

# Interventional Therapy for Cerebral Aneurysms Under the Guidance of 3D Printing Technology

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**Abstract: Objective:** To explore the clinical method and effect of 3D printing in the treatment of cerebral aneurysms. **Methods:** The authors research work on the hospital, work time in February 2019 - February 2020, this study selected patients of cerebral aneurysms, this period are selected for treatment of 100 cases of patients, randomly divided into two groups, a group to give simple intervention, named as the control group, another group for the interventional therapy under the guidance of 3 D printing, named as experimental group, analyze the effect of two groups of patients with clinical intervention. **Results:** The length of hospital stay in the experimental group was shorter than that in the control group. Meanwhile, the incidence of complications and adverse reactions in the experimental group and the control group were 6.00% and 18.00%, the experimental group was better ( $P < 0.05$ ). **Conclusion:** 3D printing technology can be applied in the treatment of patients with cerebral aneurysms to provide guidance for interventional surgical treatment. It has significant effect, can reduce the incidence of complications in patients, has significant clinical effect, and can be popularized.

**Keywords:** 3D printing technology; Interventional therapy; Cerebral aneurysms; Intervention effect

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Neurology the nervous system involved not only anatomical structure is relatively complex, and the neural function is relatively fine, cause the diseased tissue in patients with more complex, so the operation difficulty is increased, and the treatment from the perspective of the current development situation of clinical, the method for diagnosis of cerebral aneurysms layer mainly includes computer scanning angiography technology, magnetic resonance (NMR) vascular causes blood vessels caused by technology and digital subtraction angiography (DSA) technology, such as the detection rate of these techniques, can provide references for the treatment of patients with, for patients with focal position, improve the treatment efficiency, etc. Under the guidance of these technologies, interventional surgical treatment for patients can ensure the smooth operation<sup>[1]</sup>. Based on this, this study applies 3D printing technology, which is a new technology developed in recent years. 3D printing technology mainly refers to a three-dimensional entity technology formed in the case of continuous physical layer superposition. The application and rise of 3D printing technology have brought great changes to traditional manufacturing industry, medical industry, aerospace and cultural and creative work. With the development of medical impact technology and material engineering, 3D printing technology has played a positive role in the medical field. In order to explore its application effect, this study selected our hospital to carry out a group study, specifically as follows.

# 1 Materials and methods

## 1.1 General Information

In order to explore the therapeutic effect of interventional treatment of cerebral aneurysms under the guidance of 3D printing technology, 100 patients with cerebral aneurysms who were treated in our hospital from February 2019 to February 2020 were randomly divided into the control group and the experimental group and given different intervention methods. The control group was given interventional therapy alone, with 27 males and 23 females. The age range of the patients was 23-77 years old, with an average age of (54.34±5.45) years old. Patients in the experimental group received interventional surgical treatment under the guidance of 3D printing. The number of males and females was 28 and 22, respectively. The oldest patient was 78 years old, the youngest was 21 years old, and the average age of the patients was (55.04±5.04) years old. There was no significant difference between the two groups.

## 1.2 Research Methods

Patients in the control group were treated with interventional therapy alone. Specific implementation process of need to give patients Seldinger operation method, for percutaneous puncture of femoral artery or the carotid artery, in which in the 6F scabbard, given the cerebrovascular imaging technology, mainly including bilateral internal carotid artery and bilateral vertebral artery, plus do when necessary and spinal external carotid artery angiography, the discovery of cerebral aneurysm when given the 3 D reconstruction. Patients in the experimental group were guided by 3D printing technology for interventional surgery.

