

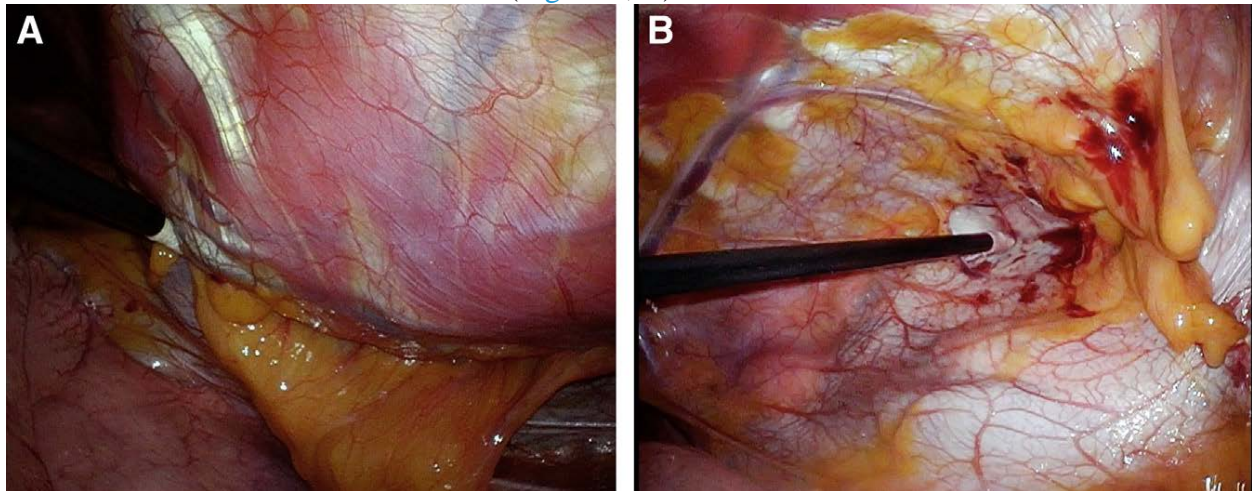
Sternal elevation before passing bars: A technique for improving visualization and facilitating minimally invasive pectus excavatum repair in adult patients

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Minimally invasive repair of pectus excavatum (MIRPE) is performed by placement of substernal metal bars. Visualization across the mediastinum is compromised in severe defects, and cardiac puncture and aortic injury have been described.¹ In adults with less chest wall flexibility, the bars require more force to rotate and intercostal muscle stripping may result, leading to bar malpositioning. We present a technique to elevate the sternum and facilitate adult MIRPE.

