

A Case of Funnel Chest Performed Sternal Turnover with Rectus Abdominis Muscle Pedicle

Kiyoto SHINKAI¹⁾, Harumi KIDA¹⁾, Hiroshi HISANO¹⁾, Shin-ichi Shibasaki¹⁾, Hiroshi YANO¹⁾, Masahito NOMURA¹⁾, Hiroyoshi AYABE²⁾

1) Department of Surgery, Ureshino National Hospital

2) First Department of Surgery, Faculty of Medicine, Nagasaki University

There are two types of surgical procedures for funnel chest: sternal turnover and sternocostal elevation. Both procedures have some merits and some demerits respectively, so the uniformed operative techniques for funnel chest are not concluded. However, it is most important that correction of excavation and prevention of postoperative respiratory dysfunction have completely performed. A 12-year-old boy with severe excavation in the anterior thorax admitted to our hospital was diagnosed as funnel chest. We underwent sternal turnover with rectus abdominis muscle pedicle. Some of reports ordinarily recommended overlap of only sternum to firm plastron and prevent postoperative flail chest. However, we respectively performed conjugation and overlap of both sternum and costal cartilages for more firm fixation of plastron (so-called Ravitch's method), because the overlap of only sternum is not enough to fix plastron firmly. The patient was successfully treated without flail chest postoperative course. The postoperative appearance was satisfactory and respiratory symptom has improved.

Key Words: funnel chest, sternal overlap, Ravitch's fixation method

Introduction

In surgical treatment for funnel chest, many techniques have previously been developed. However, in all techniques, correction of the excavation region of the sternum and prevention of flail bony thorax after fixation of the separated sternum and costal

cartilage(plastron) are considered important issues. In particular, unstable plastron causes flail chest, and is considered the most important factor in postoperative respiratory management. In this case, we report 1 surgical case in which plastron was more firmly stabilized by overlapping and conjugating the sternum and costal cartilage(Ravitch's fixation method¹⁾) for fixation of the plastron, resulting in a good course without postoperative flail chest.

Case

A 12-year-old boy was admitted to our hospital because of excavation in the anterior thoracic region. About 2 years after birth, excavation in the anterior thoracic region was noted. Thereafter, excavation gradually exacerbated. The patient was diagnosed as having funnel chest at a local clinic. At the age of 11 years, funnel chest began to exacerbate. Furthermore, the patient desired surgery due to cosmetic dissatisfaction. On September 12, 1998, the patient consulted the Department of Surgery of our hospital to undergo surgery. Family history was not contributory. Physical examination on admission: Height, 156.4 cm; body weight, 44.3 kg; In the anterior thoracic region, symmetric excavation involving the attachment site between the sternum and four costal bones was observed(Fig. 1). Laboratory findings on admission: Neither blood test nor biochemistry revealed any abnormalities. Respiratory: Volume capacity(VC) was 2490 ml. Forced expiratory volume (FEV) was 1990 ml. The percent of one second forced expiratory volume (FEV1.0%) was 79.0%. Preoperative electrocardiography revealed no abnormal findings. Preoperative thoracic computed tomographic (CT) findings: Sternal excavation was observed. The heart was compressed to the

Address Correspondence: Kiyoto Shinkai M.D.,
Department of Surgery, Uneshino National Hospital 2436,
Shimojuku, Ureshino-Cho, Fujitsu-Gun, Saga, 843-0393 Japan
TEL: +81-954-43-1120 FAX: +81-954-42-2452

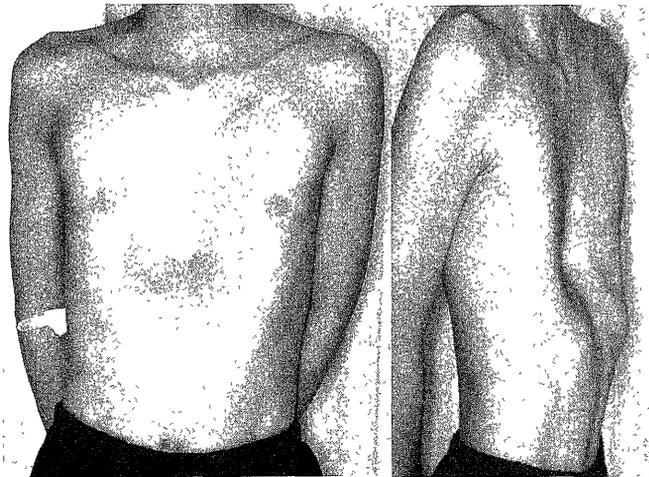


Fig. 1: Symmetric excavation in the anterior thorax was noted.

