Most people have not given their baby teeth a thought since the days of recess and multiplication tables. Even Dr. Songtao Shi, Chair and Professor in Penn Dental Medicine’s Department of Anatomy & Cell Biology, had not given them much attention until his young daughter lost her first tooth. It was then he became struck by the potential hidden within these seemingly inconsequential baby, or deciduous, teeth.

“I examined the tooth after it came out and noticed a tiny bit of rosy tissue stuck to the root end. By the time I realized this tissue was dental pulp, the living part of the tooth, it was too late to extract any cells from it,” Dr. Shi recalls. “But I couldn’t shake the suspicion that the pulp of the baby tooth might contain some interesting biological characteristics.”

DISCOVERY IN AN UNEXPECTED PLACE

Dr. Shi’s instinct proved correct. When the next tooth started wiggling, he was prepared with a test tube of culture medium. In the lab, he extracted from the dental pulp a unique type of stem cell, which he termed SHED cells (Stem cells from Human Exfoliated Deciduous teeth)—a member of the mesenchymal stem cell family. Like other types of stem cells, mesenchymal cells are found in tissue and organs throughout the body, including the tendons and bone marrow.

Since they occur naturally in tooth pulp, Dr. Shi realized these cells could be used to treat a breadth of diseases in a cost-effective manner. In fact, they multiply more rapidly and live longer than previously studied adult stem cells. They are also capable of differentiating into dental pulp and neural and fat cells, making them highly valuable in diverse treatment settings.

This discovery revealed an abundance of new opportunities to improve standards of care for both dental and autoimmune diseases. Dr. Shi has used SHED cells to regenerate dental tissue in an animal model in order to restore gum tissue in cases of periodontal disease. The success of this research has led to clinical trials, currently underway, to find out whether stem cells from dental pulp and periodontal ligament could help regrow dental pulp—an approach that could revolutionize the root canal, one of the most common and bemoaned dental procedures.

“Dentistry is primed for a shift beyond the very traditional practices that have been standard for decades,” Dr. Shi says. “The beauty of being a clinician and a researcher is that you can conceptualize new treatments at a mechanical level, but also envision their path to the patient.”

Spurred by the hidden potential of a baby tooth, Dr. Songtao Shi uncovers new treatments for difficult disorders

Moving the Entire Medical Field Forward

Dr. Songtao Shi
PROMISING OUTCOMES FOR LUPUS AND BEYOND

Another condition whose treatment could be revolutionized by mesenchymal stem cells is lupus, an autoimmune disease characterized by fatigue and joint pain. In a first-of-its-kind clinical trial, Dr. Shi demonstrated that lupus patients greatly benefited from receiving a transplant of SHED cells, which improve the functioning of bone marrow stem cells by providing a key protein called Fas. Beyond lupus, these findings have implications for other diseases in which stem cell transplants have shown promise.

“We could treat 40 to 50 lupus patients with just one baby tooth using our treatment method. This success has the potential to improve quality of life and decrease the cost of care for people with a wide array of diseases, from diabetes to arthritis,” Dr. Shi says. “Baby teeth, and the mesenchymal cells they contain, are poised to move the entire medical field forward.”

PROGRESS FOR PATIENTS FROM BENCH-TO-BEDSIDE

Alongside his work on the applications of SHED cells in new biological therapies, Dr. Shi continues to seek a deeper understanding of the biological mechanisms behind these treatments in order to harness their full potential.

“Our work runs the gamut from basic to translational research. We are in the unique position to change the game on both sides of the field,” Dr. Shi says. “When it comes down to it, we are really only asking one question: how can we benefit the patient?”

The stem cells Dr. Shi was able to isolate from the dental pulp were a new breed. Dr. Shi termed the cells SHED, for stem cells from human exfoliated deciduous teeth.

MORE INFORMATION

For more information on how to support the research of Dr. Shi, contact Elizabeth Ketterlinus, Senior Associate Dean for Development & Alumni Relations, ekett@upenn.edu, 215-898-3328.