conducted, but decided he needed to know more: he watched two autopsies at the Institute of Legal Medicine in Lyon, which was founded by Lacassagne. One of the dead bodies had been decomposing for weeks in an abandoned building. The experience gave Starr a whiff of what someone like Lacassagne may have experienced, in an era before refrigeration was common. The stench, he writes in his book, “is a mixture of every repulsive odor in the world—excrement, rotted meat, swamp water, urine—and invades the sinuses by full frontal assault.”

Starr also tracked down the scientist’s descendants. He interviewed Lacassagne’s great-grandson, a physician, and his great-granddaughter, now a judge in Lyon, who allowed him to go through cartons of her great-grandfather’s belongings. He learned that Lacassagne was a renaissance man who loved art, literature, and science, and who had an offbeat sense of humor. “He studied tattoos, which was an indicator of criminal culture,” Starr says, “and in addition to writing papers about it, he had them transcribed onto the family’s dinnerware. So a guest would be eating dinner and come to the bottom of his meal and see, in French, ‘Death to the authorities,’ or, ‘No hope for the future.’”

But Lacassagne’s life mission, Starr says, was to create standardized methods that would help solve crimes and that ordinary doctors could use. He designed autopsy procedures and compiled them in his *Handbook for the Medical Expert.* “The typical autopsy in the countryside might take place in a meadow at night, in the mist, or on some poor sucker’s kitchen table,” Starr says. “Horrible. He designed standard procedures where, if you follow his workbook, you will do more or less the right thing.”

The advances that Lacassagne and his colleagues made would not have been possible without progress in chemistry, bacteriology, microscopy, and other fields. Criminologists “realized you could use evidence to tell the truth,” Starr says, “and that if you were clever enough and methodical enough and had clear procedures, you could go to a crime scene and reconstruct what had happened.”

At the same time, some of their research methods were decidedly rudimentary. Starr recounts how Lacassagne, in investigating the case of an old man who had been shot, found that bullets have distinctive grooves that could be traced to a particular gun. “He takes the body and the gun back to Lyon and calls a neighboring hospital,” Starr says. “‘I need a body this age, this weight— anybody die recently?’ They send it over, and he starts shooting it. And he starts seeing a pattern. Soon he put out a paper with about 26 typical bullets and their striations, and this is ballistics.”

So what is Lacassagne’s legacy? Starr says it’s difficult to separate him from his colleagues near the turn of the century. “It’s the blossoming of modern forensics,” he says, “the real understanding that evidence can tell a story. Lacassagne had procedures to keep the evidence clean, chains of custody, just like today. It really got the field started in a meaningful way.”

---

The Whole Tooth and Nothing but the Tooth

SDM Researchers’ Tooth Regeneration Could Eliminate Root Canals, More

BY CALEB DANILOFF

Mey Alhabib’s mice just might put the Tooth Fairy out of business.

Alhabib, a postdoctoral student and endodontic resident at the Henry M. Goldman School of Dental Medicine, and her research supervisor, George Huang, the Herbert Schilder Chair in Endodontics and director of the school’s postdoctoral program in endodontics, have begun regenerating two major human tooth components—dental pulp and dentin—using fresh stem cells from baby teeth, which are often tossed after being placed under kids’ pillows, as well as from third molars, or wisdom teeth.

Those components could then be used to regrow damaged or decayed parts of a mature tooth, one day eliminating the need for invasive procedures like root canals and dental implants, as well as expensive crowns.

“It’s the future of treating clinical diseases,” says Alhabib (SDM ’12,’14), who hails from a family of dentists in Saudi Arabia. “The most interesting thing is that you can isolate stem cells from teeth, put them in the culture medium, and freeze them. And they’ll be there for years.” The culture medium is a liquid nutrient that cultivates cell growth.

In a unique procedure, Alhabib harvests dental stem cells from third molars—taken from patients at BU’s Dental Center—and seeds them into a scaffold,
Dental stem cells remain viable for about a week after extraction if they are stored properly.

A miniature sponge-like carrier. The scaffold is inserted into an extracted human tooth and then implanted into the body of a mouse, which serves as a substitute blood supply for tissue regeneration. After three months, if successful, the tooth is removed from the rodent with the regenerated dentin and dental pulp.

When the technology reaches humans, the scaffold would be implanted directly around the broken or decayed tooth and the empty root canal space would eventually fill with pulp-like tissue, and dentin-like tissue would regrow on the dentinal wall. But that’s years away. The next phase of Huang and Alhabib’s research will involve working with the teeth of large animals, such as pigs.

“We could regrow the lost structure without having to make a big crown, just do some minor patching,” says Huang (SDM’88,’89,’92). “We have data in animals that indicate that it’s a real possibility. Normally, we just discard wisdom teeth and baby teeth. Now we’ll definitely advocate to preserve them.”

In related research, Huang and Alhabib have successfully reprogrammed dental cells into embryonic-like cells—called induced pluripotent stem (iPS) cells—which may prove an unlimited source for tissue regeneration, and perhaps eventually whole teeth.

Until now, scientists had been able to create iPS cells from mice or from certain types of human cells such as fibroblasts, which are considered important cellular elements of tissue integrity. But all three types of human dental stem cells Huang and Alhabib tested were easier to reprogram than fibroblasts, previously considered the best way to make human iPS cells. Huang is quick to point out that regrowing a whole tooth from scratch, while being tested in large animals, is a ways off for humans.

“There's always new technology replacing old technology,” Huang says. “Nowadays, dental implants are very successful. You get a tooth pulled, you put in an implant. But it took 30 to 40 years to get to this stage. Perhaps in the future, we’ll be regrowing a whole tooth, and that may take 30 years, but once the technology is mature, it may replace dental implants.”