



# International Journal of Surgery Science

E-ISSN: 2616-3470  
P-ISSN: 2616-3462  
© Surgery Science  
[www.surgeryscience.com](http://www.surgeryscience.com)  
2022; 6(3): 68-71  
Received: 07-04-2022  
Accepted: 12-05-2022

**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

## Wang procedure: A reasonable choice for reoperation after failure of Nuss procedure for pectus excavatum

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

**DOI:** <https://doi.org/10.33545/surgery.2022.v6.i3b.921>

### Abstract

Pectus excavatum is a common thoracic deformity, and Nuss procedure is considered as the standard operation for the treatment of this deformity. However, there are often cases of Nuss procedure failure in the clinic. Once such a situation occurs, it often needs to be operated again. Since Nuss procedure can cause adhesions behind the sternum and in the bilateral thoracic cavities, if Nuss procedure is still used in the reoperation, it is not only very difficult, but also possible to cause heart and lung injuries. Therefore, Nuss procedure is not an ideal choice for reoperation. Wang procedure is a new method to treat the deformity of depressed chest wall. Since this operation is mainly performed outside the chest wall and rarely involves the structures in thoracic cavity, it is suitable for reoperation after the failure of Nuss procedure. This article reports a 12-year-old boy who had a failed Nuss procedure. We used Wang procedure for treatment and achieved satisfactory results.

**Keywords:** Pectus excavatum, reoperation, Nuss procedure, Wang procedure

### Introduction

Pectus excavatum is a common thoracic deformity, and Nuss procedure is a commonly used surgical method at present [1-3]. Due to the influence of various reasons, the operation may fail sometimes. The patients who failed the operation always have obvious deformities, therefore, most of them need to be operated again. Recently, we admitted a patient with pectus excavatum who failed Nuss procedure. We adopted Wang procedure [4-6] for him and achieved satisfactory results.

### Case Report

The patient, a 12-year-old boy, underwent Nuss procedure in the local hospital at the age of 10. The postoperative effect was dissatisfied, and the anterior chest wall was still depressed and gradually aggravated. In order to completely treat the deformity, the patient was admitted to our hospital for reoperation. Preoperative physical examination showed that the anterior chest wall was obviously depressed, and there were surgical scars on the lateral chest wall (Fig.1). Imaging examination showed that the anterior chest wall was depressed, and the heart was obviously compressed and shifted to the left thoracic cavity. A main steel bar and two short fixation plates at both ends of the bar could be seen in the chest wall. The right fixation plate was separated from the main bar. The middle part of the main steel bar was located in the upper abdominal wall below the xiphoid process, and the steel bar had no supporting effect on the depression of the anterior chest wall (Fig. 2, 3, 4). The reoperation of the patient was carried out under general anesthesia. He was in supine position, with abduction of both upper limbs. Incisions were made at the previous surgical incisions. The scars were removed and the subcutaneous tissues were dissected to expose both ends of the bar and the short fixation plates (Fig. 5A). During the operation, we found that the right short fixation plate was separated from the main bar, and the middle part of the bar was displaced obliquely forward and downward. The short fixation plates were removed at first, and then the main steel bar was taken out. A skin incision under the xiphoid process was made. The xiphoid process was exposed and split from the middle. The dorsal structures beneath the sternal end were exposed. Severe adhesions were dissected. Multiple steel wires were sutured crossing the bony structures of the depression (Fig. 5B). A tunnel was made at the deepest plane from the middle of the depression to both sides of the chest wall. The tunnel was located between the bone structures and the soft tissues of the chest wall.

A arc-shaped steel bar was inserted into the tunnel and the depression of the chest wall was pulled with steel wires and firmly fixed on the steel bar (Fig. 5C). The depression was eliminated, and the appearance of the thorax basically returned to normal. After the skin incision was closed, the operation was completed (Fig. 5D).

### Discussion

Nuss procedure is a common method for the treatment of pectus excavatum [1-3]. Because of many advantages, it is generally regarded as the standard operation for the treatment of this kind of deformity. However, this procedure is sometimes not easy to complete, especially when the operator does not understand the basic principle of the operation, which is easy to lead to the failure of the operation. Nuss procedure failure can have many specific manifestations, but the most common manifestation is still the depression of the anterior chest wall. Since such a depression is not fundamentally different from the preoperative depression, it still needs surgical treatment.

