

**Pressure reduction and distribution with Bodyzone<sup>®</sup>  
mattresses: results of a series of tests.**



## INTRODUCTION

Chronic skin lesions can be characterized by any combination of the following observations: wound healing either progresses slowly or has completely ceased; high levels of proteases continue to destroy the extracellular matrix while high levels of inflammatory cytokines can be found; at the cellular level, low mitogenic activity as well as significant levels of cell senescence result in reduced regenerative processes.

Pressure ulcers are among the more common chronic lesions. They originally were called decubitus ulcers, from the Latin *decumbere*, “to lie down”, reflecting the most common etiology.

The majority of pressure ulcers are found in immobile patients, including those with a spinal cord injury. More than 2.5 million patients in acute care facilities are treated for pressure ulcers each year (1) and sixty thousand patients are estimated to die each year from pressure ulcers and related complications (2). Depending on the setting, the incidence of pressure ulcer development is estimated to be as high as 63% (3).

Morbidity and mortality related to pressure ulcers, and the complications associated with them, e.g., infection, are high, as are the costs of treatment. The Agency for Healthcare Research and Quality found that the average stay for patients admitted to a hospital for treatment of pressure ulcers was 13 days, with an average cost of US\$37,500 dollars per hospital stay. The economic consequences are significant, with costs estimated at up to US\$11 billion per year (2).

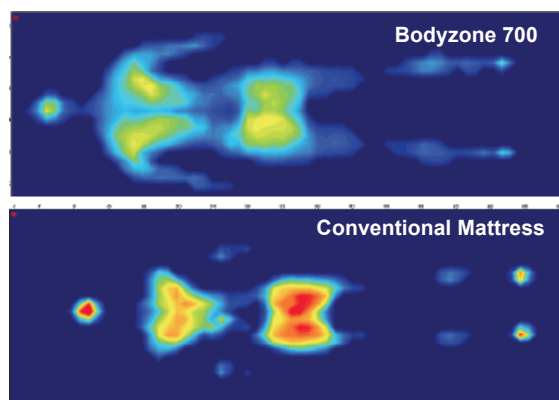
Predisposing factors for developing a pressure ulcer include limited mobility, exposure of skin to excessive moisture, friction and shear forces, and reduced sensation. At a microscopic level, external force(s) exceeding capillary pressure causes their collapse, which, in turn, leads to ischemia and reperfusion injury. This begins in the muscles, where primary lesions develop (4). Indeed, pressure ulcers resulting from deep tissue injury progress from the inside out (5).

In addition to measures such as assuring proper nutritional status (6), frequently repositioning the patient in combination with providing pressure relief and distribution is essential to preventing pressure ulcer formation. In addition, essential precautions include minimizing shear and friction, as well as reducing exposure of the skin to excessive moisture.

Surface Modification Technology (SMT™) is a technique used to alter a foam surface. This process results in better redistribution of pressure that reduces friction and shear, and enhances circulation. Variable Pressure Foaming (VPF™) is a technique used to create different levels of support within a mattress construction, which allows for a very high degree of pressure redistribution, envelopment, and maximum comfort<sup>1</sup>. When SMT is combined with VPF, the average and, more importantly, peak pressure on pressure ulcer-prone areas of the body, such as the trochanter, is reduced (Figure 1). Open cell technology, through VPF, also gives the foam better height and support retention over the life of the mattress, as well as a shorter recovery time (Figure 2).

Figure 1

### Weight Distribution



## PRESSURE REDISTRIBUTION

### EXPERIMENTS

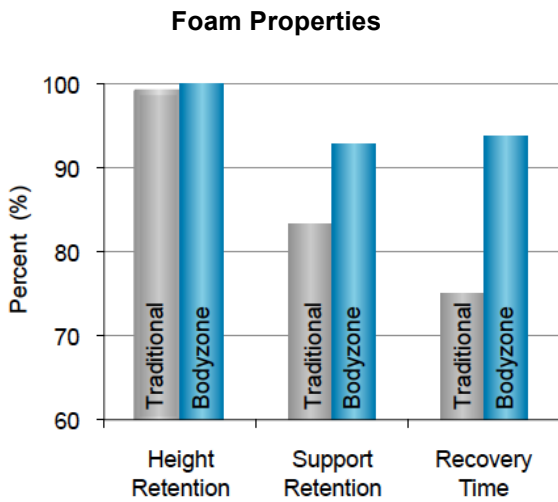
Bodyzone mattresses, in which SMT and VPF technologies are incorporated, were tested in models with volunteers to assess average and maximum whole body pressure reduction as well as envelopment levels. Specific tests were also performed to analyze pressure on the trochanter major, one of the most important pressure ulcer prone parts of the body.

#### *Average and maximum whole body pressure*

Pressures on regular and bariatric Bodyzone mattresses were compared with pressures on ten standard and two bariatric mattresses, all manufactured with conventional technologies, using

<sup>1</sup> Bodyzone, FXI, Media, PA, USA  
Bodyzone, SMT, VPF are trademarks of FXI

**Figure 2**



total body pressure mapping of human subjects in a supine position. An XSensor Pressure Mapping System<sup>ii</sup> was used for all of the measurements. Measurements included, among other values, the average pressure over the entire body surface and the maximum pressure measured anywhere on the body. Using this data, the percentage difference compared to the best performing mattress was calculated.