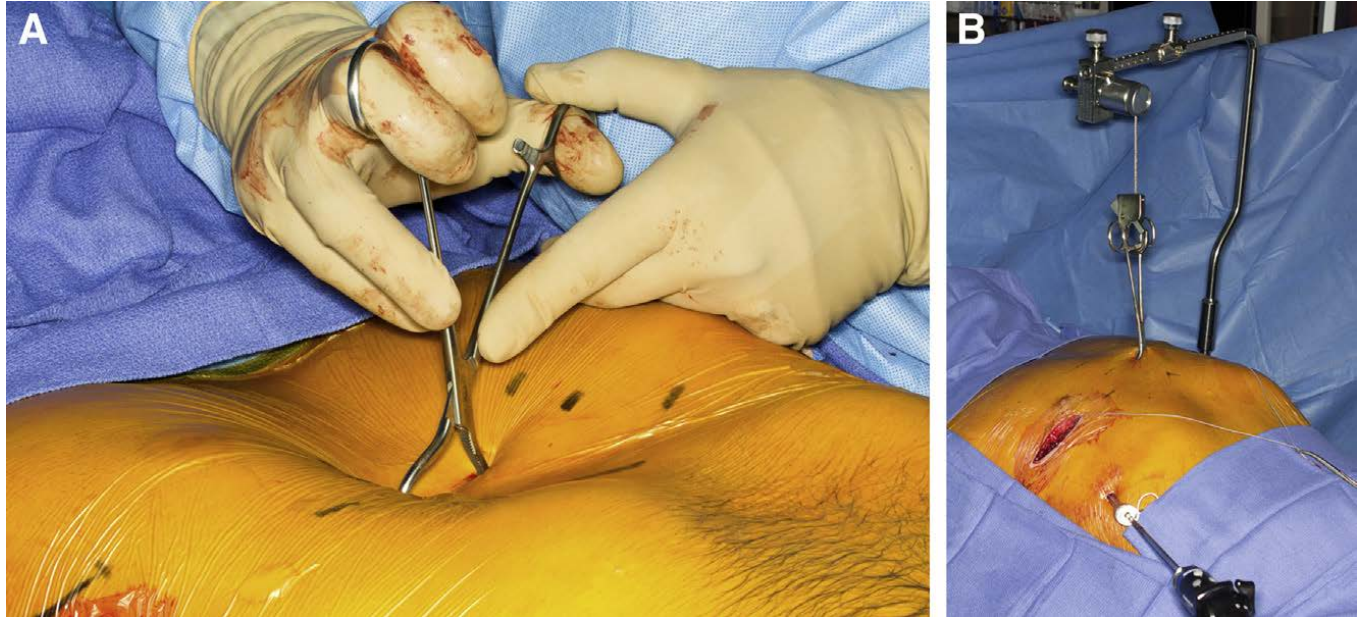
PROCEDURE

The patient is positioned supine, rolls underneath, and arms tucked at sides. Bilateral incisions and subpectoral pockets are developed. Ports are placed through the incision and inferior-lateral above the diaphragm. Cardiac compression is assessed thoracoscopically. If safe dissection is potentially compromised by defect (Figure 1, A), a bone clamp is placed into the sternum and a table-mounted retractor is used to elevate the sternum (Figure 1, B).



Patients with significant cartilage calcification and rigidity are also elevated before passing the dissector and bars. Puncture incisions in a rib space on either side of the sternum are made, and the perforating tips of a bone clamp (Lewin Spinal Perforating Forceps, V. Mueller NL6960; CareFusion, Inc, San Diego, Calif) are inserted (Figure 2,

A). The Rultract Retractor (Rultract Inc, Cleveland, Ohio) with extension arm is attached to the left side of the table, approximately level with the clavicle. The cable is then attached to the clamp, and the sternum is elevated (Figure 2, B).



Dissection across the mediastinum into the left side of the chest is performed. The Lorenz dissector (Lorenz Surgical, Inc, Jacksonville, Fla) is then passed into a right anterior interspace, woven under the sternum, and guided up through a corresponding interspace on the left. A No. 5 FiberWire (Arthrex, Inc, Naples, Fla) is attached to the passer. The passer is withdrawn, and a pectus bar is guided into position with the FiberWire. The bars are rotated into place with the sternum still elevated to minimize transverse stripping of the intercostal muscle. Under thoracoscopic guidance, each bar is circumferentially attached to a rib at 2 to 3 sites with FiberWire. The sternal elevation is released, and the clamp is removed. The pectoralis muscles are closed over the bars, and the incisions are closed with absorbable suture. Two single skin stitches are placed at the sternal punctures.

RESULTS

From June 2010 to June 2013, a series of 185 patients underwent pectus excavatum repair. In 63 patients, Rultract was used for forced sternal elevation. With experience and standardization of our technique, sternal elevation with

Rultract was used increasingly during pectus repair (9% of cases 2010 through June 2012, 57% of cases June 2012 through December 2012, 86% of cases January 2013 through December 2013). Mean patient age was 33.4 years (range 18-71 years), and 138 patients were male (75%). Procedures included 51 revisions of operations from other centers (30 open, 15 MIRPE, 6 multiple). The median Haller severity index of patients undergoing assisted sternal elevation was 5.5, versus 4.7 for patients in whom sternal elevation was not used. Rigidity of the chest wall was an additional indication for sternal elevation in 47 patients. All patients had at least 2 bars placed for repair, and 33% had a third bar. Median operative time for MIRPE with Rultract was 122 minutes (range 45-274 minutes). There were no intraoperative complications. Two patients had ecchymosis at the site of bone clamp insertion that resolved without sequelae.

DISCUSSION

Visualization and dissection across the mediastinum in patients with severe excavatum is impaired by the inwardly displaced sternum. Forced mechanical elevation increases the anteroposterior dimension and facilitates dissection and visualization. Expanding the retrosternal space has been recommended by others to minimize pericardial trauma and eliminate cardiac perforation.²⁻⁴ Other techniques require large incisions or blind dissection, although Yoon and colleagues⁵ have reported the use of wire stitches in the sternum.

We present a simple technique that requires minimal additional incisions or dissection to elevate the sternal deformity. This technique provides increased visualization and reduces stress on the intercostal spaces during bar insertion and rotation. Our use of forced sternal elevation has increased with experience, and this technique is now used in most adult MIRPE cases. We believe that this technique can facilitate safe dissection and bar passage as well as reduce the risk of intercostal muscle stripping in adult patients undergoing MIRPE.

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