

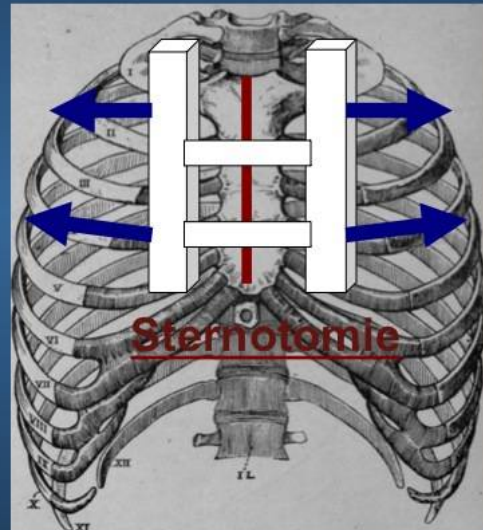
Comparison of Thorax Support Systems after Median Sternotomy; Evaluation of Force Distribution in a Biomechanical Analysis

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and Cardiovascular Surgery, Feb 14, 2011



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1. Prevention of sternal instability after heart surgical procedures
2. Determine the efficiency of support systems using pressure sensor testing along the thorax wall



Background

Sternum dehiscence: up to 10%

Infections: up to 4%

- Mortality ~ 25%
- Prolonged hospitalization
- 2,8x higher cost



Posthorax® Sternum Support Vest Compared to a Flexible Bandage

Using pressure sensors placed between the devices and around the thorax to measure how well each absorbs the forces produced by deep breathing, movement and coughing.

flexible bandage



Posthorax® vest



Literature



European Journal of Cardio-thoracic Surgery 36 (2009) 335–339

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CARDIO-THORACIC
SURGERY

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A newly designed thorax support vest prevents sternum instability after median sternotomy[☆]

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Abstract

Objective: Sternum infection remains one of the primary causes of postoperative morbidity and mortality after median sternotomy. We report the clinical efficacy for primary reinforcement of the sternum with a new design of thorax support vest. **Methods:** A prospective randomized study including 455 patients was started in September 2007 to evaluate the effectiveness of the Posthorax[®] sternum vest (Epple Inc., Vienna, Austria). One hundred and seventy five patients were treated with the sternum dressing postoperatively (group A), 227 patients did not receive the vest (group B) and 53 patients refused it (group C). Several clinical and operative data were evaluated. All patients were recorded using the STS risk scoring analysis for mediastinitis after cardiac surgery. **Results:** The median age and gender distribution were comparable in both groups. Preoperative data like renal failure, chronic obstructive pulmonary disease, peripheral artery disease, and myocardial infarction were not significant. There were more patients with diabetes in group A and C (A: 39.4%, B: 29.1%, C: 43.4%, $p = 0.036$). A total of 55.8% underwent coronary bypass grafting, 15.4% aortic valve replacement, 7.7% mitral valve repair and 21.1% concomitant cardiac procedures. The median risk factor analysis and body mass index were comparable. In the follow-up period up to 90 days, in group A we observed 0.6% sternum wound complications, in group B 4.9%, and in group C 9.4% (group A vs B: Fisher's exact test $p = 0.0152$ and group A vs C: $p = 0.0029$). **Conclusions:** The use of the Posthorax[®] sternum vest shows a favourable outcome to prevent sternum instability after cardiac surgery. There was one reoperation in patients treated with this sternum vest compared to 16 in the control groups.

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Keywords: Sternum instability; Thorax vest; Mediastinitis; Infection



Literature

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INTERACTIVE
CARDIOVASCULAR AND
THORACIC SURGERY

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Institutional report - Cardiac general A prospective randomized multicenter trial shows improvement of sternum related complications in cardiac surgery with the Posthorax[®] support vest[☆]

