

3D Printing in Medicine: Spinal Surgeries See Increased Success Rate with 3D Printed Guides



Bengbu Hospital Skyrockets Success Rates on Risk Surgery with 3D Printed Guides

“After 3D printing was applied in the hospital, we’ve had breakthroughs in vertebra surgery cases. Previously, we didn’t have many successful vertebra surgery cases. Now we experience a booming of such cases in the department.”

“[The Raise3D N2 Plus] printer is the most stable one among all I have tried. The print quality is really good. The surface features of the bone are all recovered in the printed model.”

- Niu, Guoqi_Director of Orthopedics

The Bengbu Hospital is the top grade hospital in the Anhui Province. Since the end of 2013, Director Niu launched 3D printing application research for vertebrae in the clinical field. To aid in the research, Niu wanted to establish the printing process in-house and be able to sustain running the printing functions within the office.

Director Niu’s team and this project are the first of their kind to move this technology within the Anhui Province. Director Niu emphasizes the use of 3D printing on vertebra surgery as it one of the riskiest and most difficult for doctors around the world.



Dual-color printed vertebra model with artery and tumor. Tumor and vertebra are printed in green and white respectively, while the artery is painted in red.

Prior to the breakthroughs that Bengbu Hospital has made, procedures were risky with even some of the most highly skilled surgeons. Now, 3D printed visuals and guides are increasing success rates and are allowing non-specialized surgeons to offer this life-saving procedure.

Before including 3D printing, the surgical procedure was done with traditional methods.

1. Surgeries were only performed by a handful of specialized surgeons
2. Drilling was done primarily by intuition.

3. Success rates could not be guaranteed.

By applying 3D printing, the company was able to

1. Create visual models that can provide insight when diagnosing.
2. Create guides that can increase success rates and perfect drilling.
3. Allow surgeons that do not specialize in vertebrae to reliably operate with guides

Company: Bengbu Hospital

Industry: Hospital, Orthopedics, Vertebra, and Clinical Studies

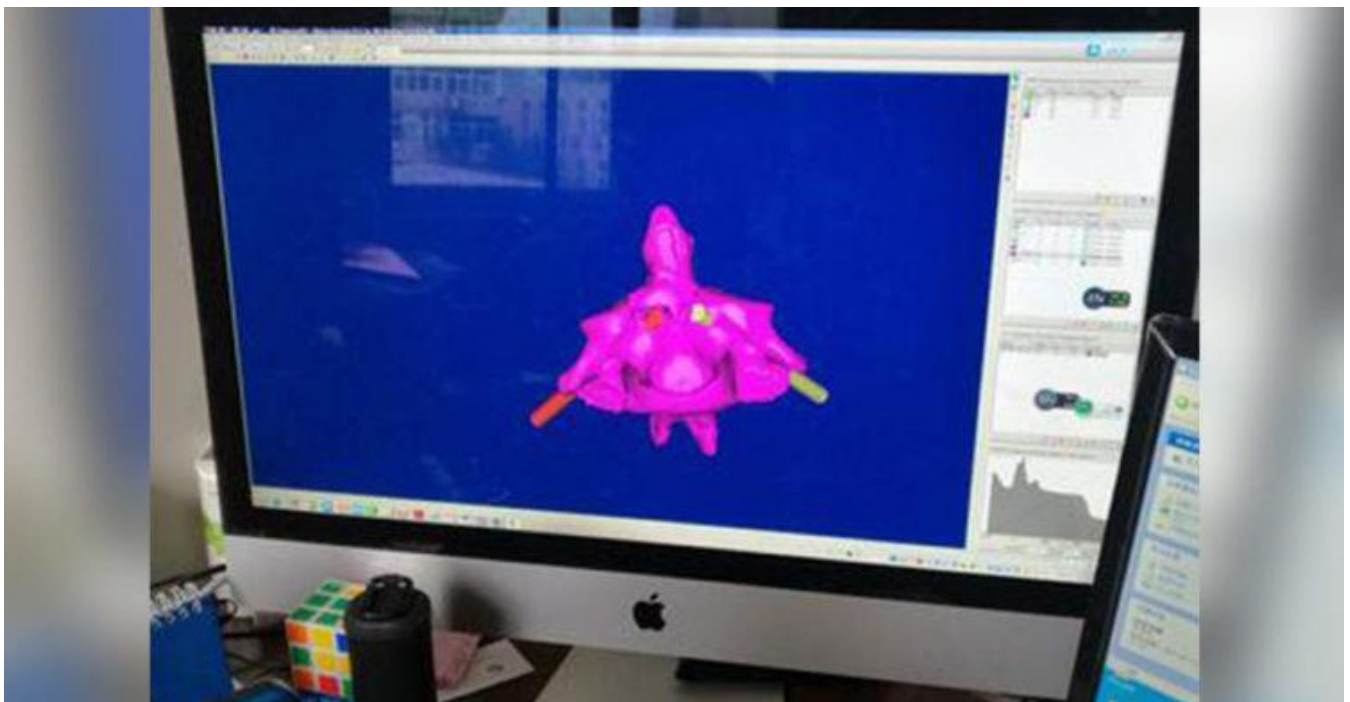
Interviewee: Niu, Guoqi

Title: Director of Orthopedics / Head of 3D Printing Lab

Process

Director Niu and his team apply 3D printing either as an observation model to use as a reference outside of the body, or a vertebra surgical guide to use as a drill guide during a procedure. For an observation model, Director Niu creates an STL file from CT scanning data that is run through specially designed software. This printed model will either be used to: locate the symptom such as deformation or fracture, or can be used to fit surgical guides and test procedures prior to attempting the surgery.