This patient is a common failure type of Nuss procedure, which was caused by the deviation of the steel bar position. The ideal position of the bar should be at the bottom of the depression, but this patient's bar slipped from the ideal position. Since it could not play an orthopedic role, it ultimately led to the failure of the operation.

In Nuss procedure, the bar needs to pass through both thorax and mediastinum, which will result in obvious adhesions in these parts after operation. Since the adhered structures include lung and heart, it will be very difficult and dangerous to separate these structures. Therefore, the reoperation will be extremely challenging.

Nuss procedure requires the placement of bar through both thorax and mediastinum [1, 2]. If Nuss procedure is selected for the reoperation, it is difficult to complete the separation of adhesions. In order to completely simplify the operation, we chose Wang procedure for this kind of patients.

Wang procedure was specially designed for young children with pectus excavatum [4-6]. In the later application, this procedure was widely used in a variety of deformity operations with chest wall depression [7-9]. The biggest advantage of this procedure is that it can complete the shaping of the depression under direct vision, and the shaping operation is to pull rather than support the depression like Nuss procedure. The main operation of Wang procedure is located on the surface of the bony structures of the chest wall, and less involves the deep structures of the chest, which means the adhesion at the bottom of the depression need not be separated too much. For the reoperation of pectus

excavatum, Wang procedure can avoid the most dangerous adhesion separation, which can not only reduce the operation risk, but also reduce the difficulty of the operation, so it is the most ideal choice.

Compared with Nuss procedure, Wang procedure has many other advantages: 1) [4-6] Direct operation on the local lesion. The incision of Nuss procedure is located on the lateral chest wall, but the main lesion is located in the middle of the chest wall. Nuss procedure is the correction of the most serious part of the depression indirectly through the steel bar. Although such an operation has certain effects, it often cannot completely eliminate the lesions. Conversely, the incision of Wang procedure is located in the middle, which can directly correct the most serious part of the depression, so the operation is more direct and the effect is more satisfactory; 2) Direct vision operation without thoracoscopy. The incision of Nuss procedure cannot directly expose the central part of the depression, so it is necessary to complete the operation with thoracoscopy. Wang procedure makes an incision directly at the bottom of the depression, therefore, all operations on the depression can be completed under direct vision, which greatly increases the reliability and safety of the operation; 3) Template shaping [10]. Nuss procedure is a plastic operation completed by external force with the help of steel bar. From the operational nature, it belongs to mechanical external force shaping. Wang procedure is a more advanced template shaping. The basic principle is to shape the steel bar to make its radian close to the radian of the normal thorax, and then use it as a template for shaping. In the process of shaping, the deformed structures of the chest wall are firmly fixed to the steel bar, so that the chest wall is shaped according to the shape of the steel bar to achieve the goal of shaping. The biggest advantage of template shaping is that the deformed structures can be completely shaped according to the expected shape of steel bar, so it can obtain a very perfect effect. Wang procedure is one of the typical template shaping operations, and its effect is significantly better than Nuss procedure.

Above all, it can be seen that for the reoperation of pectus excavatum, Nuss procedure is not only high-risk and difficult, but also has many defects. For this kind of operation, if Wang procedure is adopted, relatively satisfactory results can be obtained. Our patient had accepted the Nuss procedure previously, but it was not successful. After the operation, there was obvious deformity in his anterior chest wall, which required reoperation. Considering the risk and difficulty of Nuss procedure, we regarded that Wang procedure should be the reasonable choice.

