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First single-centre Moroccan case series using the cross-bar technique for pectus excavatum repair: Early outcomes and feasibility

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Abstract
Background: The Cross-Bar technique has emerged as a valuable modification of the minimally invasive Nuss procedure, particularly for severe or asymmetric pectus excavatum. This study reports the first Moroccan single-centre experience with this technique.
Methods: A retrospective analysis was conducted on four patients who underwent surgery between July 2023 and July 2025 at CHU Ibn Rochd, using the Cross-Bar technique. Demographic data, severity indices, surgical details, and early postoperative outcomes were collected and analyzed.
Results: Four male patients (mean age: 20.25 years) underwent successful repair using two or three Cross-Bars. The mean Haller Index was 3.87. No intraoperative complications occurred. Postoperative pain was adequately controlled, and the median hospital stay was 4.5 days. One patient developed a surgical site infection as an early complication. After a median follow-up of 15 months, all patients maintained optimal correction, with a 100% satisfaction rate reported as good to excellent by patients and families.
Conclusion: This initial Moroccan experience demonstrates that the Cross-Bar technique is feasible, safe, and effective for correcting severe and asymmetric pectus excavatum, with excellent short- to mid-term outcomes. Further multicentre studies with larger cohorts and longer follow-up are needed to validate these findings.

Keywords: Pectus excavatum, cross-bar technique, morocco, minimally invasive repair, chest wall deformity

Introduction
Pectus excavatum (PE), also known as funnel chest, is the most common congenital anterior chest wall deformity, accounting for approximately 80% of cases. It is frequently associated with both aesthetic concerns and functional impairments.
The advent of the Nuss procedure in the late 1990s marked a major advance in PE correction, introducing a minimally invasive technique based on the placement of a retrosternal bar. However, in patients with severe, broad, or asymmetric deformities, the traditional single-bar approach may not provide sufficient chest wall remodelling.
Epidemiological data on PE prevalence remain scarce in Africa, and no registry exists in Morocco or North Africa. Nevertheless, international studies provide useful estimates, with prevalence ranging from 0.4% to 1.3% depending on the ^population studied, with a clear male predominance. These figures highlight the global relevance of this deformity and underscore the importance of reporting regional experience.
The Cross-Bar technique, first described by Park (1), involves the placement of two or more intersecting bars across the sternum. This method enhances anterior sternal elevation and improves stabilization, particularly in patients with wide, asymmetric or low-positioned deformities. Although widely adopted worldwide, this approach remains underreported in African settings. The present study describes the first Moroccan case series of PE repair using the Cross Bar technique, with the objective of assessing its feasibility, safety, and early postoperative outcomes.

Materials and Methods
A retrospective review was conducted on four patients who underwent minimally invasive repair of PE repair using the Cross-Bar technique at CHU Ibn Rochd, a tertiary thoracic surgery centre in Casablanca, Morocco, between July 2023 and July 2025.

Surgical indications were established in all cases following a comprehensive evaluation, including clinical symptoms, anatomical severity of the deformity and calculation of the Haller Index. Informed consent was obtained from each patient and, when applicable, from their parents.

All patients underwent a standardized preoperative work-up consisting of chest Computed Tomography (CT) with three-dimensional reconstruction, echocardiography and spirometry. The following data were collected for each patient: demographic information, preoperative Haller Index, deformity type according to Park's classification, number and position of bars, operative time, intra- and postoperative complications, length of hospital stay, and postoperative outcomes. Pre- and postoperative photographs were systematically obtained.

Surgical Technique

All patients received epidural analgesia, and the procedure was performed under general anesthesia with double-lumen endotracheal intubation. Patients were placed in the supine position, slightly shifted to the right side of the operating table, with both arms abducted. The surgeon stood on the patient's right side. The entire anterior chest and both groins were prepared and draped in a sterile manner.

A surgical skin marker was used to identify the deepest point of sternal depression as well as the planned entry and exit points. Full elevation of the depressed sternum was achieved using the crane technique, which involved wire sternal sutures to lift the chest wall beyond its natural level, thereby ensuring optimal exposure and correction.