Acquisition of 3D-DSA images: The Philips Alura Xper FD20 tablet DSA system was mainly applied, and the American Mecorao marK V high pressure syringe was also applied. The non-ionic contrast agent was mainly iodixacin. In specific implementation process, help patients to choose the supine position, given routine disinfection shop towel, then apply 3 D printing technology, giving the right femoral artery puncture, patients will be 5 F arterial sheath into it, and will be 5 F pigtail catheter inserted into the aorta, giving patients with DSA, the patients with left subclavian artery, dry head arm and the left common carotid artery for display. The conventional comparator rate was 3-4 mL /s, the dosage was 5-7

ml, and the pressure was 250-300 PSI. Using thread guide, will be 5 F imaging tube into the bilateral internal carotid artery and vertebral artery, the blood vessels of the area of interest for rotating three-dimensional figure collection, which the imaging of internal carotid artery contrast medium dose for 3 ml, Angle of 200 degrees, the rotating speed of 40, to ensure access to a relatively high resolution 3 D - DSA images, after complete the operation data will automatically be transferred to the 3 d workstation, and the data for 3 d reconstruction, output artery cut out film<sup>[2]</sup>.

Image 3D reconstruction: To process 3D-DSA slice data, it is mainly required to import it into the medical 3D image processing software in the form of DICOM. Mimics15.0 is mainly applied, and Thresholding and other algorithms included in the software are also applied to give patients brain artery segmentation preprocessing. The target vessels were segmented with a threshold between 2800 and 3071. The Regio Growing module was applied to remove the small redundant structure that was not associated with the blood vessels, and then the Caculatie calculation function module was applied to obtain the 3D image of the intracranial aneurysm of the patient, which was converted into STL format, and then the 3D calculation was performed to obtain the volume mesh optimization model<sup>[3]</sup>.

3D printing vascular model: input the designed cerebral aneurysm model data into the SL 450 3D printing machine for printing. The model was pretreated to promote the model making and molding, followed by cleaning, sandblasting, polishing, polishing, spraying, etc. Finally, the model of cerebral aneurysm was printed.

## 1.3 Observation index

After the treatment, the clinical symptoms of the patients were judged and the therapeutic effect was evaluated, which mainly included three indicators of good recovery, residual and plant survival. Among them, the recovery of good means that the clinical symptoms and signs of the patient can disappear and completely improve; In the case of residual aneurysms, the patient was found to still have residual aneurysms after examination, with obvious sequelae and dysfunction. On the other hand, the plant survival state indicates that the patient has been unconscious for a long time and is difficult to respond to the

outside world, but still has a certain heartbeat and normal respiratory function, and has obvious sleep and awakening cycles<sup>[4]</sup>.

The complications of the patients mainly included infection, hemiplegia and aneurysm rupture. The incidence was observed, recorded, and compared<sup>[5]</sup>.

### 1.4 Statistical Methods

SPSS 20.0 statistical software was used for data statistical analysis. The measurement data are expressed as mean ± standard deviation (mean ± SD). The differences of measurement data were compared

with the T test.  $\chi^2$  test was used for Counting data.  $P < 0.05$  is considered as statistically significant difference<sup>[6]</sup>.

## 2 Results

### 2.1 Therapeutic effect

The length of hospital stay in the experimental group was (25.34±8.34), which was significantly lower than that in the control group, with significant difference in data.

**Table 1.** Comparison of operation time between the two groups [ $n$  (%)]

Group	$n$	Length of hospital stay (d)
Experimental group	50	25.34±8.34
The control group	50	40.23±10.24
$t$		10.204
$P$		<0.05

### 2.2 Incidence of complications

Complications in the two groups mainly included infection, hemiplegia and aneurysm rupture, with an

incidence of 6.00% in the experimental group and 18.00% in the control group, with a low incidence in the experimental group ( $P < 0.05$ ).

**Table 2.** Comparison of complication rates between the two groups [ $n$  (%)]

Group	Infection	Pupture of aneurysms	Hemiplegia	Occurrence rate
Experimental group( $n=50$ )	2(4.00)	1(2.00)	0(0.00)	3(6.00)
The control group( $n=50$ )	4(8.00)	3(6.00)	2(4.00)	9(18.00)
$\chi^2$				8.495
$P$				<0.05

### 2.3 Comparison of drug safety

In terms of drug safety, the incidence of adverse reactions was 6.00% in the experimental group and

18.00% in the control group, with a lower incidence in the experimental group and significant difference in data ( $P < 0.05$ ).