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Abstract

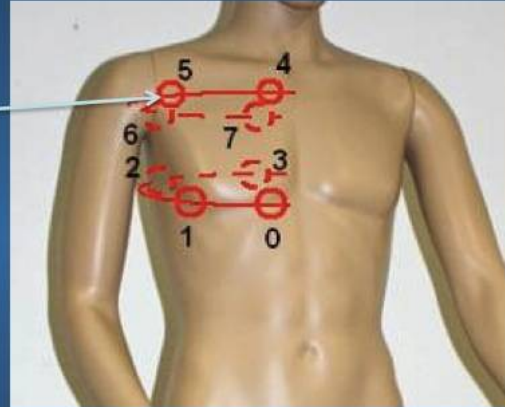
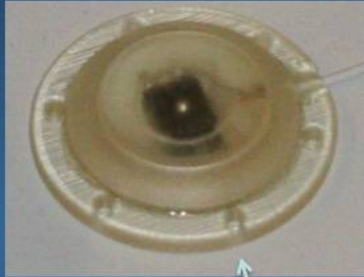
Sternal instability, dehiscence and mediastinitis are major causes of morbidity and mortality in cardiac surgery. The aim of this analysis is to determine the effect of a Posthorax[®] support vest (Epple Inc, Vienna, Austria) after median sternotomy. One thousand five hundred and sixty cases were included in a prospective randomized multicenter trial. Patients were randomized as follows: 905 received a flexible dressing postoperatively (group A) and 655 patients were given a Posthorax[®] support vest (group B). Patients in groups A and B were well matched. Their mean age was 68 years (range: 34–87 years). The patient characteristics and operative data were equally distributed in both groups. The mean total hospital stay was significantly shorter in group B than in group A (A: 17.33 ± 17.5; B: 14.76 ± 7.7; $P = 0.04$). Sternal wound complications necessitating reoperation during the 90 days follow-up period were observed in 4.5%. Reoperation rates were as follows: 3.9% in group A and 0.6% in group B ($P < 0.05$). The use of the Posthorax[®] sternum support vest is a valuable adjunct to prevent sternum-related complications after cardiac surgery. In the 90 days follow-up period, additional surgical procedures were significantly reduced by the use of the support vest.

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Keywords: Mediastinitis; Sternum; Infection; Postoperative care



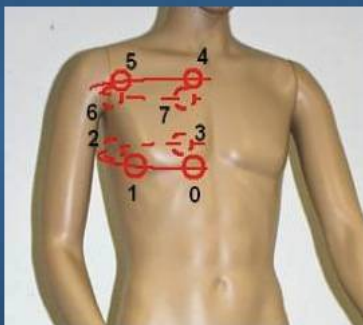
Pressure Sensor Design and Location Around the Thorax



8 pressure sensors are placed around the thorax, between the device and the thorax wall

Median Counter Pressure in NM/cm²

Sensor location

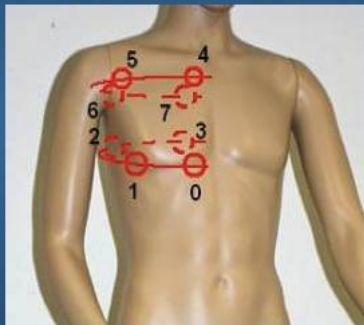


Median Values	Posthorax® Vest	Elastic Bandage	p-value
Sensor 0	2,28	0,89	p<0,05
Sensor 1	1,35	1,18	n.s.
Sensor 2	1,66	1,35	n.s.
Sensor 3	2,37	1,22	p<0,05
Sensor 4	2,35	2,43	n.s.
Sensor 5	1,71	1,28	n.s.
Sensor 6	1,28	1,26	n.s.
Sensor 7	0,167	0,1	n.s.

