

## Case Report

# A case of obsolete foreign body removal surgery by 3D printing technology

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**Abstract:** Purpose: We introduce a novel method to conduct the old obsolete foreign body removal surgery. Methods: A case of old obsolete foreign body removal surgery was performed with the aid of 3D printing technology. The old obsolete foreign body was printed out as 1:1 scale model by 3D printing technology at preoperative. And the size, shape and the space position of adjacent bones were successfully identified. Results: The operation was completed successfully and 3D printing technology was successfully used to remove obsolete foreign body. The patient was healed. Conclusions: 3D printing technology was introduced into the field of medicine, which provides surgical assistance for medical care. Preoperative design of surgical procedures, determining the foreign bodies' location and shape, the smooth and successful completion of the operation could be done by means of 3D printing technology.

**Keywords:** Obsolete foreign body, 3D printing technology, removal surgery

### Introduction

Sometimes, foreign body could happen when a patient was in an accident. The foreign body with high density could be developed under the X-ray, which was easy to remove. But for others, such as wooden tissue, which cannot be developed or be developed indistinctly under the X-ray, were difficult to diagnose. So the surgery often results in difficult extraction and obsoletes the foreign bodies.

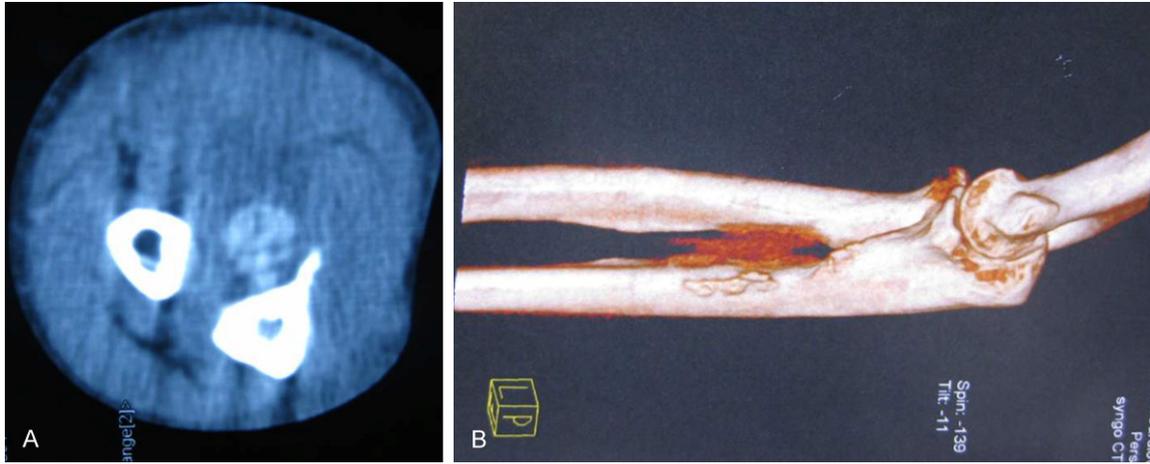
3D printing technology has been widely used in the field of medical clinical, and it also has many advantages. The technology has the advantages of optimizing preoperative plan and design, providing personalized and accurate treatment.

This case report, performed with the aid of 3D printing technology, is an old obsolete foreign body removal surgery. We hope to provide a reference for the similar clinical treatment, such as the location or the shape of foreign bodies that is hard to determine.

