



Sternal Banding for High Risk Cardiac Surgery Patients – Curse or Cure? -A Prospective Study

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ABSTRACT

A comparative study of two sternal closure techniques in 14 numbers of patients. Group A consists of conventional sternal wire, peristernal closure and group B consists of sternal band, para-sternal closure. To study postoperative results in high risk patients for sternal dehiscence and mediastinitis. Also need for rewiring in this group of patients. We conducted a prospective study of all the patients who underwent sternotomy for open heart procedures and excluded the patients who does not fit into the selection criteria and followed up these patients for a period of 6 months and analysed the various predisposing factors causing sternal infections and dehiscence.

KEYWORDS : Sterna infection, Dehiscence, Sternal wire, Sternal band, Sternal corset

Background:

A comparative study of two sternal closure techniques in 14 numbers of patients. Group A consists of conventional sternal wire, peri-sternal closure and group B consists of sternal band, para-sternal closure. To study postoperative results in high risk patients for sternal dehiscence and mediastinitis. Also need for rewiring in this group of patients. We conducted a prospective study of all the patients who underwent sternotomy for open heart procedures and excluded the patients who does not fit into the selection criteria and followed up these patients for a period of 6 months and analysed the various predisposing factors causing sternal infections and dehiscence. By deciding on table by putting sterna band for all high risk patients, can avoid significant rate morbidity and mortality in these group of patients and also avoid long duration of stay in the hospital following infection, dehiscence and rewiring the sterna.

Objectives:

To plan in high risk sternotomy group of patients, who require sterna band for closure of sternum instead of conventional sterna wiring. This group of patient develops sternal infection and dehiscence leading to prolonged antibiotic usage, long duration of stay, sterna corset and requiring re-surgery in the form of sterna rewiring once the infection is under control, which is an avoidable complication in these patients.

Materials and Methods:

A prospective study on high risk cardiac surgery patients, patients with uncontrolled diabetes, post menopausal female patients with thin sternum and osteoporotic patients with > 65 years of age under went cardiac surgery was included in our study group. Randomized, double blind technic was following to categories group A & B patients. This study was done during the period January 2013 to June 2015.

Observations and Results:

It has been proved beyond doubt that for all high risk patients is better to electively proceed with sternal banding during closure to avoid sternal dehiscence due to mediastinitis, uncontrolled diabetes and osteoporotic sternum, when compared to sternal wired patients, who needs prolonged hospitalization, higher antibiotic usage, sternal corset and few patients need sternal rewiring or banding which itself carries very high of mobility and mortality. During the study period, 14 patients were included and prospectively randomly allocated to one of the two treatment groups. Patients were listed at the cardiac thoracic centers in Madras Medical College (n 14 patients). Age, Sex and operative data were comparable in both groups (Table1). Both groups were well balanced except for the distribution between the sexes and the New York Heart Association (NYHA) classification.

Table 1. Clinical profile of the sternotomy patients for cardiac

surgeries during our study

Total Number: n=14	08 : 06
Male : Female	
Group A	07 patients
Group B	07 patients
Age range	
20 – 35 years	02 patients
36 – 50 years	03 patients
51–65 years	06 patients
More than 65 years	03 patients
Procedure performed	
CABG	04
Valvular	08
Reoperation	02

(Note: Group A- Sternal wiring & Group B- Sternal Banding)

In all, 07 patients (50%) received a conventional sternal wiring; and in 07 patients (50%), chest closure was done using sternal band technique. Thus, no significant difference with respect to the primary end-points was seen between the two treatment groups. Isolated sternal dehiscence without evidence of infection was observed in 02 patients (14%), superficial sternal wound infections occurred in 03 patients (21%), 07 patients (50%) in the conventional treatment group and 07 patients (50%) in the sternal band treatment group (p 0.07). Eleven patients suffered from diabetes, 04 patients (28%) in the conventional treatment group and 03 patients (21%) in the sternal band treatment group (p 0.00; Table 2).

Table 2. Incidence of risk factors for sternal dehiscence in patients group A and B

Risk Factors	Age more than 65	Diabetic	Obesity	Post menopausal	Thin sternum
Group A	1 (1.72) [0.30]	7 (6.32) [0.07]	4 (4.03) [0.00]	9 (9.20) [0.00]	2 (1.72) [0.04]
Group B	2 (1.27) [0.41]	4 (4.68) [0.10]	3 (2.98) [0.00]	7 (6.80) [0.01]	1 (1.27) [0.06]
Totals	3	11	7	16	3

The chi-square statistic is 1.0002. The p-value is .909764. The result is not significant at p < .05.

Patients with sternal dehiscence were more likely to have a body mass index greater than 30 kg/m², NYHA class greater than III, sternal closure performed by an assistant doctor (p 0.004), postoperative bleeding (p 0.53, 0.48), re-exploration for bleeding. The impact of sternal band (p 0.03, 0.11, 0.48, 1.95) or conventional sternal closure (p 0.03, 0.12, 0.53, 2.15) reached no significant correlation on body mass index, NYHA class greater than III, postoperative bleeding and rewiring, respectively (Table 3).