Significant differences in the dorsal ventral axis
Sensor = 0 & 3

Maximum counter pressure in NM/cm²

Sensor location

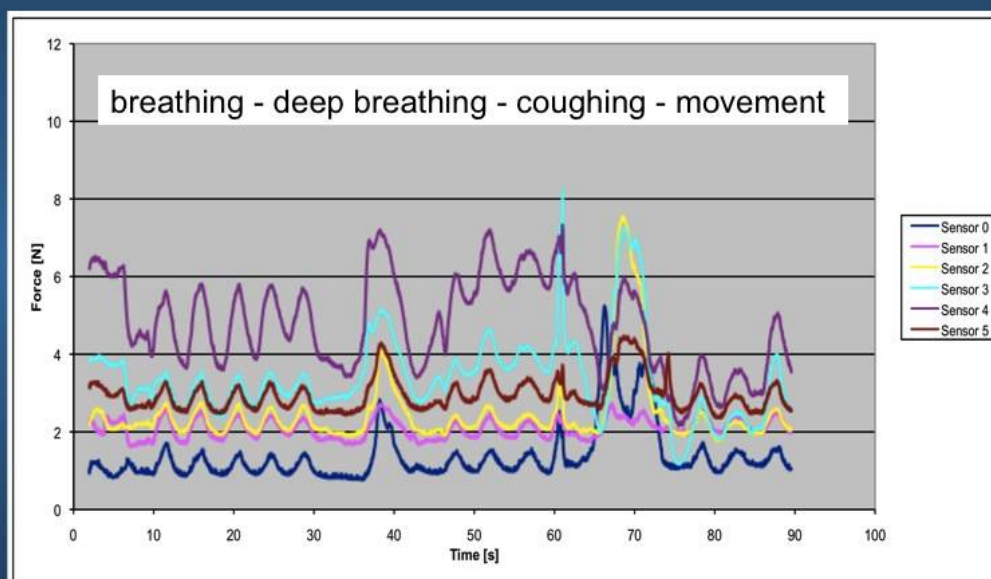


Maximum Values	Posthorax® Vest	Elastic Bandage	p-value
Sensor 0	3,6	1,5	p<0,05
Sensor 1	3,04	2,1	n.s.
Sensor 2	3,9	2,5	n.s.
Sensor 3	6,3	2,7	p<0,05
Sensor 4	6,9	4,1	p<0,05
Sensor 5	4,2	2	p<0,05
Sensor 6	2,9	1,8	n.s.
Sensor 7	3,4	1,9	p<0,05

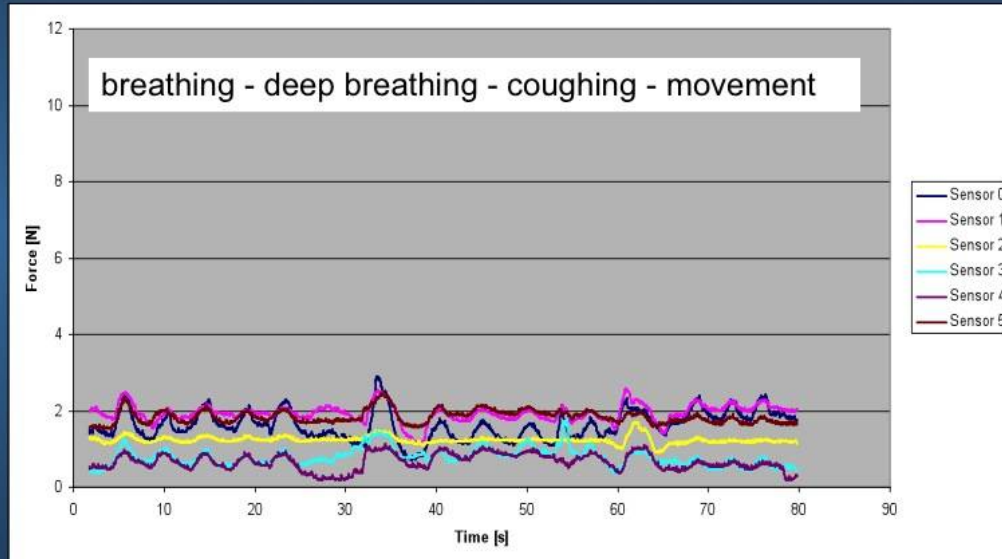
Significant differences in the dorsal ventral axis
Sensor = 0,3,4,5,7



