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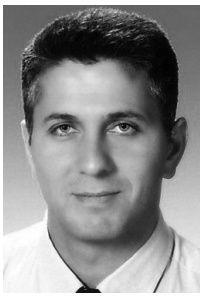
An Alternative Reinforced Closure Technique with External Kirschner Wires in Sternal Dehiscence



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ABSTRACT

Objective. We present an alternative closure technique that is effective in length stabilization of the dehisced sternum, technically easy, and less time consuming.

Methods. Between June 2000 and June 2003, 850 patients underwent open heart surgery in the participating clinics. In all of the patients, the sternotomies were primarily closed with No. 5 steel wires in a figure 8 manner or with single sutures. Eleven patients with sterile sternal dehiscence underwent operations with Kirschner wires.

Results. During the postoperative period, no complications related to the implants were observed in any of the patients in the early and late follow-ups.

Conclusion. With this technique, the fragile sternum is easily and effectively stabilized by reinforcing with suprasternal Kirschner wires without applying complicated manipulations.

INTRODUCTION

Sternal dehiscence is an infrequently seen complication of open heart surgery, but because it causes immobilization of the patient, it lengthens hospital stay and may lead to mediastinitis and additional sternal dehiscence, which may cause an increase in morbidity and mortality. In this report, we present a different type of closure technique applied to our patients with sterile dehisced sterna that occurred after coronary artery bypass operations.

MATERIALS AND METHODS

Between June 2000 and June 2003, 850 patients underwent operations in the participating clinics. Among these 850 patients, 11 patients had secondary operations for dehisced sterna. None of the patients had mediastinitis. Three of the 11 patients had their primary operations performed by different surgeons, whereas all 11 patients were secondarily operated on by the same surgeon. In all 850 patients, the sternotomies were primarily closed with No. 5 steel wires in a figure 8 manner or with single sutures. The patient data are summarized in the Table.

In the revision operation of each patient, after performing the bilateral medial mobilization of the pectoralis muscles achieved by meticulous dissection over the sternum, the old steel stitches were removed from the dehisched sternum. Then 2 Kirschner wires 2 mm in diameter that were the same length as the sternum were shaped to fit the angle and the longitudinal axis of the sternum.

We bent the Kirschner wires in 3 places to make 3 notches. We used 3 steel wires to connect the 2 Kirschner wires. We used the notches to prevent the slipping of the steel wires. Then we took the Kirschner wires, each with 3 notches, and approximated these notches to the unfractured areas of the sternum. Then the 2 ends of the Kirschner wires were bent and imbedded into the sternum; one end plugged into the manibrium and the other end into the corpus sterni.

After confirming the stability of the imbedded Kirschner wires, the 2 Kirschner wires were connected with 3 No. 5 steel wires. Each steel wire was passed over a notch on the right Kirschner wire, then passed through the intercostal space, beneath the sternum via retrosternal space, and positioned in the contralateral side of the sternum. A loop around the contralateral notch on the left Kirschner wire was formed. Then the steel wire was passed through the intercostal space on the left side, passed beneath the sternum via the retrosternal space again, and positioned in the right intercostal space. Finally, the 2 ends of the steel wire were twisted on the notch to secure the stitching (Figures 1 and 2). The 2 great pectoral muscles were approximated with single sutures over the sternum to diminish the contractile force of the muscles on the sternum. The operation was completed after closing the subcutaneous tissue and the skin (Figure 3).

RESULTS

The patients were extubated in the first 12 hours after the operation and discharged from the hospital between the 9th

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Demographic Data of the Patients and the Day of the Postoperative Sternal Dehiscence

Patient	Gender	Age	Diabetes	Chronic Obstructive Pulmonary Disease	Day of Sternal Dehiscence	Additional Disease
1	F	55	+	–	3	
2	M	60	+	–	8	
3	M	63	–	+	9	
4	M	64	–	–	10	
5	M	67	+	–	4	
6	M	70	–	+	3	
7	M	57	+	–	13	Chronic renal insufficiency
8	F	71	–	+	9	
9	F	72	–	+	9	
10	F	54	+	–	15	Congestive heart disease and hypothyroidism
11	M	50	+	+	8	

and 12th days. The patients were followed for 7 to 24 months after discharge. During this follow-up period, no sternal dehiscence, implant migration, or skin erosion were observed.

DISCUSSION

The rate of sternal dehiscence after open heart surgery is 0.8% to 1.5%, and this rate increases up to 8% after coronary artery bypass grafting operations in which bilateral mammarian arteries are used [Kirklin 2003]. Sterile sternal dehiscence following open heart surgery generally occurs between the 7th and 10th day after the operation [Edmunds 1997]. In several studies, the mortality rates were reported to be 60% to 70%, and with effective treatment this rate decreased to 5% to 10% [Kirklin 2003]. Because of these high mortality and morbidity rates, maintaining a strongly stabilized sternum at the initial operation is crucial.