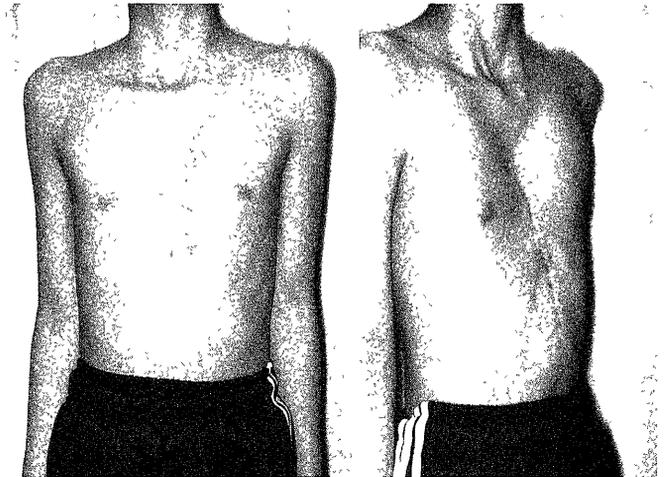


Fig. 3: Excavation in the anterior thoracic region was corrected cosmetically.



Fig. 2: Preoperative CT revealed that sternal excavation was observed. The heart was compressed to the left.

left (Fig.2). Surgical technique: On December 24, 1998, surgery was performed under general anesthesia. On the median line of the anterior thorax, longitudinal skin incision was made from the attachment site of the fourth costal bone to the xyphoid. According to Sheer,s original method², sternal turnover with rectus muscle pedicle was performed. The attachment sites of the major pectoral muscle and minor pectoral muscle were separated from the sternum and costal bone-costal cartilage to expose the entire excavation site of bony thorax. The sternum was incised at the fourth intercostal space. Subsequently, the fifth, sixth, seventh and eighth left and right costal cartilages were separated from the periost. In addition, the left and right internal thoracic arteries and veins were ligated and separated. The plastron was isolated from the mediastinum by ligating and separating the intercostal

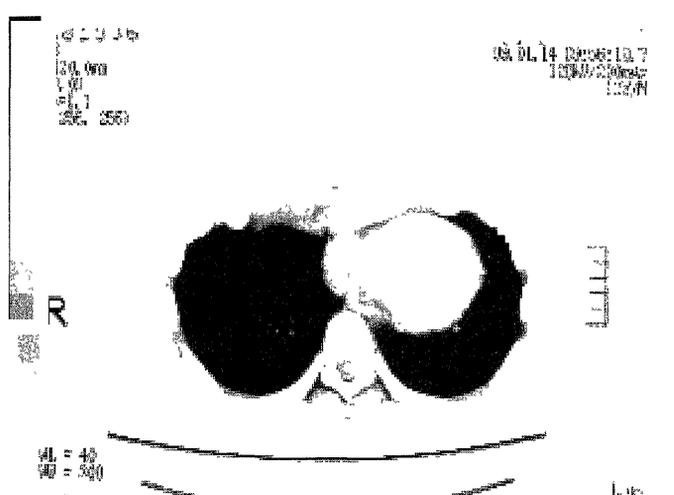


Fig. 4: Postoperative CT revealed that excavation in the anterior thoracic region was corrected and the heart was not compressed to left

