

## Technical note

# Original bar fixation technique in minimally invasive repair of pectus excavatum in adolescents: a 36-case series.

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## **Abstract**

In pectus excavatum, minimally invasive endoscopic repair is the current gold standard in adolescents. The main postoperative pitfall is bar displacement, making fixation a major issue. We report an original transcostal technique using absorbable USP-2 suture in 36 patients.

There was a single case of bar displacement (2.78%; 95% CI, 0.07-14.53).

Bar stability was comparable to literature reports; but the present technique avoided the complications potentially incurred by use of metal wire, pericostal fixation points and stabilizers.

**Key-words:** Pectus excavatum, Nuss procedure, minimally invasive surgery, bar fixation.

# 1. Introduction

Pectus excavatum mainly affects males [1] and is usually present from birth. The deformity persists or worsens during rapid thorax growth at puberty. Impact is mainly psychological, or more rarely cardiorespiratory. The Nuss procedure, also known as minimally invasive repair of pectus excavatum (MIRPE), is the gold standard in adolescence, providing lasting results [2,3]. It has become an attractive alternative to sternochondroplasty, with smaller lateral scars and conserved costal cartilage [4]. There are, however, complications: secondary bar displacement, with risk of recurrence and of mediastinal injury, and residual pain at the fixation points [2-5]. Kabbaj et al. [6] described costal bar fixation by pericostal wire, with a single case of traumatic displacement in a series of 70 patients. Bond et al. [7] described use of pericostal and subxyphoid absorbable suture, with only 2 cases of displacement in 73 patients. And Yoo et al. [8] reported zero displacement in 44 patients, using “sutureless” fixation with 2 bars connected by metal devices. The present technique extends the range of bar fixation options, using absorbable transcostal suture. It seems technically easier than pericostal suture and less expensive than use of stabilizers, and facilitates hardware removal.

## 2. Surgical technique

Bar placement follows the princeps technique described by Nuss et al. [3].

The configuration between the ribs and the emergence of the bar is analyzed, and an absorbable USP (United States Pharmacopeia) size 2 polyglactin 910 transcostal suture is performed using a large needle under the positioned bar, facing the notches (Medxpert, Eschbach, Germany) intended for stabilizer fixation (**Figures 1 and 2**). If possible, a second suture is made contralaterally. No drainage is used.

Movement and sport are restricted:

- no twist or lateral flexion of the trunk for 3 weeks;
- no individual sports activity for 6 weeks;
- no team sports for 3 months.

The bar is removed at 2 years.

### **3. Study population and results**

Thirty-seven pectus excavatum patients operated on by this technique between January 2010 and December 2016 were included, 1 of whom was subsequently excluded for early bar ablation due to infection.

Table 1 shows results, and Table 2 complications. There was 1 case of neurologic deficit, in the left upper-limb C5 and C6 root territories due to bad sleep posture, in a patient receiving morphine derivatives. There was 1 case of bar displacement: 1/36, 2.78%; 95% CI, 0.07-14.53.

### **4. Discussion**

Incidence of bar displacement was comparable to the 2.1% reported by Nuss and Kelly [5] for stabilizers associated to pericostal suture, within the present 95% confidence interval, suggesting no real difference.

The present technique has several advantages:

- Absorbable suture avoids the complications of metal wire breakage (subcutaneous irritation, pulmonary parenchyma lesion) and facilitates subsequent bar removal.
- Transcostal, unlike pericostal, suture avoids intercostal needle passage with

risk of neurovascular bundle lesion (neuropathic pain, dysesthesia, bleeding with hemopneumothorax) or pulmonary parenchyma lesion.

- The absence of stabilizer reduces local discomfort and scar disorder, reduces procedural cost and shortens operative time.

## **5. Conclusion**

The present study demonstrated the efficacy and safety of this bar fixation technique over follow-up until removal: only 1 displacement was observed, out of 36 cases.

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## **Author contributions**

Eric Nectoux: study concept and design, re-editing.

Adrien Fournier: data collection, analysis and interpretation, article writing.

Damien Fron, Michel Bonnevalle, Bernard Herbauts, Aurélie Mézel: re-editing and advice.

## **Conflicts of interest**

The authors have no conflicts of interest to disclose.

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## Figure legends

Figure 1: Bar fixation by absorbable transcostal suture. Left: cross-sectional view; bar in front, rib behind.

Figure 2: Intraoperative photographs. 2A: Transcostal passage of suture, positioning the two ends in the notches on either side of the bar. 2B: Tying to bar.



Table 1: Patient data (n=36).

Male n(%)	31 (86.1)
Age at first consultation (years)	14.7 ± 2.2 (8.0 18.2)
Reason for consultation n(%)	
<i>Esthetic</i>	27 (75.0)
<i>Intolerance of effort</i>	7 (19.4)
<i>Pain</i>	3 (8.3)
<i>Feeding issues</i>	1 (2.8)
Symmetric pectus excavatum n(%)	28 (77.8)
Associated spinal deformity n(%)	8 (22.2)
Depth of excavatum (cm)	3.2 ± 0.9 (1.0 5.0)
Age at surgery (years)	15.7 ± 1.3 (13.0 18.7)
Preoperative Haller index	3.7 ± 0.8 (2.8 5.7)
Hospital stay (days)	7.4 ± 1.2 (5.0 10.0)
Operative time (min)	61.1 ± 14.7 (39.0 117.0)
Bar in place (years)	2.1 ± 0.2 (1.6 2.9)

*Qualitative variables reported as number (percentage), and quantitative variables as mean ± standard deviation (range).*

Table 2: Postoperative complications (n = 36)

Bar displacement	1 (2.78)
Thoracic drainage	2 (5.56)
Neuropathic pain	4 (11.1)
Hardware discomfort	0 (0.0)
Pneumopathy	1 (2.78)
Atelectasis	2 (5.56)
Metal allergy	1 (2.78)
Neurologic deficit	1 (2.78)

*Data reported as number (percentage).*