**Table 3.** Comparison of drug safety analysis between the two groups [ $n$  (%)]

Group	Nausea	Vomiting	Incidence of adverse reactions
Experimental group( $n=50$ )	2(4.00)	1(2.00)	3(6.00)
The control group( $n=50$ )	5(10.00)	4(8.00)	9(18.00)
$\chi^2$			7.500
$P$			<0.05

## 3 Discussion

The neurological diseases in the department of neurology are relatively complex, and the clinical safety and hidden diseases are relatively high. Cerebral aneurysms mainly refers to the vascular anomalies caused by local bulging pathological cystic, is the leading cause of subarachnoid hemorrhage, once the improper handling, easily lead to rupture hemorrhage patients, patients' morbidity

and mortality rates are relatively high, the case for clinical treatment is mainly to aneurysm clip craniotomy technique and interventional embolization method<sup>[7]</sup>. However, the vascular tortuous anatomical structure in the part of craniocerebral injury is relatively complex, and there are more surrounding nerve tissues. Therefore, once the mountains are careless, the patients will have serious complications, and even death<sup>[8]</sup>. Even if endovascular treatment for intracranial aneurysm belongs to the minimally invasive treatment for patients, but in the concrete

implementation process, this method is more complex for surgery doctors, need to consider of aneurysm of the unknown, to determine size of aneurysm, and to determine whether there is a narrow of the aneurysm and involvement of distal artery, etc., because there are important link these factors and the success rate of surgery. 3 D printing is a kind of rapid prototyping technology, has been applied in medical field, the corresponding 3 D printing is usually for reverse engineering, applying imaging equipment technology, mainly from the DICOM data imported into the 3 D reconstruction software in the optimization design, and connecting with the concrete model, the specific format file to import into the 3 D printer for 3 D printing<sup>[9]</sup>.

When applying this technology, its individualized aneurysm model can be established, pledged to the size of the aneurysm, clearly show the shape, guarantee the intervention operation process, the blood vessels to avoid overlapping parts, guarantee for doctors to establish the three-dimensional, intuitive visual and tactile, thereby promoting the doctor for a comprehensive evaluation of the risk of treatment to ensure operation success rate has been effectively improved, at the same time improve the postoperative effect. This method can promote the surgeons to design the operation, better choose the appropriate surgical equipment, and explain the operation method to the patients and their families through 3D printing, which is beneficial to the understanding of the patients and their families. Meanwhile, the three-dimensional molding of the microcatheter established by this technology can improve the safety and stability of the microcatheter. The neurointerventional team of our hospital can provide 3D printing technology services routinely, and it only takes half an hour from 3D blood vessel image processing to blood vessel modeling and molding. As a classic laser engraving stent, Enterprise1 is widely used in the auxiliary embolization of intracranial aneurysms. For beginners, there are certain requirements for stent insertion, stent release and recovery, release location and labeling. After the stent is released, a spring coil slightly smaller than the longest diameter of the aneurysm can be selected. When the spring coil is plugged, care should be taken to prevent the microcatheter from coming out of the aneurysm. Continuous radiographic evaluation is required during the circumferential filling to ensure

complete tamponade of the neck. In this case, the microcatheter was formed into C and performed very stably in the aneurysm. After the release of the spring coil, the microcatheter was withdrawn continuously according to the situation and finally reached the dense embolization at the aneurysms neck. At the same time, the corresponding production time in the application process of this technology is relatively short, which reduces the economic cost to a certain extent and is of positive significance to clinical development<sup>[10]</sup>.

The results of this study showed that patients in the experimental group had a shorter hospital stay. Meanwhile, the incidence of complications and adverse reactions were both 6.00% lower than those in the control group ( $P<0.05$ ).

To sum up, interventional therapy with 3D printing technology is of significant significance for patients with cerebral aneurysm, which can provide basic guidance for treatment, improve patients' clinical symptoms, ensure the success rate of surgery, and promote patients' recovery, and can be actively promoted in clinical practice.

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