Pectus bars were contoured intraoperatively to match the thoracic anatomy of each patient. Two-centimeter vertical skin incisions were made on both lateral chest wall, and an additional incision was created for thoracoscopic access.

Following chest wall elevation, two or three bars were placed through submuscular tunnels at predetermined intercostal spaces (hinge points) under thoracoscopic guidance. Based to the morphological features of the deformity, three patients were treated with a cross configuration, whereas one patient underwent an XI pattern (a cross-bar configuration with an additional upper horizontal bar). The first bar was oriented from the right upper to the left lower chest, and the second from the right lower to the left upper chest, both passing through the same mediastinal tunnel.

Once the desired thoracic contour was achieved, the bars were secured to minimize the risk of displacement. In three patients treated with the cross-bar technique, single lateral stabilizers were used, whereas in the XI configuration, the bars were fixed using the Wang technique (2). A pleural chest drain was placed in one patient. All incisions were then closed in standard fashion.

Results

A total of four male patients were included in the study, with a mean age of 20.25 years (range: 14-36 years). The mean preoperative Haller Index was 3.87 (range: 3.2-5). Symmetric deformities were observed in one patient (25%), while three patients (75%) presented with asymmetric deformities. According to Park's classification, one patient had type 1B, two patients had type 2A2R, and one patient had type 2B2L. Preoperative characteristics are summarized in Table 1.

Three patients underwent placement of two Cross-Bars, whereas one patient required two Cross-Bars plus an additional upper horizontal bar in an XI configuration to correct the upper sternal depression. A crane technique with sternal wiring was used in three cases to facilitate elevation of the chest wall. The mean operative time was 120 minutes, and no intraoperative complications occured.

Postoperative pain was managed using a multimodal regimen consisting of epidural analgesia for approximately three days, followed by oral analgesics. Chest X-rays were systematically performed to exclude pneumothorax, pleural effusion, and bar malposition (Figure 1). Intravenous antibiotics were administered for three days and then switched to oral antibiotics until discharge. The mean length of hospital stay was 4.5 days. One patient developed a surgical site infection, representing the only early complication observed. Intraoperative and postoperative details are presented in Table 2.

All patients achieved optimal correction of the deformity. After a median follow-up of 15 months, no cases of recurrence, bar removal, or revision surgery were reported. All patients expressed improved body image and satisfaction with cosmetic results rated as good to excellent in 100% of cases by both patients and their families.

Table 1: Preoperative characteristics

Patients	Gender	Age	Haller Index	Type
1	Male	14	3.87	2A2R
2	Male	36	5	2A2R
3	Male	16	3.2	1B
4	Male	15	3.44	2B2L

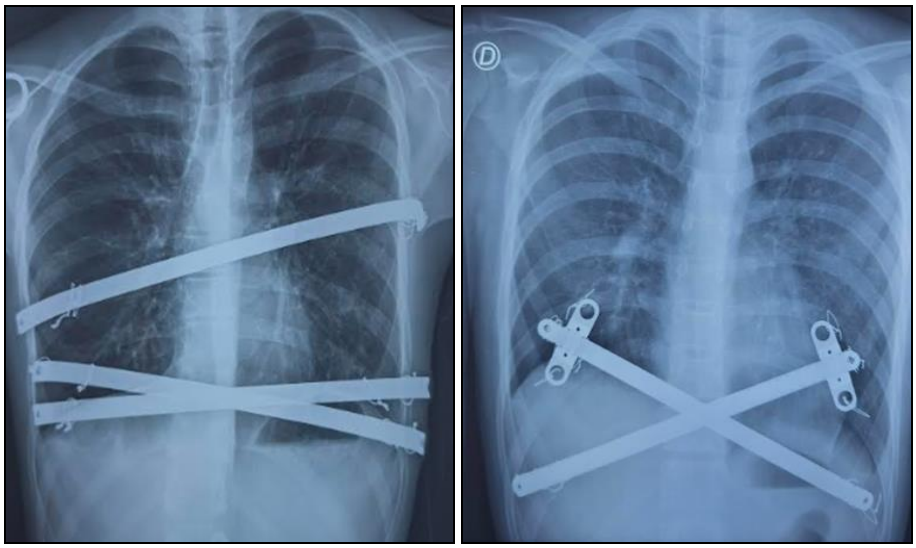

Fig 1: Postoperative chest radiograph after Cross-Bar technique (right) and XI technique (left)

