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Dr. Wenlin Wang
Professor, Department of
Chest Wall Surgery,
Guangdong Second Provincial
General Hospital, Guangzhou,
China

Dr. Weiguang Long
Associate Professor,
Department of Chest Wall
Surgery, Guangdong Second
Provincial General Hospital,
Guangzhou, China

Dr. Yang Liu
Resident Doctor, Department
of Chest Wall Surgery,
Guangdong Second Provincial
General Hospital, Guangzhou,
China

Dr. Bin Cai
Resident Doctor, Department
of Chest Wall Surgery,
Guangdong Second Provincial
General Hospital, Guangzhou,
China

Dr. Juan Luo
Resident Doctor, Department
of Chest Wall Surgery,
Guangdong Second Provincial
General Hospital, Guangzhou,
China

Corresponding Author:
Dr. Wenlin Wang
Professor, Department of
Chest Wall Surgery,
Guangdong Second Provincial
General Hospital, Guangzhou,
China

Chest wall reconstruction with digital material after sternal tumor resection

Dr. Wenlin Wang, Dr. Weiguang Long, Dr. Yang Liu, Dr. Bin Cai and Dr. Juan Luo

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Abstract

Sternal tumor is a common chest wall tumor. After tumor resection, the chest wall will be damaged and needs reconstruction. In the past, there were many kinds of materials used for reconstruction, each of which had its own characteristics. Since 2018, we have proposed the concept of digital material and used it in our operations. In this article, the operation of a 48-year-old patient with sternal tumor was reported. During the operation, we used digital material to reconstruct the chest wall after tumor resection, and achieved satisfactory results.

Keywords: Digital material, sternal tumor, chest wall reconstruction

Introduction

Chest wall tumor is a common type of chest wall surgical diseases, the main treatment of which is resection^[1-3]. After the resection, chest wall defect will appear, which will affect the integrity of the chest wall and the respiratory function, so reconstruction is required^[1-4]. In the past, there were many kinds of materials for reconstruction, each of which had its own advantages, but also had corresponding defects^[1-5]. In 2018, we proposed the concept of digital material^[1-3]. We used this material in chest wall reconstruction surgery and achieved satisfactory results. In this article, the operation of a 48-year-old patient with sternal tumor was reported. We used digital material to reconstruct the chest wall after tumor resection, and achieved satisfactory results.

Case Report

The patient was a 48-year-old male who was admitted to the hospital for surgery in 2 months after the discovery of chest wall tumor. Preoperative physical examination showed that there was a mass in the middle of the anterior chest wall. However, the protruding part of the tumor on the body surface is not obvious, and the skin is not abnormal (Fig 1). Imaging examination showed that the tumor was located in the body of the sternum and the surrounding costal cartilages were involved (Fig 2, 3). The patient has a clear diagnosis and surgical indication. In order to obtain ideal surgical effect, digital material with personalized design were designed and processed before operation (Fig 4). The operation was performed under general anesthesia. The median incision was used to free the tumor tissues, and then the tumor was removed together with the surrounding bone structures. The digital material was put into the chest wall defect and firmly fixed, and its inner and outer surfaces were covered with fiber membranes (Fig 5). After drainage tubes were placed in the operation field, the incision was closed and the operation was completed (Fig 6). The operation was smooth without any complications. Postoperative X-ray examination showed satisfactory location of digital material (Fig 7). The patient was discharged 10 days after operation. Follow up for 1 year showed normal appearance of chest wall without discomfort.

Discussion

The operation of chest wall tumor generally includes two parts, namely tumor resection and chest wall reconstruction^[1-4]. Because of the superficial location of such tumors, it is not too difficult to remove them. Reconstruction is the key to successful surgery. Reconstructions include bone structures and soft tissues reconstructions. The reconstruction of bone structure needs special materials. So far, a variety of materials have been used in surgery^[4, 5]. The characteristics of these materials are different, and the reconstruction effects are also different. In recent years, 3D printing materials are gradually used in clinic^[6, 7].

The biggest advantage of this material is personalized design, that is, the most suitable material can be designed for specific tumors. In 2018, we proposed the concept of digital material, which include not only 3D printing material, but also another kind of material, namely digital customized material [1-3, 8]. We used the latter in our operations and have accumulated a lot of experiences.

Digital material is not ready-made material, but need temporary design and processing [6-8]. The first step is to perform imaging examination for the patient to obtain digital data, which is used to simulate the 3D image of the lesion and chest wall. With this image, the resection range of the tumor is designed, and then the digital material scheme is made according to this range. Finally, the digital material is obtained through a specific processing technology. Due to different processing technologies, the final material names are also different. The material obtained through 3D printing process is 3D printing material, and the material obtained through numerical control machine tool is personalized customized material, which is the material we used in our operations (Fig 8). Since the two processing technologies are different, and the final materials will also have obvious differences. However, because the previous steps are the same, both have the characteristics of personalized design.

