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Letter to the Editor

New improved sternal bands – a biomechanical analysis

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Median sternotomy is the most commonly used surgical approach in cardiac surgery. Sternal dehiscence results in significant mortality and morbidity. The efficacy and safety of sternotomy closure using sternal bands has previously been demonstrated to provide an effective median sternotomy fixation [1].

We have previously measured the force-displacement curves of various fixation techniques with a metal sternal model using a computerized materials-testing machine [2]. Steel sternal bands (Sternaband, Stony Brook Surgical Innovations, Inc., Stony Brook, NY) have recently been modified by the addition of a spot weld on either side of the buckle region. The two different types of sternal bands were tested and the results interpreted using force-displacement curves in order to assess any change in biomechanical characteristics. The rigidity of sternotomy fixation, defined as displacement at 20 kg force (the force at which wires used in sternotomy closures start to untwist), was also determined. We also measured the pull-through strength of sternotomy fixation using sternal bands.

The most rigid closure was the new welded sternal band closure that displaced 0.5 ± 0.1 mm (mean $\pm$ SD) at a force of 20 kg. The original non-welded sternal band closure displaced 1.4 ± 0.5 mm (t-test $P = 0.003$, single factor ANOVA $P = 0.001$). Failure displacement for the welded closure was 72.2 ± 9.4 kg and 73.3 ± 1.6 kg for the non-welded closure (t-test and single factor ANOVA, non-significant).

The new welded sternal bands demonstrated significantly superior rigidity compared to the non-welded closure. The rigidity of the welded sternal bands is 345% that of the non-welded sternal bands. Rigidity is an important characteristic of a closure technique since rigid fixation of the sternum results in earlier union with primary osseous healing (osteosynthesis) [3]. The method of failure of the two sternal bands is different, with the non-welded buckle unravelling by rotating through 90° to an upright position, before failing by fracturing at the junction of the buckle with the band. The welded buckle on the other hand does not fail, and the sternal band visibly stretches until it finally fractures.

The spot welds in the buckle produce a considerable change in the biomechanical properties of the sternal bands. The new welded sternal band is now 50% more rigid than a closure with two conventional steel wires, whilst in comparison the original non-welded sternal band had only half the rigidity of the steel wires [2].

References

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