The advances in medicine that have occurred in the past 60 years are nothing short of astounding and we are accelerating at an ever increasingly rapid pace. The human genome, molecular genetics, and the manipulation of the genetic code have ushered in personalized medicine as a new frontier.

The foundation for this revolutionary change began in 1953 when Watson and Crick characterized DNA as the double helix nature of amino acids and proteins consisting of 2 biopolymer strands coiled around each other. DNA sequencing of the entire human genome followed, and the Human Genome Project was completed in 2003 at a cost of $3 billion. Soon thereafter, clustered regularly-interspaced short palindromic repeats (CRISPR), which is a normally occurring bacterial process, came into existence. Bacteria may incorporate foreign DNA and even scavenge damaged DNA from their foreign environment. These clustered repeats were first described in 1987 by Ishino et al of Osaka University for the bacteria Escherichia coli (E coli). Shortly thereafter, CRISPR was shown to work as a genome editing tool in human cell culture. This advance, made by Jennifer Doudna and Emmanuelle Charpentier working independently, has the potential to eliminate genetic disease by making changes to our DNA. They devised a synthetic guide RNA that could be used for gene editing. The CRISPR interference technique has enormous potential application, including altering the germline of humans, animals, and other organisms. Altering an organism’s genome by gene editing and regulation will generate revolutionary changes in the way we treat patients in the future, but it has raised concerns of the prospect of editing the human germline. The future of medicine seems limitless, and conceivably we may be able to add telomeres to our chromosomes and enhance our life expectancy.

Patient-specific treatments and precision medicine and surgery personalized to the specific patient’s DNA are advancing in every medical and surgical subspecialty, including spine surgery. These new diagnostic approaches are paving the way to identifying the molecular basis of disease and treating patients based on their individual genomics.

Personalized, patient-specific medicine and precision surgery are shaping technology that is being used for spine surgery. The first of the following 3 Trending in Orthopedics articles discusses patient-specific rods. The second article addresses treating the sacroiliac joint with minimally invasive techniques personalized to the individual spine using 3-dimensional navigation. The third article, about patient-specific templating of lumbar disk replacement to restore normal anatomy, discusses development of a tool to determine optimal placement and size for total disk replacement. These advances are occurring in all areas of our specialty. Orthopedics looks forward to publishing more about this new frontier.

REFERENCES


