

## *3-D Printed Implant Gives Patches the Dachshund a New Skull*

By **Christine Hauser**

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Last year, Patches the dachshund earned the nickname Little Unicorn after she developed a large tumor that jutted out of her forehead.

Now, with the tumor gone, her Pennsylvania family calls her Titanium Top.

Those terms of endearment for the 9-year-old dog trace the narrative of how Patches became a case study in 3-D medical printing, a developing frontier in the field of reconstruction surgery in animals.

In March, American and Canadian veterinarians removed a tumor from Patches's head that was so large they had to carve out as much as 70 percent of her skull.

So they made Patches a new "skull" to cover the gap. The team members used 3-D printing to tailor a titanium plate to match what was left of the bone. Then they implanted the custom-made plate in Patches's head like a puzzle piece.



“The plate fit,” said Dr. Michelle Oblak, a veterinary surgical oncologist with the University of Guelph’s Ontario Veterinary College, who worked on Patches during the operation at Cornell University College of Veterinary Medicine in Ithaca, N.Y. “It was quite jagged, so we had to follow the contour of the tumor.”

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Although the technology has existed since the 1980s, 3-D printers have been used in clinical applications only in recent years, mostly in veterinary teaching hospitals, according to a 2014 article in The Journal of the American Veterinary Medical Association.

The technology is used to make 3-D models from two-dimensional CT scans before operations on animals like horses and dogs, enabling surgeons to plot their approach before the first incision is even made.

“We use it for surgical planning,” said Dr. Frank Verstraete, a surgeon at the University of California, Davis, whose team has done dozens of lower-jaw reconstructions. “It saves us time in the actual operating room.”

3-D printing has also been used to make implants that replace damaged mandibles and leg bones, such as one placed in a young German shepherd with a limb deformity at Cornell in 2009.

But it has not entered mainstream use in surgery in small veterinary clinics. The costs associated with 3-D printed custom implants in surgery for disfigured or injured animals can be prohibitive. But some animals will not survive without such an implant.

That was the case with Patches, according to the team that worked on her.

Patches started to develop a small bump on her head several years ago, said Danielle Dymeck, a corrections officer in Pennsylvania who has raised the dog since she was 2 months old. The bump did not seem to bother Patches when she chased cows or frolicked with Ms. Dymeck's grandchildren.

But it grew quickly, alarming the family. Their local veterinarian referred them to Cornell University, where Dr. Galina Hayes, an assistant professor, took on a leading role in the treatment in February.

Patches's tumor soon became so large it "ran out of room on the top of her head," Ms. Dymeck said. It started to invade the eye cavity and press inward onto the brain, Dr. Oblak said.

"It was like a big orange on her forehead," she said.

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The tumor was so widespread that the veterinarians could see they needed to carve out more than half of the skull bone. But then they had to decide how to cover the vast gap. A common plate made of titanium mesh would leave too much of Patches's brain vulnerable to being compressed if it were hit by something.

"And that would be the end of Patches," Dr. Hayes said.

While there are off-the-shelf implants, custom-made 3-D implants are particularly good for dogs, Dr. Oblak said, because their skulls vary in shape, from the flat snouts of boxers to the long ones of greyhounds.

So the veterinarians settled on a custom 3-D printed titanium implant.

On March 22, Patches went into the operating room. The team used a high-speed drill to cut around the tumor so it could be removed without damaging the brain.



Patches after surgery. Now, her family calls her Titanium Top. Dr. Michelle Oblak

“We popped the plate on,” Dr. Oblak said. “It was amazing. It fit like a glove.”

The operation took about four hours. Ms. Dymeck said that she paid the medical costs but that the implant was provided by Adeiss, a Canadian company. The procedure was highlighted in an article by The Canadian Press on Sunday.

Ms. Dymeck said Patches had an unrelated back injury and recently had seizures, but the family does not know if the seizures are related to the skull surgery. “She is doing really well,” she said.

Dr. Verstraete, who said the Cornell operation was an “interesting development,” said his team uses commercially available implants in work that has involved mostly jaw reconstruction.

“We have not had the need for custom printing our own plates,” he said. “I think it is fair to say that as we make advances we will use more of it, but it will always be a small niche application.”

Dr. Hayes said the team was preparing its work for peer review in *The Canadian Veterinary Journal* as a case study.

She described the Patches operation as “unusual” rather than groundbreaking, and said its contribution could be for cases “where there is literally nothing else you can do than euthanize the animal.”

“I think this is still a technology we are figuring out how to incorporate into veterinary medicine,” she said. But, she added, “it is always going to be a niche demand, mainly because the cases that need it are fairly rare, but also because of the financial cost.”