Table 3. Patient & Operative factors in patients group A and B

Closure type	Body mass kg/M ²	NYHA III-IV	BLEEDING	REWIRING
Group A	3 (3.32) [0.03]	8 (9.02) [0.12]	2 (3.32) [0.53]	6 (3.32) [2.15]
Group B	4 (3.68) [0.03]	11 (9.98) [0.11]	5 (3.68) [0.48]	1 (3.68) [1.95]
Totals	7	19	7	7

The chi-square statistic is 5.3872. The *p*-value is .145546. The result is not significant at *p* < .05.

Discussion:

The key factor in preventing sternal dehiscence and infection is a stable sternal approximation. All sternal closure techniques claim to maximize sternal stability, but it is difficult to differentiate between the merits of various techniques. In 2005, survey at all German cardiac surgical departments revealed that there was no uniform osteosynthetic method for primary sternal closure in high-risk patients. Furthermore, if the usual sternal closure technique was abandoned in patients who were supposed to be at risk for sternum instability and subsequent DSWI, the most commonly mentioned preventive technique was the sternal closure technique described by Robicsek, followed by the use of more wire cerclages [27].



Figure 1. Sternal infection and dehiscence in post MVR at 7th postop day

The current standard for sternotomy closure remains the method of wire circlage (here defined as conventional technique). Many authors described that sternal halves fixed with wire fixation techniques have proved to be more stable biomechanically than other methods of sternal closure [30, 28]. Losanoff and colleagues [3] found in a fresh adult human cadaveric model that mechanical stability of peristernal and alternating peristernal and transsternal wires were significantly greater than pericostal and figure-of-eight closure technique. Friberg and associates [9] could prove that the use of seven or more sternal fixation wires was associated with a marked reduction in DSWI (0.4%) compared with employing six or fewer wires (4.2%; *p* 0.001). The authors described growing evidence that an additional wire at the caudal sternum substantially reinforces sternal fixation and has a preventive effect on the incidence of DSWI [9]. Studies on embalmed cadavers and clinical experience suggest that, in most cases, the wire would likely cut through the bone before suture breaking or unwinding due to increased stress [18]. Depending on the amount of movement and tension placed on the point of contact, the bone will often fracture before the period of healing is complete. These considerations led to the adoption of surgical techniques in patients with an increased risk for sternal instability to decrease morbidity, mortality, and hospital costs.

The technique described by Robicsek and coworkers in 1977 has several advantages: it stabilizes the sternum if it is fragile or broken; if subsequent instability develops, it prevents the wires cutting through the bone; it changes the site of pressure and provides wider support, especially if the sternum has been mishandled with the

sternum retractor. This technique changes the point of contact from metal to bone to contact of metal to metal. The disadvantage of this technique is that it produces a constrictive weave that can disrupt the collateral blood supply of the sternum, and effective approximation of the top and bottom of a gaping sternum cannot be obtained [26, 28]. In a study by Molina and colleagues [20], 123 obese patients were prospectively divided into two groups (Robicsek technique, *n* 54, versus standard sternal closure, *n* 69). The Robicsek technique group had no dehiscence (0%) versus the standard closure group with 6 dehiscence's (8.7%) [20].

This multicenter trial could not demonstrate that the Robicsek technique results in less sternal dehiscence or sternal infection, nor did this technique positively influence clinical postoperative factors such as mechanical ventilation, blood loss in the intensive care unit, transfusions, re-exploration for bleeding, postoperative delirium, intensive care unit stay, hospital stay, and mortality related to DSWI. It was not our intent to establish multiple preoperative, intraoperative, and postoperative risk factors associated with an increased risk for sternal wound complications; these have been done by several other authors and could even be confirmed in this study [1, 8, 13, 14, 16, 28]. This study contains the obvious limitations of missing documentation concerning the internal mammary artery preparation. Furthermore, we only evaluated those cases of sternal dehiscence, SSWI, and DSWI identified before hospital discharge.

Conclusion:

In conclusion, the key factor in preventing sternal dehiscence and sternal wound infection is a stable sternal approximation. Careful attention to hemostasis and meticulous surgical technique remains the mainstays of prevention and must include precise sternal alignment and stable closure. The methodological strength of this trial is that the influence of the surgical performance in a multicenter approach leads to an obvious consideration of the individual surgical influence. Especially if a more complex technique seems theoretically to be superior (one surgeon's results), it is not able to achieve the requirements under "real life" conditions. Therefore, in this setting, we did not observe any benefit of a reinforced osteosynthesis according to the Robicsek technique in patients with an increased risk for sternal wound complications. Even though the study group is very small number, the outcome and inference we get from the study is definitely acceptable. This study proves that for high-risk cardiac surgery patients the use of sternal band for median sternotomy closure is simple, safe, cost effective, reliable and reproducible technique. When compared to the complication like mediastinitis, dehiscence and re-wiring.

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