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The ‘Double Twist’ Technique: A Novel Approach to Secure Sternal Closure and Prevent Dehiscence in Obese Patients After Cardiac Surgery

Dmitriy Panfilov, Boris N. Kozlov

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Abstract

> Sternal wound dehiscence after cardiac surgery, particularly in people with obesity, is a devastating complication. We present a ‘double twist’ technique for sternal closure, which firmly stabilizes the sternal halves without additional risk of wound complications.

Keywords: sternotomy, sternal closure, dehiscence.

Background

Sternal wound dehiscence (SWD) is a devastating complication after failed sternal closure. It is associated with a mortality rate reaching 50% [1], mostly due to mediastinitis caused by bone fracture and wound infection[2]. Among numerous comorbidities contributing to sternal instability, obesity is one of the major preoperative risk factors [1][3]. Different sternal closure techniques have been described to overcome SWD particularly in obese patients. However, the efficacy of the proposed methods is still debated [4][5]. We developed a secure technique of sternal approximation for rigid sternum fixation in patients with obesity (high body mass index of 40 kg/m^2 or greater) who underwent cardiac surgery.

Surgical Technique

The ‘Double twist’ technique is described step-by-step.

1. Initially we place stainless steel wire (no. 7, Ethicon, UK) parasternal sutures: one in the left half and one in the right half of the sternum (Figure 1, A). Starting from the manubrium, wires were passed down to ribs cartilage through the intercostal spaces sequentially skirting up and down each next rib.
2. Then six no. 7 single cerclage sutures are placed: two in the manubrium and four in the body of the sternum on the upper and lower edges of each rib gripping parasternal wires. Approximation of the sternal halves of the ribs starts by

twisting neighboring wire ends on the same sternal half (‘single twist’). Simultaneously every rib is embraced by twisting adjacent wires (Figure 1, B).

3. Alternate twisting of contralateral wire ends with increasing tension causing the sternal edges to come together.
4. In the final stage, the twisted wire ends of one sternal half are twisted tightly together with the wire ends of the opposite sternal half (‘double twist’) for rigid sternal closure (Figure 1, C). The wire surplus is cut and the twisted portion of the wires is bent to lie along the sternal surface.

Computed tomography performed at 12 months of follow-up confirmed sternal stability without fractures, deep sternal wound infection or noninfectious sternal wound complications (Figure 2).

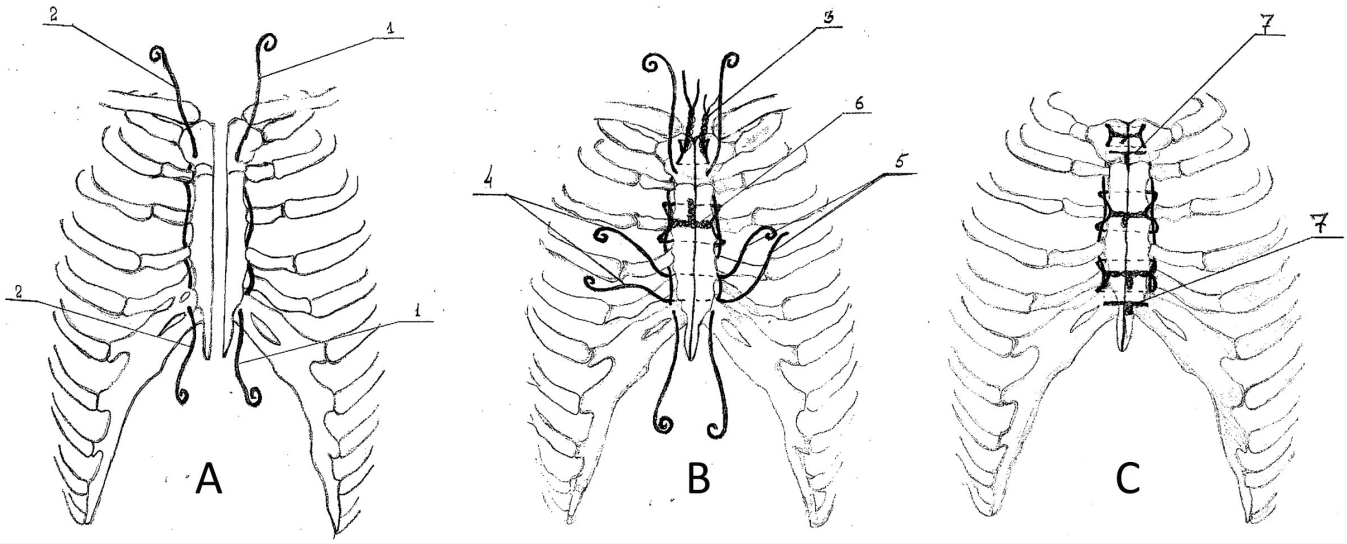

Figure 1.

