A novel technique in sternal closure after cardiac surgery for high-risk patients: a pilot study

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Background
Sternal closure after cardiac surgery is a very important step, especially in high-risk patients such as obese, old age, osteoporotic females, diabetic, and after coronary artery bypass grafting. Poor sternal fixation is one of the postoperative complications that can result in increased morbidity and mortality.

Patients and methods
The idea of this technique is to take the advantage of peristernal circulage by use of heavy stainless-steel wires, which direct the dispersion forces on the body of the sternum, and also to use a trans-sternal wires to control the up and down movement of each part of the sternum.

Results
This technique was applied in six patients, comprising three females and three males. Intraoperative evaluation of the sternal stability by the surgeon revealed completely stable sternum. Moreover, postoperative examination and follow-up till 2 months revealed completely stable sternum.

Conclusion
This technique is a simple, easy, and effective method for prevention of sternal dehiscence after sternotomy.

Keywords:
sternal closure, sternotomy, high risk

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Introduction

Postcardiac surgery sternal closure is a crucial step, especially in high-risk patients, such as with obesity, diabetes, old age, osteoporosis in females, and also in some operations such as coronary artery bypass grafting (CABG). Although poor sternal fixation as a postoperative complication can result in increased morbidity and mortality, sternotomy is still preferred over other techniques, for example, lateral thoracotomy, in most cardiac surgeries. Surgical options for sternal fixation after median sternotomy include wiring, interlocking wiring, plate-screw fixation, peristernal anchor system, and cementation techniques. Deep sternal wound infection is one of the most important postoperative sternal wound complications. It can increase the risk of mortality up to 47%, compared with 2.7–5.5% in uninfected controls [1–3].

Patients and methods

Aim of the study

The aim was to find a nonstandardized technique to prevent sternal complication after sternotomy in cardiac surgery in patients with increased risk for poststernotomy complication by using a simple, easy, and cost-effective method in centers with limited resources. Consent and ethical approval was taken the IRB number is 17300573.

Population under study

Patients with increased risk for sternal dehiscence such as obese, old age, osteoporotic females, diabetic, post-CABG, and large muscular males were included.

Description of the surgical technique

The idea of this technique is to take the advantage of peristernal circulage by use of heavy stainless-steel wires, which direct the dispersion forces on the body of the sternum, and also to use trans-sternal wires to control the up and down movement of each part of the sternum. The idea behind the use of peristernal wiring only as by simple wiring or as in other anchor techniques is that it will not hinder the rocking movement of each part of the sternum, which will lead to instability of the sternum and sternal dehiscence. So, trans-sternal wires will be applied mainly to guard against the rocking movement. Moreover, the use of stainless-steel wire only is a simple and cost-effective method.

Surgical technique

The idea of this technique is to take stainless-steel wire size 7. Simple stiches are made in the intercostal space around the sternum with great care not to injure the mammary vessels, followed by another stich in the sternum (trans-sternal) within the same level. The result being 8–10 simple stich half peristernal and half trans-sternal.

Examination of the technique is done intraoperatively by the surgeon and postoperative examination and follow-up of the patients till 2 months, and also by asking the patient if there is any sensation of sternal movement during the follow-up period.

Results

This technique was applied in six patients, comprising three females and three males. Among the females, a 67-year-old female patient with osteoporosis came for redosternotomy after prosthetic mitral valve thrombosis, one 33-year-old obese (95 kg) female patient came for redoprosthetic mitral valve thrombosis, and another 28-year-old, 106-kg patient came for the first time for open heart surgery (isolated pulmonary stenosis).

There were three male patients, one 116-kg male patient came after CABG procedure, another one 120-kg male patient came after CABG procedure, and another tall muscular 95-kg male patient came for redosternotomy. All patients were not diabetics, and the left internal mammary artery was taken in the two CABG patients. It is a simple, easy, and cost-effective technique.

All patients were free from wound complication. By asking the patients if they felt any rocking movement in the sternum, all patients did not feel any sternal movement, except one patient who underwent CABG (116 kg patients) and experienced postoperative bronchitis and paroxysmal irritant postbronchitis cough after he was discharged home; in the follow-up, he told us that he felt a rocking movement in the lower part of the sternum with cough. Later on the follow-up with the use of only chest belt and after 4 months, the sternum was completely stable.

Discussion

This pilot study describes a new, simple, and cost-effective technique of sternal closure using stainless-steel wires with the aim to avoid bone rupture in high-risk patients in comparison with the standard technique of sternal closure after sternotomy for cardiac surgery.

Robicsek *et al*.[4] performed a sternal closure technique by placing steel wires on both sides of the sternum, and anterior and posterior to the costal cartilage in an alternating fashion, which were tied together. Then six wires were passed around the parasternal weave and also were tied together. Their technique was applied in eight patients, in five of them to prevent complications and in the other three to correct existing complications (nonunion and infection). Satisfactory results were reported in terms of correcting preexisting instability and infection. This technique was also reported by other researchers either in a simple or a more complex manner [5,6]. Besides it being a time-consuming surgical technique, several complications can possibly be detected such as internal thoracic artery-pseudoaneurysms and increased bleeding [7]. Those complications were not reported in our technique.

Some authors compared the use of new techniques with the standard technique of sternal closure in patients with one or more risk factors as a prophylactic method to avoid complications. Narang *et al*.[8] found a lower chance of sternal dehiscence in patients with one or more risk factors with the use of peristernal anchoring techniques of stainless-steel wires than the standard technique. However, they found no difference between standard and nonstandard methods in patients with a single risk factor. The incidence of sternal dehiscence was reported to be 12.5% after routine stainless-steel wiring for sternal closure and 2.5% after nonstandard techniques. It was concluded that routine sternal closure is sufficient in patients with a single risk factor, but the use of prophylactic anchoring techniques of stainless-steel wires should be performed in high-risk patients, with two or more risk factors, undergoing median sternotomy for cardiac surgery.

Lazar *et al*. [9], who used Robicsek technique in closing multiple sternal fractures, found that this technique may decrease the chance of sternal dehiscence and wound infection. Sharma *et al*.[5] also found a lower incidence of sternal dehiscence in patients with anchorage techniques than in standard sternal closure technique.

Conclusion

The peristernal anchoring techniques using stainless-steel wires as a nonstandard technique for median sternotomy closure after cardiac surgery to prevent bone rupture have lower incidence of postoperative complications (sternal dehiscence and infection) in comparison with the standard, trans-sternal, stainless-steel wires technique in patients with risk factors. In addition, our technique is a simple, easy, and effective method for

prevention of sternal dehiscence after sternotomy in high-risk patients after cardiac surgery.

According to the current study, this technique for sternal closure can be applied in high-risk patients who undergo elective cardiac surgeries. However, this technique was not studied to be performed for patients in which sternal separation and infection had already occurred.

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Conflicts of interest
There are no conflicts of interest.

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