstructive surgery.

CRISPR Has Implications for Congenital Malformations, Wound Healing, Transplantation and More

CRISPR—the abbreviation stands for "clustered regularly interspaced short palindromic repeats—was discovered as an adaptive immune mechanism in bacteria. Before the development of CRISPR techniques, gene editing was labor intensive and limited to laboratories with advanced molecular biology tools.

"CRISPR gene editing is revolutionizing the potential of gene therapy due to its simplicity, specificity, efficiency, low cost, and versatility," Dr. Liao and coauthors write. "Potential applications of CRISPR are numerous and will certainly impact plastic and reconstructive surgery."

The authors discuss some key areas where CRSIPR has foreseeable implications for plastic surgery, including:

- *Craniofacial Malformations*. Basic science studies using CRISPR techniques have already led to new insights into craniofacial developmental pathways. CRISPR enables quick identification of individual gene mutations, and may one day lead to the ability to correct mutations and prevent the development of cleft lip, cleft palate, and other congenital malformations.
- *Wound Healing and Tissue Repair*. Gene therapy is a promising approach to enhancing wound and tissue healing. In addition to accelerated healing of skin wounds, CRISPR may lead to new approaches for repair and regeneration of bone, cartilage, nerve, and muscle.
- *Cell Therapy and Tissue Engineering*. Genetic techniques may enable the creation or modification of the patient's own (autologous) cells to graft or replace damaged tissues, stimulate cell development, or modulate immune functions. "[Techniques] of creating skin grafts with therapeutic potential would have widespread impact in reconstructive surgery," Dr. Liao and coauthors write.
- *Flap Biology and Transplants*. In addition to modifying tissue flaps, gene editing with CRISPR may make it possible to reprogram vascularized composite allotransplants—such as face

> or hand transplants—to promote tolerance and prevent rejection by the recipient's immune system. Similar immune modulation approaches might also promote tolerance of tissues from animal donors (xenotransplantation).

Dr. Liao and colleagues emphasize that many challenges remain in realizing these and other clinical advances with CRISPR gene editing, including potential "off-target" effects, FDA regulation and high costs, and ethical issues related to genetic editing of human cells and tissues. The authors write, "The ASPS and its members should become stakeholders as well, and participate in future debates on the ethical use of CRISPR for the betterment of our patients."

More information: Danny S. Roh et al. CRISPR Craft, *Plastic and Reconstructive Surgery* (2018). DOI: 10.1097/PRS.0000000000004863

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