Panel A. Placing of parasternal wire sutures in the left (1) and in the right half (2) of the sternum.

Panel B. Placing of single cerclage sutures (4, 5). ‘Single twist’ (3) and ‘double twist’ (6) creation.

Panel C. Final view of sternal closure. Twisted parasternal wire sutures (7)

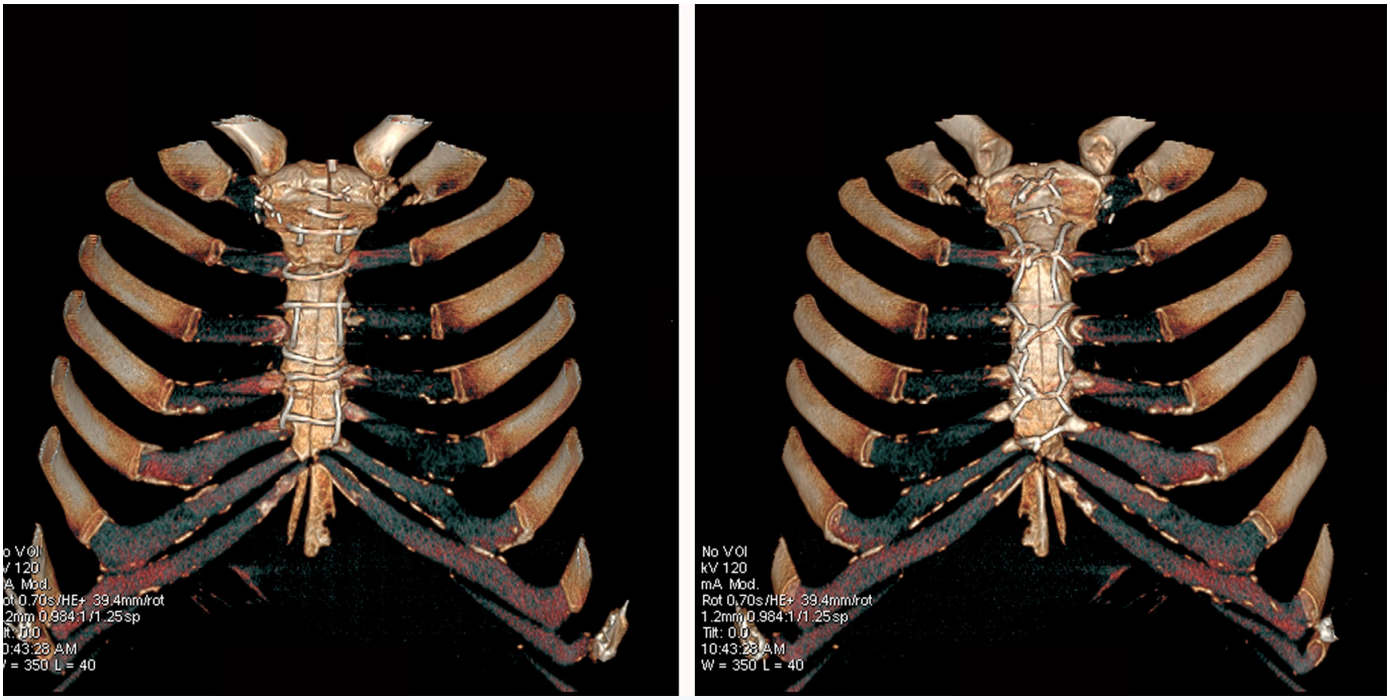

Figure 2. Three-dimension chest computed tomography after sternal closure using 'double twist' technique. Left panel – posterior view, right panel – anterior view.

Discussion

Sternal stability after cardiac surgery in people with obesity, diabetes mellitus and chronic obstructive pulmonary disease is a challenge. According to the literature, wire cerclage closure is associated with a high risk of sternal dehiscence [4][6]. Use of more complex sternal closure techniques as Z-shaped or figure-of-eight sutures are limited in patients with a narrow sternum. Additionally, these techniques did not show superiority over traditional sternal closure in prevention of SWD [5][7].

A number of different sternal closure techniques have been used to provide rigid fixation and freedom from SWD, such as: titanium plates, titanium hooks, thermo-reactive nitinol clips, flat wire sternal closure systems, plastic zip-tie-based systems and titanium cables with a specially designed tightening rig. The shortcomings of abovementioned methods are increased surgery costs and prolonged operative time when compared with the traditional osteosynthesis without a significant difference in outcomes [8]. This necessitates alternative approaches intended to achieve durable, cheap and non-complex sternal closure, particularly in patients with risk factors for SWD.

The main goal of the 'double twist' technique is possible prevention of acute and chronic sternal disunion resulting in reduction of duration of mechanical ventilation, hospital length of stay and total cost of care.

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