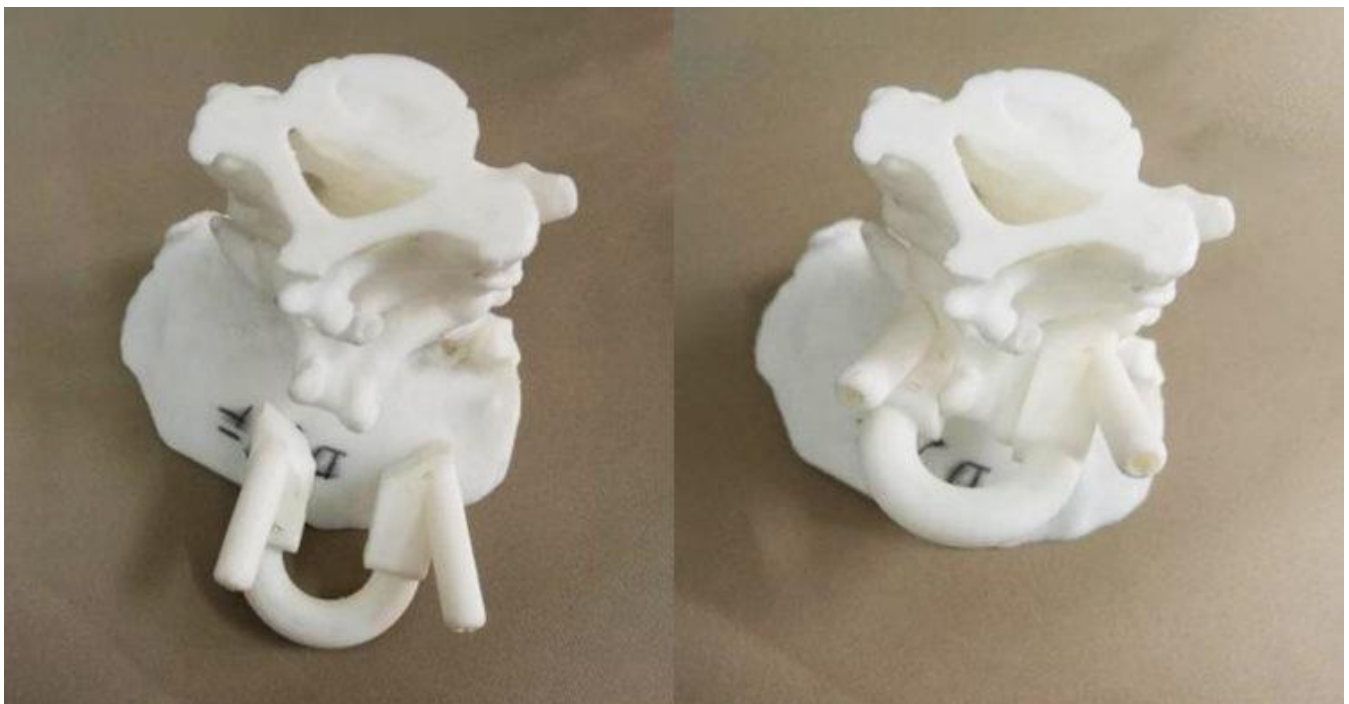
For surgical guides, Niu again utilizes the capabilities of computer design which allows him to ensure stability and fit for these more sensitive and precise parts. When creating a vertebra surgical guide, Director Niu uses digital software to create a guide with identical geometry to the mounting area on the body. This vertebra section has complicated geometry that can be utilized to clench onto, in preparation for a drill operation.





In software, Niu's team designs these models with tubes or canals that will guide the drill holes. These holes are designed at specific angles, lengths, and diameters to precisely match up with the desired outcome and the surgery tools that will be used. The team will test the printed guide on the observation model and adjust the model if necessary; guaranteeing a perfect fit.

The print time for a model like this will only be around one hour. From there, the printed surgical guide can then be used and mounted on the vertebra to execute drilling and can easily be detached without a need for extra equipment or strong forces.





Challenges

Prior to 3D printing, the diagnosis phase was only possible by observing layers of CT scanned data or a composited 3D model of these images. In this method, it's common to miss more minor deformities and fractures. With a tangible model, they can interact with the part in multiple angles with the light and shadow properties that a computer can't provide.

Another huge challenge is surgery difficulty. Without 3D printed surgical guides, all surgery requires incredible experience and hand skills. Much like any skilled trade; the more experience and practice, the greater the success rate and result. Even with the most skilled surgeons, vertebra surgery is one of the riskiest operations in the world due to its critical position in the human body. One wrong move can breach the artery, damage the central nervous system, or result in fatal consequences. Because of the extremely high skill threshold, only a small number of the most experienced doctors dare to execute such a risky operation as it traditionally relies heavily on operator intuition.

Result:

The introduction of the Raise3D printer allows Niu's team to perform otherwise difficult and risky surgeries with the use of 3D printed guides and visual models. The printed surgical guides increase success and reduce the experience required for the operator. With Niu's breakthrough surgical guide application, the hospital is experiencing a boom in the successful vertebra operations. From a patient's perspective, success is creating a remarkable sense of joy and relief. These procedures are now more reliable and are viable life-saving operations, rather than being the risky and uncertain procedure that it once was.

The team utilizes a Raise3D N2 Plus to print all of their models. They rely on the smooth surface and high resolution to ensure the quality and effectiveness of their models. They note that the small geometries in the model are well preserved by the N2 Plus' printing methods and allows the observer to recognize and capture certain positions of the model precisely. In addition, the ability to print in dual extrusion allows the team to create a high contrast model that aids them in observation.

Since the introduction, vertebra surgeries performed with 3D printing have increased from none to 26. This technology is making the surgery a possibility for a wide variety of surgeons as opposed to the prior need of specialized surgeons. With the introduction and reliability of this technology, there are many more applications expected to come.



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