Table 2: Intraoperative and postoperative findings

Patients	Number of bars	Bar fixation	Crane technique	Duration of surgery (min)	Length of stay (days)	Complication
1	2	Stabilizers	Yes	150	4	Yes
2	2	Stabilizers	Yes	135	4	No
3	2	Stabilizers	Yes	120	4	No
4	3	Wang Technique	No	180	7	No

Discussion

The Cross-Bar technique, first described by Park in 2016 for the treatment of the Grand Canyon-type deformity, demonstrated excellent aesthetic outcomes without major complications such as bar displacements or the need for reoperations. This approach combines crane elevation of the sternum with bridge fixation of the bars, often complemented by the addition of a third horizontal bar to achieve complete chest wall remodeling [1, 3].

Subsequently, Ermerak and Yüksel [4] introduced a modification using short crossed bars combined with a third horizontal bar, which proved effective in reducing bar migration and addressing specific anatomical challenges, including a short or steeply descending sternum and complex Grand Canyon deformities. More recently, Weinhandl *et al.* [5] adapted the concept of short crossed bars specifically for paediatric and adolescent patients, further broadening the applicability of this methos.

In our series, we achieved excellent correction in both symmetric and asymmetric deformities, without intraoperative complications and with only one early postoperative surgical site infection. These findings are consistent with larger international cohorts [3], which have shown that the addition of multiple bars does not increase operative risks or complication rates [3]. Kim *et al.* [3], for instance, compared 157 patients treated with cross-bars to 90 treated with parallel bars and reported no higher incidence of bar displacement or complications, despite more severe deformities in the cross-bar group. Similarly, recent studies suggest that the use of ≥ 3 bars provides superior correction highly asymmetric deformities, although it may be associated with a slightly increased risk of pleural effusion [4].

Compared with the classical single-bar NUSS procedure, the Cross-Bar technique offers superior sternal elevation and enhanced stability, thereby reducing the risk of bar migration. However, this comes at the cost of longer operative times and potentially increased postoperative discomfort, which in our experience were effectively managed with a multimodal analgesic strategy.

Our initial Moroccan experience confirms that the Cross-Bar technique is both feasible and safe in a resource-limited setting. Its success relies on meticulous preoperative planning, thoracoscopic guidance, and a coordinated multidisciplinary approach. The limitations of our study include its retrospective design, the small number of patients, and a relatively short follow-up period.

To our knowledge, this is the first Moroccan case series to report the use of the Cross-Bar technique for PE repair. Our results align with international reports, supporting its safety and effectiveness, particularly for severe and asymmetric deformities. These findings emphasize the importance of introducing and evaluating advanced chest wall techniques in North Africa, where epidemiological data remain scarce and clinical experience is still emerging

References

1. Park HJ. A technique for complex pectus excavatum repair: The cross-bar technique for Grand Canyon type deformity (Park classification). Ann Cardiothorac Surg. 2016;5(5):526-7. DOI: 10.21037/acs.2016.08.01
2. Wang W, Long W, Liu Y, Cai B, Luo J. Wang technique: A simple and practical steel bar fixation technique in thoracic deformity surgery. Int. J Surg Sci. 2022;6(3):78-83. DOI: 10.33545/surgery.2022.v6.i3b.924
3. Kim H, Rim G, Park HJ. Technical advances in pectus bar stabilization in chest wall deformity surgery: 10-year trends and an appraisal with 1,500 patients. J Chest Surg. 2023;56(4):229-237.
4. Ermerak NO, Yuksel M. Modification of the Nuss procedure: The crossed bar technique for new subtypes of pectus excavatum. Gen Thorac Cardiovasc Surg. 2023;71(10):577-583.
5. Weinhandl AC, Ermerak NO, Yüksel M, Rebhandl W. Short bars crossed to remodel the entire chest wall in children and adolescents with pectus excavatum. J Pediatr Surg. 2024;59(10):161590. PMID:38914508. DOI: 10.1016/j.jpedsurg.2024.05.020.

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