Counter - Pressure of up to 8 NM / cm² by the Posthorax® Vest



Counter - Pressure of up to 2,5 NM / cm² by the Felxible Bandage

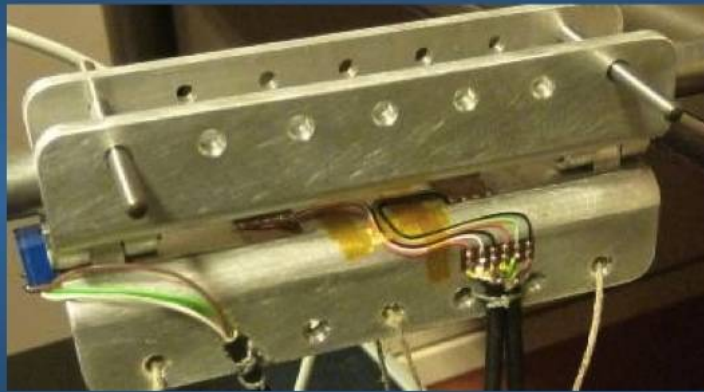


Additional Measurements Inside the Sternum Fracture

Thorax model



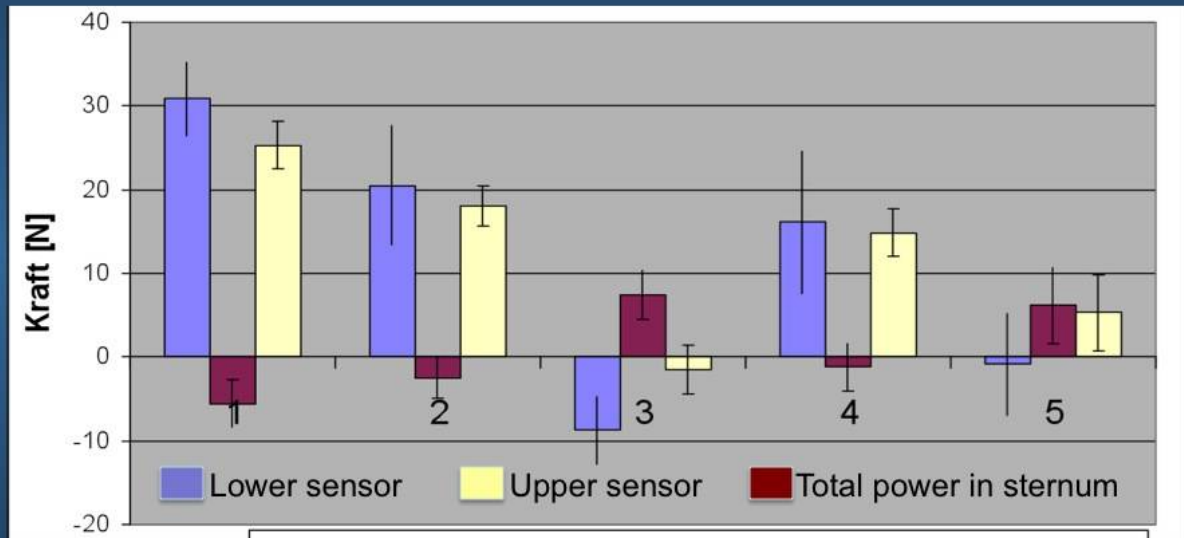
Sensor Placed Between Fracture



Thorax Modelling

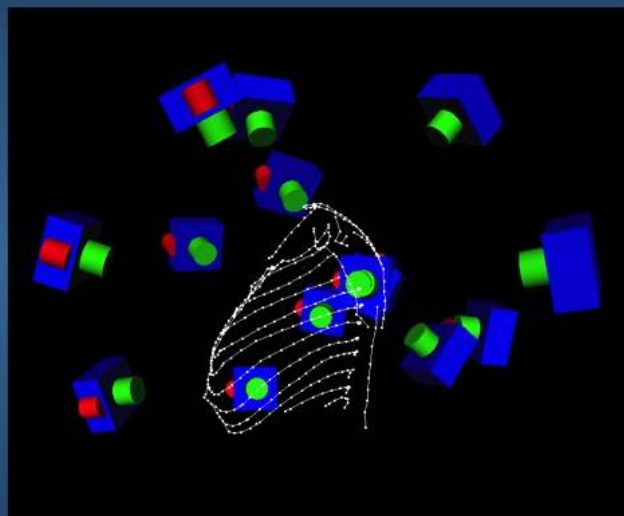


Traction Power Inside Sternum



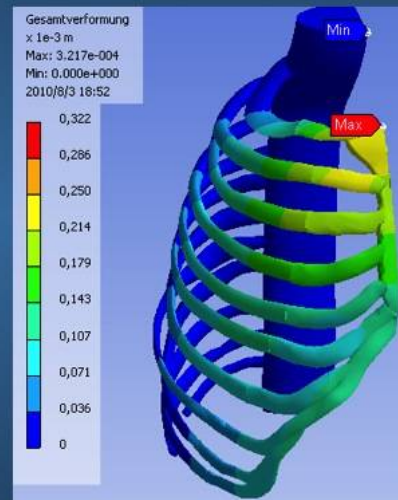
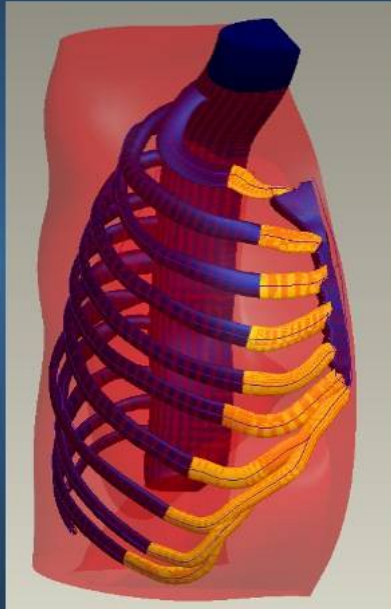
1: Without support 2: Flexible bandage 3: Posthorax® vest
4: Posthorax® vest loose 5: Posthorax® vest moved up

Digital 3D Model



Camera positions around the 3D-model of the thorax

Digitalized 3D Model



Conclusion

- The Posthorax® sternum vest produces significantly higher counter pressure on the thorax wall around the sternum in the dorsal ventral axis
- In the thorax model a significant reduction of tension and tractive power was observed
- Digitalized 3D-model for more information
- michael.gorlitzer@wienkav.at

Wissenschaftliches Programm | Scientific Program

Monday, February 14th, 2011

10:30 - 12:00 Hall C6.2	Abstract Session Wound Healing <i>Chair: T. Kuntze (Bad Berka)</i> <i>R. Leyh (Würzburg)</i>
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- V48 **Comparison of thorax support systems after median sternotomy: Evaluation of force distributions in a biomechanical analysis**
M. Gorlitzer, R. Holzer, M. Bijak, E. Unger, S. Folkmann, F. Wagner, S. Pfeiffer, M. Grabenwöger (Wien, Hamburg, Nürnberg)
- V49 **Posthorax[®] prevents sternal dehiscence and instability: preliminary results of a Prospective Randomized Multicenter Trial**
G. Santarpino, T. Fischlein, S. Pfeiffer (Nürnberg)