Theoretically, digital material is the most ideal reconstruction material [8]. However, there are still many drawbacks in practical operation. First of all, this material has no ready-made products and can only be processed temporarily. This will undoubtedly affect the implementation of the operation. Secondly, this material cannot fully meet the needs of surgery sometimes.

In the past, we have used digital material to complete a large number of reconstruction operations [1-3, 8]. Our experiences showed that although this material can meet the needs of most surgeries, sometimes it is not perfect.

Another chest wall reconstruction material we used is MatrixRIB, which was originally used to fix rib fractures, but we found that it can be used for chest wall reconstruction, especially for rib defect reconstruction. When it is necessary to reconstruct the sternum defect, the use of Matrix RIB cannot completely restore the shape of the sternum, but can well complete the reconstruction of the chest wall. Therefore, this is a relatively satisfactory reconstruction material [5].



Fig 1: Appearance of chest wall before operation

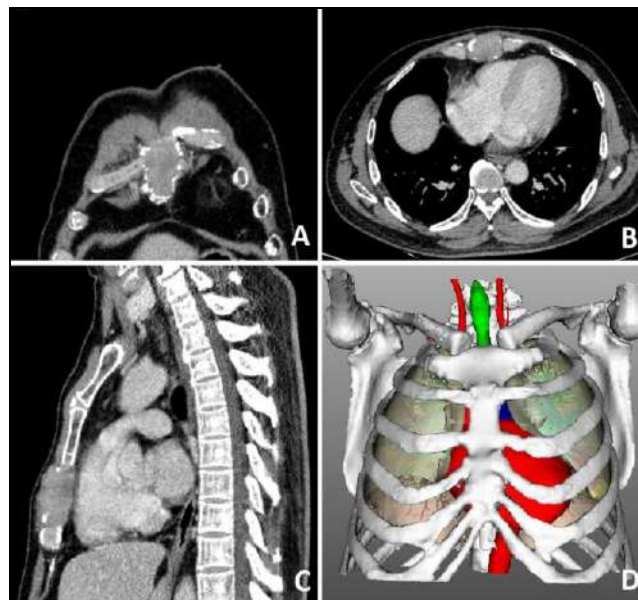


Fig 2: Preoperative imaging examination. A. CT coronal plane; B. CT horizontal plan; C. CT sagittal plane; D. 3D reconstruction.

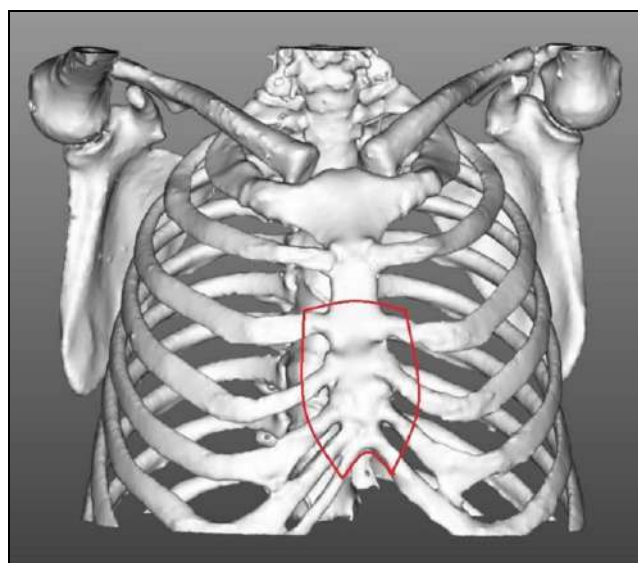


Fig 3: Range of tumor resection



Fig 4: Digital material after processing

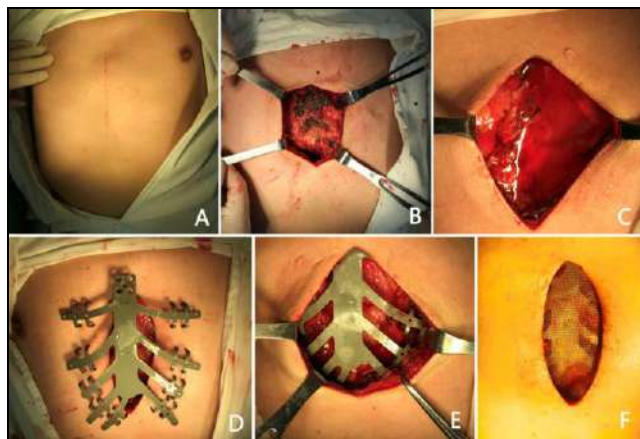


Fig 5: Surgical pictures. A. Incision position; B. Tumor exposing; C. Tumor resection; D. Location of digital material; E. Digital material is placed and fixed; F. The inner and outer surfaces of digital material were covered with fiber membranes