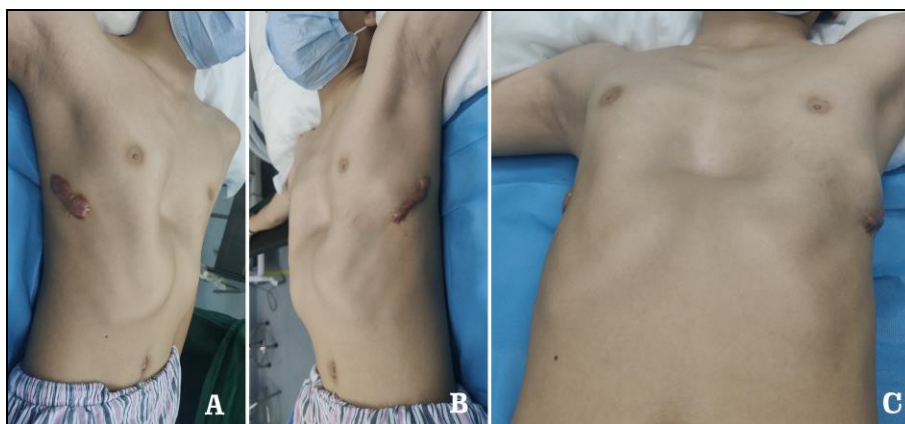
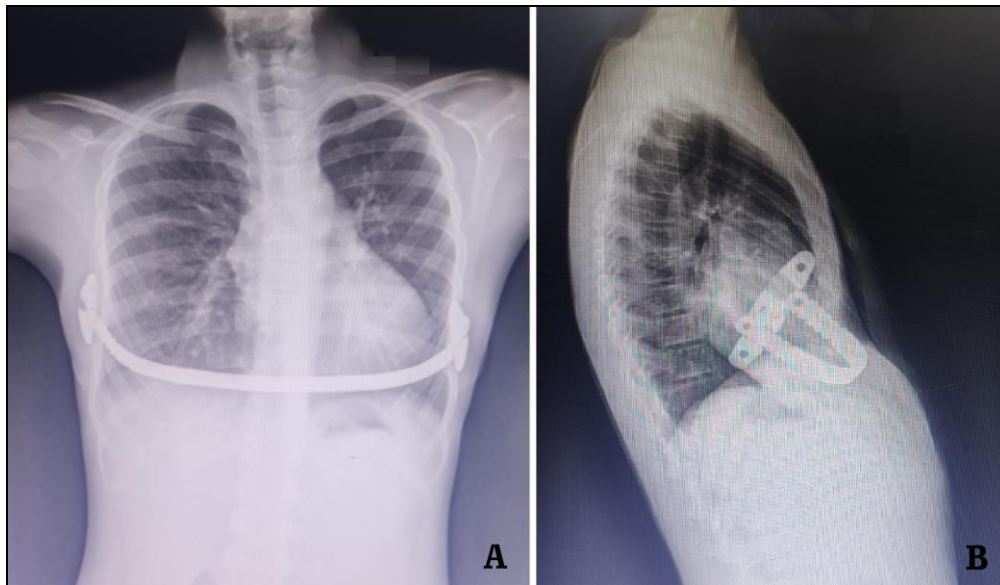
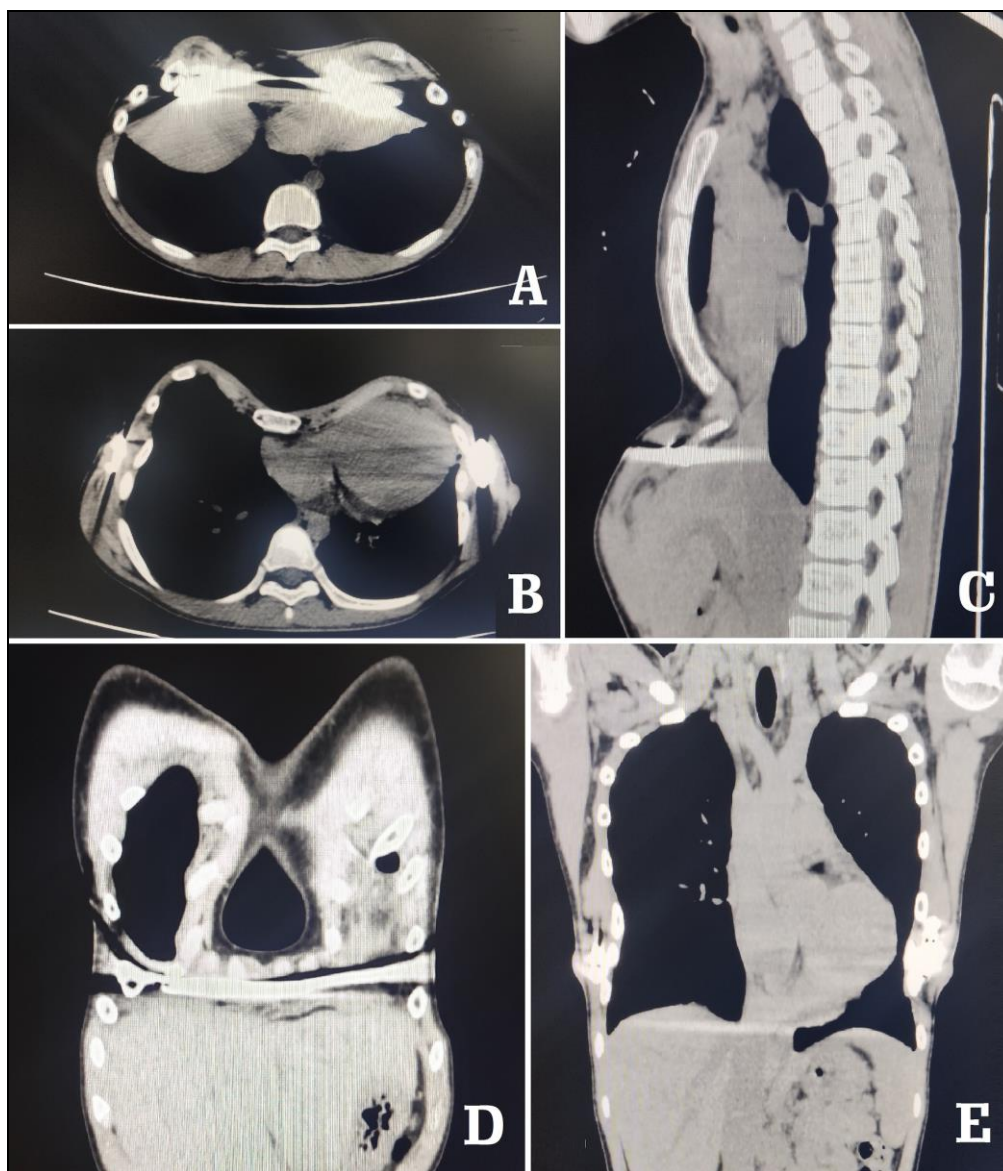