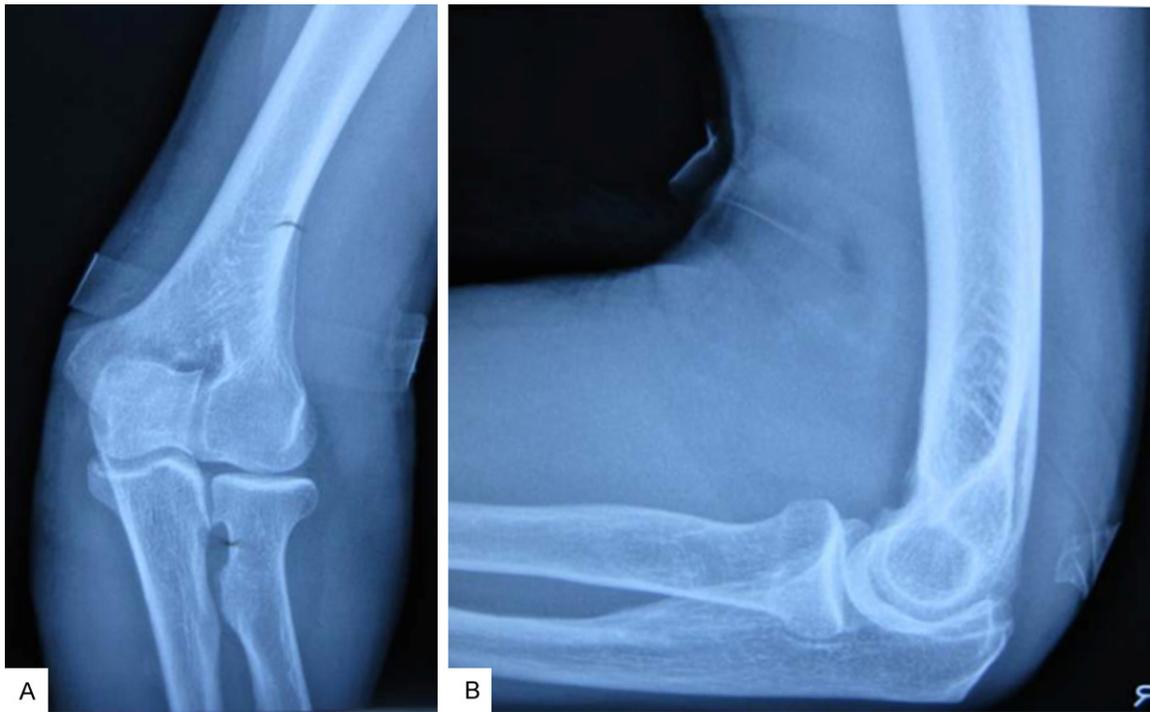
### Case report

The patient was a 59 years old male. When he fell from a high place, a branch was inserted

into the middle of the antebrachium and the foreign body went deeply into the interosseous membrane of the ulna and radius. Chief complaint was that the right elbow fossa soft tissue wound has been dehiscence for more than 2 months after the foreign body removal surgery. Physical examination showed there was a length of about 1 centimeter longitudinal fissure in the right medial cubital fossa. The skin was red and swelling while the local skin temperature was not high, with the local soft tissue sclerosis obviously. A slight yellowish discharge was seen in the wound. The wound was deep and had formed a sinus. There was no obvious abnormality in peripheral blood flow, skin sensation and finger movement. The CT scan and 3D reconstruction showed there was a mildly high-density mass in the middle and upper right ulna, considering a pathogenesis of hematoma (**Figure 1A, 1B**). Because the foreign bodies under the X-ray or the CT scan was negative developed (**Figure 2A, 2B**), it was unable to locate, and the operation was very difficult. Although the patient had received two operations in other hospitals, the wound was still persistently exudative and unhealed. In consideration of the remaining foreign body, the patient came to the Department of orthopedics of Affiliated Hospital of Yan'an University. After the



**Figure 1.** The CT scan showed there was a high-density mass in the middle and upper right ulna (A). The 3D reconstruction of CT scan image showed there was a high-density mass in the middle and upper right ulna, considering a pathogenesis of hematoma (B).



**Figure 2.** The X-ray of anteroposterior showed there was no sign of foreign body (A). The X-ray of lateral showed there was no sign of foreign body (B).

actively preoperative preparation and using the 3D printing technology to print the bone and the foreign body model (**Figure 3**), with the model auxiliary positioning, the foreign body was successfully removed (**Figure 4A-C**).

#### Discussion

To a great extent, preoperative planning of the obsolete foreign body removal surgery depends

on the shape and the location of the foreign body. So, it was necessary to understand the three-dimensional shape of the foreign bodies before operation, and to determine the foreign bodies' location and the local nerves, blood vessels and other tissues. It was also necessary to clear the invasion of the foreign bodies to the surrounding tissues. If the foreign bodies were metallic properties, it is possible and easy



**Figure 3.** The bone and foreign body model were printed by the 3D printing technology preoperatively.

to locate and determine. So this kind of foreign bodies could be taken out completely by means of intraoperative X-ray fluoroscopy, and be checked whether it remained.

In this case, the foreign body in the patient was a branch. The wooden branch cannot be imaged by X-ray imaging, that was it could not be located and detected by X-ray preoperatively. The three-dimensional reconstruction of CT scan was advanced, while it made a misdiagnosis and caused mistreatment of a pathogenesis of hematoma (**Figure 1A, 1B**). Therefore, although the patient had two operations, the foreign body still remained and could not be completely removed that led to the wound persistently exudative and unhealed for more than 2

months. In addition, the patient had undergone two operations, so the local scar tissue appeared and the anatomical structure changed. That meant it was unknown whether the foreign body wandered or displaced. So the difficulty of the surgery was beyond our imagination. We suspected that the hematoma (the sign on the CT scan) might be the foreign body, which we were searching for. Finally, using 3D printing technology, we successfully printed out the 1:1 model of skeletal and the foreign body. There was undoubted that we could successfully confirm the so-called hematoma was the foreign branch. So it was quite easy to understand clearly the three-dimensional shape, the size and the location of the foreign body. The position between it and bones was also defined, which was important to assess the likelihood of a successful operation and to avoid the risks of failure. The operational difficulty was reduced, which may ensure a complete and successful surgery to remove the residual foreign branch.

3D printing technology had the advantages of optimizing surgical procedures, promoting personalized surgery, and performing precision operation [1]. It also had a unique advantage, in the field of medical treatment, which was regarded as a new bright spot in the development of precision medicine [2]. The technology could optimize preoperative planning and a good preoperative planning was significantly important to the success of operation. This technology could overcome the drawbacks of plane image, which cannot give people the visual and three-dimensional image. It, to some extent, not only facilitated the communication between doctors and patients and the cultivation of young doctors, but also transformed the traditional treatment model into a preoperative



**Figure 4.** The operators were seeking the foreign bodies during the operation (A). The foreign bodies were successfully and absolutely removed (B). The removed foreign bodies and 3D printing model were displayed together (C).

rehearsal, intraoperative practice and postoperative check treatment mode. 3D printing technology was introduced in surgery that may greatly reduce the difficulty of operation, improve medical outcome and have a good application prospect [3].

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### Disclosure of conflict of interest

None.

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