

2020 PSBR High School Essay Contest
Finalist

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Medicine is constantly evolving, following the exponential pace of technological innovation, and it is the application of these discoveries that is altering humanity. Diseases have been eradicated through the creation of vaccines, medical conditions that used to be fatal have become manageable, and quality of life of those with a variety of medical conditions is increasing - all due to biomedical research. I am one of those individuals whose life has been impacted by multiple forms of biomedical achievement by undergoing the MACI procedure following years of debilitating congenital knee defects.

Six years ago my life changed when my first knee subluxation occurred. What was supposed to be a simple soccer injury revealed to be genetic anomalies in my knees that make them unstable causing me to have 12 additional dislocations, undergo seven surgeries, and spend countless hours in hospitals and physical therapy. My life has had a deep connection to biomedical research with treatment of my disorders not being able to occur without it. From the knee braces that I wear daily, to the creation of the medical equipment used to reposition my tibia, there is a connection. The most innovative treatment that I have undergone is the MACI procedure.

Throughout the many injuries I have sustained, I have destroyed the majority of the atherocartilage that cushions the knee joint, developing incurable arthritis at a young age. However, the MACI procedure is a means of combating such damage through the implantation of the MACI implant that consists of a collagen membrane embedded with a patient's own chondrocytes biopsied and grown from existing cartilage of the joint. Chondrocytes have the capability to generate matrix proteins in a chondral defect and reduce the painful bone on bone contact that is experienced with the arthritis (UNLOCKING THE POTENTIAL OF YOUR PATIENT'S OWN CELLS).

"Cell therapy is the infusion, injection or transplantation of whole cells back into a patient for treatment of a condition" (Advanced Cell Therapies). The MACI procedure is cutting edge cell therapy in the field of tissue regenerative studies conducted by biomedical engineers at Vericel Corporation. The MACI graft is a type of autologous cell therapy in which a patient's own cells are used to create the chondrocyte scaffolding that stimulates the regrowth of fibrocartilage to repair cartilage defects. The company based in Cambridge, Massachusetts uses an innovative cell-processing technique that puts a sample of cells under cellular expansion specific to a patient's need (Advanced Cell Therapies).

Commonly overlooked by the medical achievement itself, is the important role animals play in allowing for a procedure such as MACI to occur. Although the graft is constructed from a patient's own cells, the base of the scaffolding is a porcine collagen membrane (Full Prescribing

Information). The membrane is necessary as a structural basis the body is able to reabsorb for attachment of the chondrocytes implanted onto the cellular patch (A step-by-step guide to the MACI procedure). Additionally, it is because of animals that the MACI procedure was approved for clinical trials. Rabbits and horses were used to test the vitality of the procedure by creating a graft using the same porcine base membrane, but using the animal's own cells to monitor what reaction would occur in their joints. These tests concluded that the membrane was "non-toxic and compatible with biological tissue" (Full Prescribing Information).

Due to the success of the MACI procedure during animal trials, the clinical trials were able to be conducted. The two-year trial composed of 144 patients paired into two groups of 72, comparing the effectiveness of the graft to a microfracture procedure in which small fractures made in underlying bone stimulates cartilage formation (Commissioner, O; Knee microfracture surgery: MedlinePlus Medical Encyclopedia). With the addition of a three-year follow up study, it was concluded that the overall data proved the MACI implant had more long-term benefits than the other procedure (Commissioner, O). It is because of these findings that patients like me are able to have relief of the painful symptoms of cartilage damage and arthritis, which also is attributed to the animal origin that allowed for it all to occur.

Biomedical research is and will continue to be the future of medicine. It is a necessary branch of STEM in the improvement of human lives through the treatment of medical ailments. From the animal origins to the clinical trials that resulted in the FDA approval of the MACI procedure, it has had the ability to improve the lives of many, including myself.

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