For the closure of the sternotomy, many techniques like silastic band, Parham band, implantation of steel plates, figure 8 manner, and Robicsek technique have been used [Robicsek 1977; Di Marco 1989; Scovotti 1991]. In addition to these techniques, Watanabe and Misaki closed the sternum of a patient with pectus excavatus by using intramedullar Kirschner wires [Watanabe 1996]. They recommended that this technique be used in open heart operations on patients with osteoporotic sterna or on patients in whom there were sternal fractures caused by sternal retractors.

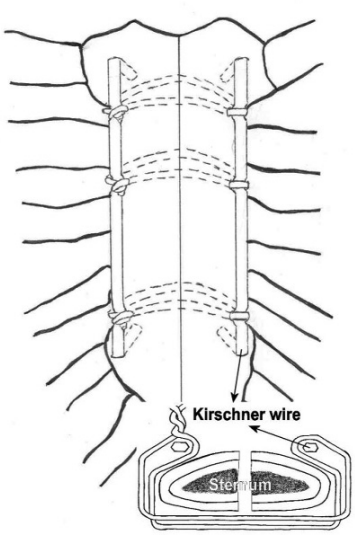

Figure 1. Drawing demonstrating the Kirschner wires plugged into the sternum, the steel wire stitches, and showing the transsectional view of the sternum.

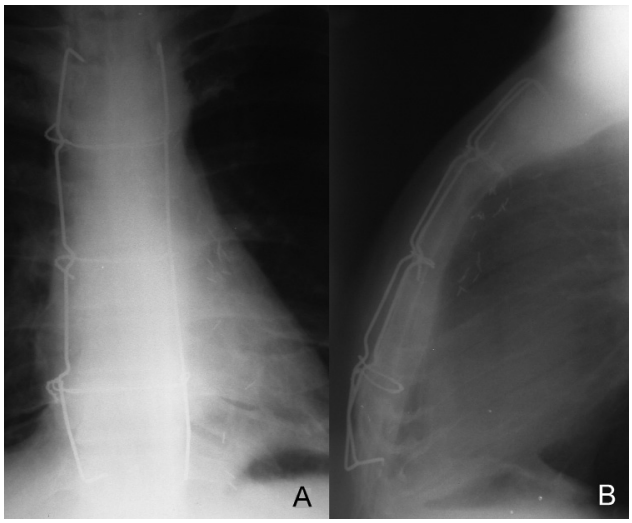

Figure 2. A, Roentgenogram showing the posteroanterior view of the sternum postoperatively. B, Roentgenogram showing the lateral view of the sternum postoperatively.

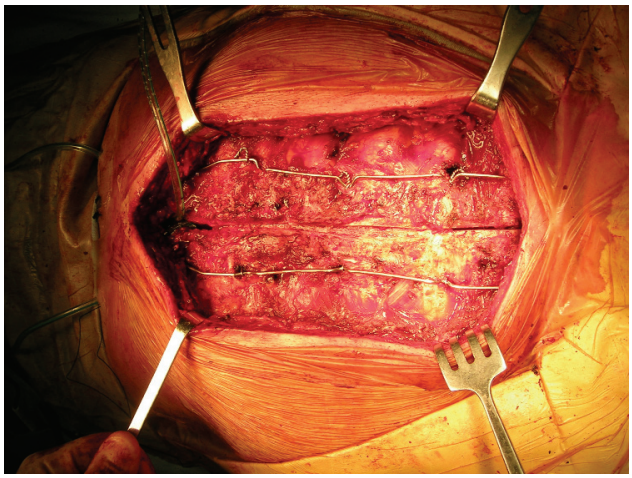

Figure 3. Intraoperative view of the sternum after the closure.

Usually there are multiple fractured pieces on both sides of the sterna because of the wires that pull through and leave the sterna unstable on both the longitudinal and the horizontal axis. These fractured pieces cause paradoxical motion of the sternum. That is why the main goal is to avoid this paradoxical thoracic motion and speed up the healing of the sternum through stabilizing the longitudinal as well as the horizontal axis.

The Kirschner wires that were used to buttress the peristernal wire sutures in our technique are identical in shape and size and are assumed to apply balanced forces on each hemisternum, hence providing better stabilization and protection against the peristernal wires cutting into the fractured bone. For this purpose, the width of the Kirschner wires plays an important role and needs to be thick enough to resist the force exerted by the lateral movement of the thorax. We find Kirschner wires 2 mm in diameter are suitable for this purpose because these wires do not bend easily. Since the sternum is multifractured and fragile, it is important not to traumatize it, which can be done by avoiding excessive stitches. That is why we applied each Kirschner wire only at 2 points. These points must be chosen from the strongest parts of the sternum and the wires must be imbedded with great care and strongly secured. The stability of the sternum, and the success of the operation, depend on these 4 points. The parasternal steel wires that pass through the retrosternal space support the Kirschner wires by impeding the inward motion of the fractured sternal pieces during inspirium. We believe that our technique is effective in treating the dehisched sterna and can be an alternative approach in the stabilization of a sternum that has been excessively damaged and fractured.

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