How to do it

Routine sternal closure using interlocking multitwisted wires

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Abstract

We describe a method of sternal closure that enhances sternal stabilization and minimizes bleeding from sternal fractures caused by retraction. With the technique of interlocking multitwisted wires the initial placement of the wire sutures is the same as in traditional sternal closure, however the twisting technique is improved, with multiple twisting including four twisted strands. Our method of closure is effective, simple and quick to perform and has several advantages over conventional or figure-of-eight closure. This closure is also biomechanically more rigid than conventional or figure-of-eight closure. We therefore recommend routine sternal closure using interlocking multitwisted wires.

Keywords: Sternalotomy; Wires; Biomechanics

1. Introduction

Median sternotomy is the preferred incision in cardiac surgery with a small [1] but troublesome [2] risks of sternal dehiscence, infection and non-union. We have used a technique of interlocking multitwisted wires to approximate the sternal edges. This technique is useful in cases with troublesome oozing from the sternal marrow and is particularly good in cases with osteoporotic or fractured sternums.

2. Technique

We use stainless steel no. 5 wire sutures for sternal closure. Initial placement of wire sutures is identical to traditional sternal closure, shown in Fig. 1; wire 1. We place all wires approximately 1.5 cm from the sternal edge, or parasternally in narrow sternums. Six to eight such wires are placed, four to six in the body of the sternum and two in the manubrium.

Approximation of wires starts by twisting adjacent wire ends as in Fig. 1; wire 2. No tension is required at this stage, however it is important to keep the twisted portion of the wires equidistant from where the wires emerge from the sternal half. The contralateral ends of the adjacent wires are then hand-twisted under tension causing the inner portion of the sternum to come together. To aid this, an assistant approximates the sternal edges using the other wires. Again it is important that the twisted portion of the wires are equidistant from where the wires emerge from the bone. The two twisted ends of the wires are then twisted together, as shown in Fig. 1; wire 3, further tensioning all portions of the interlocking multitwisted wires. The resultant four-strand twisted portion is then bent 90° to lie along the surface of the sternum. Absorbable sutures are then used to close the wound in layers.

Removal of these wires can be achieved quickly and simply by cutting the two wires on one side flush to the sternum. Pulling the central four-stranded portion easily removes the wire.

3. Comment

Sternal instability, wound infection, osteomyelitis and dehiscence are related [3]. The key factor in preventing these complications is a stable sternal approximation [4]. All techniques claim to maximize sternal stability, but it is difficult to differentiate between the merits of various techniques scientifically. The stability of sternotomy closures lies in the wire-twisting [5]. Our technique of interlocking multitwisted wires offers maximal sternal stability over other types of closures as the twisted portion of this closure contains four strands of...
wire [6]. This greater stability in the sternal closure results in a more secure bony union [7]. Our closure technique has been used in routine surgery in our institution in more than 2000 patients over 10 years with a dehiscence rate of 0.5%. In particular it has been used in patients at a higher risk of sternal dehiscence, like osteoporotic and/or fractured sternums, with a satisfactory outcome. We believe that placing eight wires as opposed to six further reduces the dehiscence rate.

In the interlocking multitwisted technique each unit of the closure consists of two straight strands of wire and two twisted wires bridging the sternum. As in a strand of rope, wire twisting increases the strength of the wire beyond the additive contributions of its constituent parts - in effect the twisted wire corresponds to a larger gauge of wire.

Advantages over figure-of-eight wires include the following:

1. The wires behind the sternum are tensioned before the wires anterior to the sternum. This obviates the difficulty of tensioning all portions of a figure-of-eight wire.

2. Lateral compression of the sternum [4] stabilizes fractured portions of the sternum and diminishes bleeding from the sternum and marrow. This is better achieved with the interlocking multitwisted wiring technique than figure-of-eight wires as in our technique the lateral compression is produced by wires at 90° to the cut in the sternum instead of at 45°.

3. With our technique there are four wires twisted together instead of two, thus reducing the risk of untwisting resulting in a more secure closure in the cases where dehiscence occurs by wire-untwisting. Also untwisting with our technique would result in failure of the anterior element of the closure but not the posterior element, which is tightened independently.

4. The area within the ‘bite’ of an interlocked multitwisted wire is greater than a figure-of-eight wire. The interlocked multitwisted wire configuration results in distribution of sternal stress over an increased area thus diminishing the risk of wire-cutting-through bone [8].

Theoretical disadvantages of this technique relate to the increased amount of foreign material located anterior to the sternum. This has not proved to be problematic in practice. The larger twisted knot may however be more prominent than the conventional twisted knot in extremely thin individuals, especially because of its near midline location.

We do not hesitate to place wires parasternally utilizing the strength of the lateral sternal cortex, if the sternum is thin, narrow or shows signs of osteoporosis. These include denting of the sternum by retractors, buckling of the sternal cortices with destruction of the marrow space, minimal resistance to the wire needle or sternal fractures.

We have biomechanically tested the rigidity of the wire closure in a metal sternal model [6]. Our results showed that the most rigid closure was the interlocking multitwisted closure that displaced only 0.37 mm at a force of 20 kg, whereas figure-of-eight wire displaced 1.20 mm and conventional closure 0.78 mm (single factor ANOVA test P < 0.0001). It has been shown that rigid fixation of the sternum results in earlier union [9]. This biomechanical evidence adds weight to our favourable clinical experience with this closure technique.

Our method of closure is effective, simple and quick to perform. It does not prolong closure of the chest as compared to conventional sternotomy closure. There are no complications from this closure. We believe that interlocking multitwisted wires is a reliable method of sternotomy closure that should significantly reduce the use of complex rescue closures for failed closures.

References


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