

**NATHAN ROWLAND:** Hi. My name's Nathan Rowland. I'm one of the neurosurgeons here at MUSC. And today, I wanted to talk to you about a special case of cranial reconstruction.

One of our patients was in a moving vehicle and sustained an injury to the head, and that caused several skull fractures that needed to be replaced and repaired. As we were working, the brain was swelling to an extent that we were not able to place the bone back on as it was originally. And not only that, the bone was actually shattered in many places, so that in taking the bone off, we were not able to correctly and precisely fit all the pieces back together.

So we allowed the bone to remain off, the swelling went down eventually, and then we were able to think about how to reconstruct the skull at that point. We actually work with a cranial reconstruction team. So it's myself and another surgeon specifically trained in cranial facial reconstruction, and we work together to understand all of the nuances, and fine points, and details of the way that the skull would fit back onto the original area that we had removed it from.

So that included getting the eye, or the orbital reconstruction correct, the sides of the head correct, the top of the skull correct. So all of those angles in all of those areas had to come back neatly and precisely. So what we did was we actually had the patient undergo a very precise CT scan, so that would be millimetric or submillimetric precision CT scan.

And in that case, we had several slices of the CT scan to work with. And then that CT scan was able to be fed into a 3D printer, and the 3D printer then reconstructed the skull out of a porous material that's also biocompatible. So the prostheses is made of material called PEEK, P-E-E-K, which stands for Polyether Ketone. It's like a bone cement kind of material, and so that has to cure, it has to harden.

The way that we measured it was that we actually got feedback from the company. They actually sent us shots of the way it would be made, some of the measurements, and we checked it before was actually printed. And then once it was printed, it was actually shipped to us in its container. And then once we actually got it back, we sterilize it.

But then on the table, once we remove it-- the patient's actually there on the table-- we could place it before securing it. And then we could actually start shaping it on another table just with our drills and a set of tools that allows us to shape it even further, even more precisely. So we could put it on the skull. We could see where it fit, where it doesn't fit, if there are rough spots and we think that would cause issues with the patient being uncomfortable, versus whether the skin would heal and things like that.

So we were able to get it really nice and precise for the patient before we actually put it on. And when we did put it on, we used very thin skull plates and screws. And those skull plates and screws just hold it in place, so we put those all over between the patient's actual skull and the 3D printed material, and it held really nicely.

So the short-term recovery is about two or three days, so it's very short. We do leave a drain there just to collect anything that might drain. And when it dries, we actually send the patient home. Patient did great, and his long-term prognosis is excellent. When we bring the face back together, the orbits, the forehead, everything looked perfect. His hair has now grown back. It looks really nice and clean, and you can't even tell we did anything.