Fig 6: Postoperative appearance of chest wall

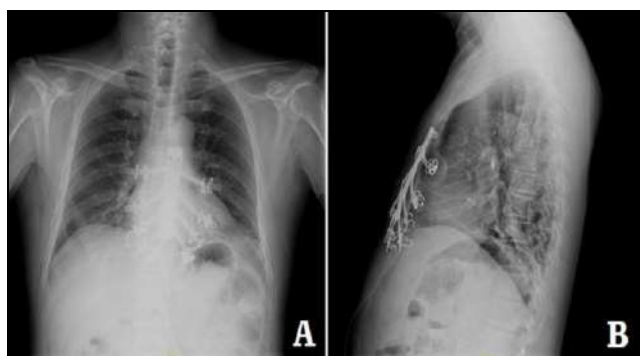


Fig 7: Postoperative X-ray examination. A. Front view; B. Side view

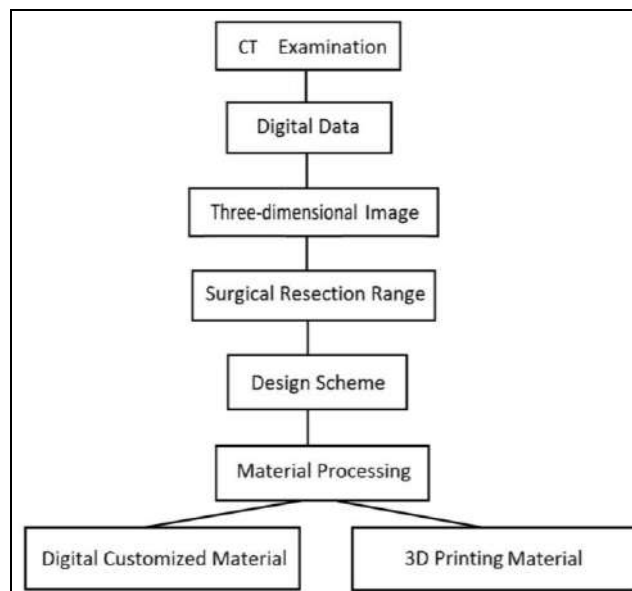


Fig 8: Flow chart of design and processing of digital material

Conclusion

Digital material is a special material for chest wall reconstruction. Theoretically, this material can meet the needs of reconstruction to the maximum extent, but it has inherent defects. Therefore, this material still needs to be improved before it is widely used.

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Author's Contribution

Not available

Conflict of Interest

Not available

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Reference

1. Wang W. Basic theories and concepts of chest wall surgery. *International Journal of Surgery Science*. 2022;6(3):12-4. DOI: doi.org/10.33545/surgery.2022.v6.i3a.909.
2. Wang W, Long W, Liu Y, Cai B, Luo J. Progress in chest wall surgery. *International Journal of Surgery Science*. 2022;6:161-6. DOI: doi.org/10.33545/surgery.2022.v6.i3c.938.
3. Wang W. Chest wall surgery: Chest wall plastic surgery or chest wall orthopedics. *International Journal of Orthopedics Sciences*. 2022;8(3):82-4. DOI: doi.org/10.22271/ortho.2022.v8.i3b.3174.
4. Gonfiotti A, Salvicchi A, Voltolini L. Chest-Wall Tumors and Surgical Techniques: State-of-the-Art and Our Institutional Experience. *J Clin Med*. 2022 Sep 20;11(19):5516. DOI: 10.3390/jcm11195516.
5. Wang W, Long W, Liu Y, Cai B, Luo J. Reconstruction of chest wall with MatrixRIB plate after sternal tumor resection in children. *International Journal of Orthopedics Sciences*. 2022;8:236-8. DOI: doi.org/10.22271/ortho.2022.v8.i3d.3205.

6. Hoang D, Perrault D, Stevanovic M, Ghiassi A. Surgical applications of three-dimensional printing: A review of the current literature & how to get started. *Ann Transl Med.* 2016 Dec;4(23):456. DOI: 10.21037/atm.2016.12.18.
7. Wen X, Gao S, Feng J, Li S, Gao R, Zhang G. Chest-wall reconstruction with a customized titanium-alloy prosthesis fabricated by 3D printing and rapid prototyping. *J Cardiothorac Surg.* 2018 Dec;13(1):4. DOI: 10.1186/s13019-017-0692-3.
8. Liu Y, Wang W, Long W, Cai B, Chen C, Wang W, *et al.* Chest wall reconstruction with digitally designed materials for straight back syndrome with tracheal stenosis: A case report. *Ann Transl Med.* 2021 Aug;9(16):1357. DOI: 10.21037/atm-21-3976.

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