muscle as well as intercostal arteies and veins. The rectus muscle was thorough exfoliated with the superior epigastric arteries and veins so that the superior epigastric arteries and veins might not be occluded during turnover. Turnover of the plastron was performed in a clock direction, a portion of the protruding region of the sternum was resected and protruding regions of costal cartilages were resected in a wedge shape, then these sites were rejoined with 2-0 nylon. After surplus costal cartilages were resected, the plastron was conjugated with the sternum and costal cartilages. After this time, to prevent flail bony thorax, mattress suture and fixation with 2-0 nylon were performed so that the plastron overlapped the sternum and costal cartilages according to Ravitch's fixation method. Postoperative course: Immediately after

surgery, slightly flail bony thorax was observed. However, assisted respiration was not required. On the first postoperative day, flail bony thorax disappeared. Thereafter, there were no changes during respiratory management. The postoperative course was good. Both the patient and his family were satisfied. On the fifteenth day, the patient was discharged. After discharge, exercise in daily life was not restricted. Upper body twist exercise was prohibited for 3 months after surgery.

Postoperative thoracic findings: Excavation in the anterior thoracic region was corrected (Fig. 3). Postoperative thoracic CT findings: One month after, CT revealed that excavation in the anterior thoracic region was corrected. There was not compression of the heart detected (Fig. 4). Respiratory function 2 months postoperatively was as followings; VC was 2150ml. FEV was 1860ml. FEV1.0% was 75%. Bone scintigraphy 3 month Postoperatively demonstrated a good blood supply to plastron.

Discussion

Surgical therapy for funnel chest is mainly classified into sternal turnover (STO), which was developed by Wada et al.³, and sterno-costal elevation (SCE), which was developed by Brown et al.⁴. Previous studies reported that each procedures had merits and demerits. To date, a uniformed surgical procedure has not been established. In any case, it is most important to prevent postoperative paradoxical respiration, although correction of plastron with excavation is needed for surgical therapy. SCE induces a higher incidence of postoperative paradoxical respiration than STO. This is a significant issue in postoperative respiratory management⁵. Therefore, to prevent flail plastron, reinforcement materials such as Kirschner's steel line and strut must be used⁶. Although STO induces a low incidence of postoperative paradoxical respiration, flail plastron may occur. Therefore, when re-fixing the isolated sternum and costal cartilage, simple conjugation

of both stumps only may easily cause flail thorax. Furthermore, to prevent excavation at an area above the incision line of the sternum, which is indicated as a limitation of this technique, overlapping the sternum according to Ravitch's fixation method is recommended (STO-Overlap, STO-O). In our patient, re-fixation was performed by overlapping not only the sternum but also costal cartilages. Thus, the plastron could be firmly fixed. There was no postoperative paradoxical respiration detected in any patient. However, the overlapping procedure may make an uneven surface more marked. If the pectoral muscles are sutured, uneven features on the skin surface may be less marked. Furthermore, results will be cosmetically satisfactory, considering further advances in pectoral muscles development.

Conclusion

Sternal turnover with rectus muscle pedicle was performed to treat funnel chest in a 12-year-old boy. Sufficient fixation of the plastron and correction of excavation were achieved by overlapping the sternum and costal cartilage according to Ravitch's fixation method.

References

- 1) Ravitch MM. Congenital deformities of the chest wall and their operative correction, Philadelphia, 1977, W.B. Saunders Co., p146
- 2) Scheer R. Uber eine neue Methode der chirurgischen Behandlung der Trichterbrust Die gestielte Umwendungsplastik. Der Chirurg 28:312-314, 1957
- 3) Wada J. Surgical correction of the funnel chest sternoturnover. West J Surg Obstet Gynecol 69:358-361, 1969
- 4) Brown AL. Pectus excavatum (funnel chest). J Thorac Surg 9:164-184, 1939
- 5) Katsuya H, Masayoshi O. Operative corrections of funnel chest depend on age group. Kyoubu Geka 49:4-7, 1996
- 6) Masahiro Y, Takuro T, Hidetaka O et al. Early and long term results of sternocostal elevation combined with bridge external traction for funnel chest in children. Jpn Assn Thorac Surg 41:41-48, 1993