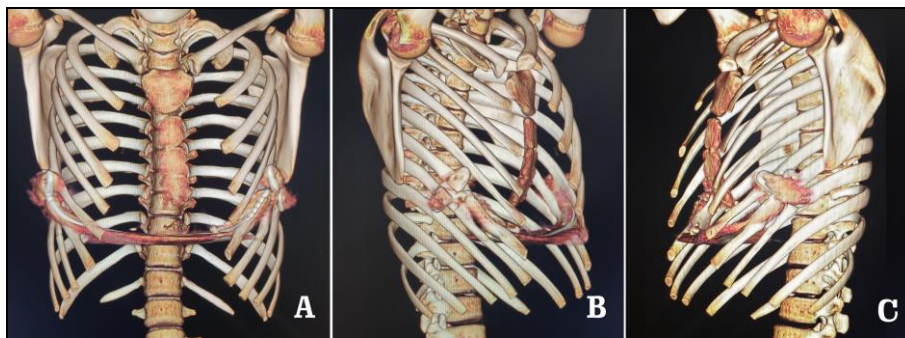
Fig 1: Appearance of chest wall before operation. A, B, Lateral view; C, Front view.



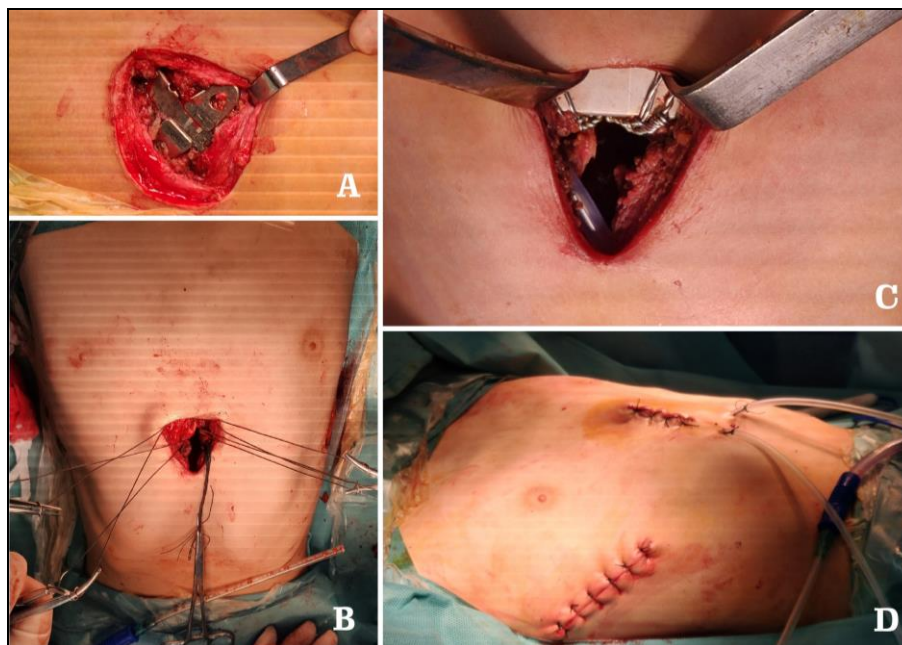
**Fig 2:** X-ray examination after operation. A, Posteroanterior radiograph. The main steel bar is displaced, and the right short fixation plate is separated from the main steel bar; B, Lateral radiograph. The main steel bar is seriously displaced.