Comparison of thorax support systems after median sternotomy: Evaluation of force distribution in a biomechanical analysis

M. Gorlitzer¹, M. Bijak², M. Egger², S. Folkmann¹, E. Unger², R. Moidl¹, M. Grabenwöger¹;

Heartcenter Hietzing, Vienna, Austria,

²Medical University Vienna, Center for Biomedical Technology and Physics, Vienna, Austria.

Abstract text:

Objectiv

Based on the clinical success using the Posthorax support vest to prevent sternum related complications the biomechanical mechanism of different sternum support systems were evaluated.

Methods

Elastic bandages were compared with the Posthorax support vest in 27 patients after sternotomy and 27 volunteers. The effect of the supportive devices was acquired with eight special designed high sensitive real time pressure transducers, which were placed between chest wall and support devices. Measuring points during normal breathing, coughing and arm movement were analyzed.

Results

The Posthorax support vest proved to be superior in the parasternal and posterior region comparing with the elastic bandage in all groups at normal breathing (Sensor 0+4: 2.788±0.79 N vs 0.88±0.2 N and Sensor 3+7: 2.06±0.88 N vs. 0.78±0.04 N; p= 0.001).

During coughing and arm movement all sensors at the anterior and posterior chest wall revealed a significant higher pressure using the Posthorax support vest (Sensor 0+4: 3.34±0.98 N vs. 1.47±0.59 N; Sensor 3+7: 5.69±2.99 N vs. 1.92±0.7 N; p= 0.001).

Conclusion

The findings of the study proved a positive biomechanical effect of the Posthorax support vest in the anteroposterior movement which predicates its favorable clinical effect in avoiding sternum related complications.