**Fig 3:** CT examination before reoperation. A, B, sectional view showed the abnormal position of the steel bar and the depression of the anterior chest wall; C, Sagittal view showed that the anterior chest wall was severely depressed, the heart was severely compressed, and the position of the steel bar was abnormal; D, E, Coronal view showed that the anterior chest wall was obviously depressed and the heart shifted to the left.



**Fig 4:** 3D reconstruction images before reoperation. A, Front view showed obvious displacement of the main steel bar; B, C, Lateral view showed that the middle part of the main steel bar was located on the upper abdominal wall.



**Fig 5:** Operation pictures. A, The position of the short fixation plate and the end of the main steel bar of the previous Nuss procedure; B, Picture of Wang procedure. The pulling steel wires were placed; C, Picture of Wang procedure. After the main steel bar was placed, the depression was pulled and fixed to the bar; D, Chest wall appearance after Wang procedure. The appearance of chest wall basically returned to normal.

## Conclusion

After Nuss procedure, patients with pectus excavatum may have adhesion in mediastinum. If the Nuss procedure fails and requires reoperation, and the Nuss procedure is used for this additional operation, it will have great risks and difficulties. At this time, the reasonable choice is Wang procedure, which can not only make the operation safe and convenient, but also obtain satisfactory results.

## References

1. Nuss D, Obermeyer RJ, Kelly RE. Nuss bar procedure: past, present and future. *Ann Cardiothoracic Surg.* 2016;5:422–433. Doi.org/ 10. 21037/ acs. 2016. 08. 05.
2. Nuss D, Kelly RE Jr, Croitoru DP, Katz ME. A 10-year review of a minimally invasive technique for the correction of pectus excavatum. *J Pediatr Surg.* 1998;33:545-552. Doi.org/10. 1016/ s0022- 3468(98) 90314-1.
3. Wang W, Long W, Liu Y, Cai B, Luo J. Wung procedure: A minimally invasive operation for pectus excavatum. *International Journal of Case Reports in Surgery.* 2022;4:19-21.
4. Wang W, Chen C, Long W, Li X, Wang W. Wang procedure for treatment of pectus excavatum. *SI Clin Exp Cardiol.* 2018;2:113.
5. Wang W, Chen C, Long W, Li X, Wang W. Wang procedure: novel minimally invasive procedure for pectus excavatum children with low age. *Case Reports and Images in Surgery.* 2018;1:1-2. Doi:10.15761/cris.1000104.
6. Wang W, Long W, Chen C, Liu Y, Cai B, *et al.* Experience of the Wang procedure in treating pectus excavatum in two hundred fifty-six paediatric patients. *International Orthopaedics.* doi.org/10.1007/s00264-022-05483-1.
7. Wang W, Long W, Liu Y, Cai B, Luo J. Surgical treatment of pectus excavatum after cardiac surgery: Wung procedure + Wang procedure + Wenlin procedure. *International Journal of Surgery Science.* 2022;6:15-18. doi.org/10.33545/surgery.2022.v6.i3a.910.
8. Wang W, Long W, Liu Y, Cai B. Wang procedure for treatment of asphyxiating thoracic deformity. *Journal of Pediatric Surgery Case Reports.* 2022;85:102404. doi.org/10.1016/j.epsc.2022.102404.
9. Wang W. Surgical treatment of a 36-year-old patient with asphyxiating thoracic dysplasia. *Interactive Cardio Vascular and Thoracic Surgery.* 2022;34:153-155. doi:10.1093/icvts/ivab217.
10. Wang W. Basic theories and concepts of chest wall surgery. *International Journal of Surgery Science.* 2022;6(3):12-14. Doi.org/10.33545/surgery.2022.v6.i3a.909.