**Results**

Among 11 non-bariatric mattresses, including the Bodyzone 700, the average pressure ranged from 14.85 to 20.19 mm Hg. Peak pressure ranged from 35.39 to 58.34 mm Hg (Figure 3). The Bodyzone mattress demonstrated lower pressure readings compared to all other regular support surfaces tested. Expressed as a performance difference versus the best performing (Bodyzone) mattress, differences ranged from 34% to 65%.

Three bariatric mattresses, including the Bodyzone 1000, were measured and compared in the same way. The average pressure ranged from 18.04 to 22.04 mm Hg, with maximum pressures ranging from 40.47 to 55.39 mm Hg (Figure 3). The Bodyzone mattress performed 22% and 37% better than the two regular bariatric mattresses.

**Trochanter pressure**

Ten healthy volunteers (4 male, 6 female) were used for this experiment. The average age was 65.5 years

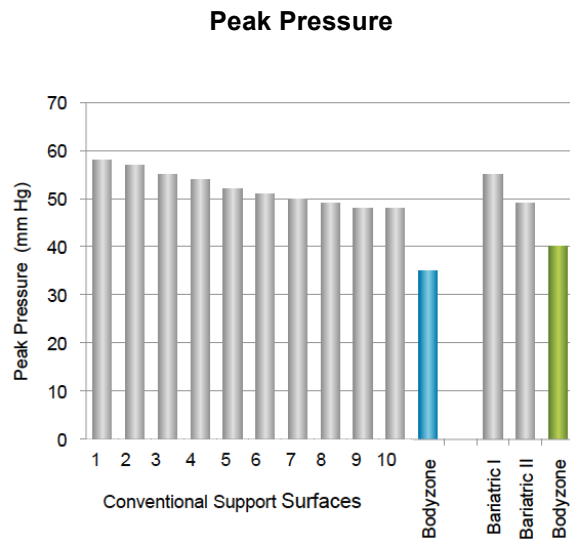
(range 60.0 - 70.0) and the average weight of the volunteers was 181.1 pounds (range 93.0 - 233.0)<sub>3</sub>, with an average body mass index (BMI) of 29.5 kg/m<sup>2</sup> (range 18.2 - 38.9). Four subjects were obese (BMI > 30) and 2 were morbidly obese (BMI > 35). The Bodyzone mattress was compared to a widely used, regular standard polyurethane foam static mattress.

Pressure on the left trochanter major was measured in the left lateral position, using a single sensor tissue interface pressure test. Subjects were allowed to settle on the mattresses for 10 minutes. Three measurements were taken and the highest peak pressure value was recorded.

**Results**

The conventional, non-VPF/non-SMT mattress showed an average peak pressure of 94.2 mm Hg ±15.2 (range 78.6 - 119.3) compared to the VPF/SMT Bodyzone mattress, with a value of 47.2 mm Hg ± 6.8 (range: 38.0 - 56.0). On average, the reduction in interface pressure was 49.2% (range: 37.8 - 58.8).

**Figure 3**



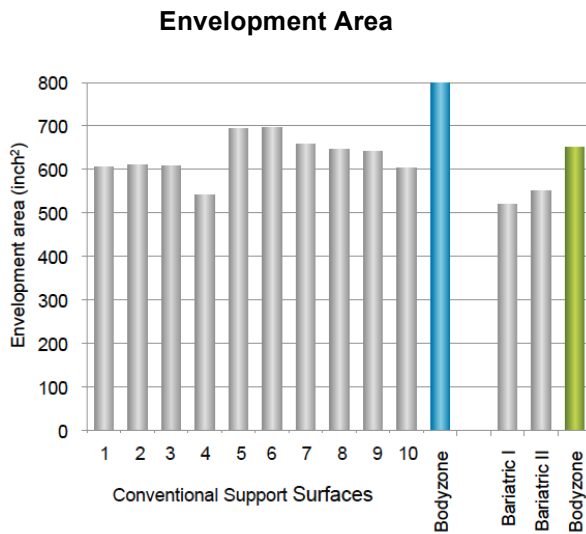
**Envelopment**

The level of envelopment indicates the total support surface with which the body surface is in contact. A higher level of envelopment results in better pressure distribution. Generally, a high level of envelopment also gives a higher level of comfort.

<sup>ii</sup> XSENSOR Technology Corporation, Calgary, Alberta, CANADA

Pressure distribution in a supine position was measured on ten commercially available conventional mattresses that were manufactured using standard technologies, and compared to results with the same volunteer on two Bodyzone mattresses. In addition, two bariatric mattresses were compared to a Bodyzone mattress.

**Figure 4**



### Results

The range of envelopment for the standard mattresses was 541 to 697 inch<sup>2</sup> (average 631 inch<sup>2</sup>) while envelopment for the Bodyzone mattress was 798 inch<sup>2</sup> (Figure 4). This corresponds with an average performance increase of 21% (13% - 32%) for the Bodyzone mattress. A similar test for the bariatric Bodyzone mattress versus two standard bariatric mattresses showed a performance increase for the Bodyzone mattress of 15% and 20% (Figure 4).

### LIMITATIONS

Often, tests with healthy volunteers in a laboratory setting do not correlate with patients in a hospital or other health care facility. Although this argument theoretically may be relevant for the evaluations presented here, there is no reason to expect that the results cannot be translated to the clinical situation.

A controlled clinical trial is necessary to confirm that, indeed, the laboratory tests have clinical relevance.

## CONCLUSION

Pressure reduction and redistribution is essential to the prevention and treatment of pressure ulcers.

Among the static mattresses, viscoelastic polyurethane foam mattresses are considered to offer the best combination of pressure reduction and redistribution. Bodyzone mattresses use innovative, new manufacturing techniques, including open cell technology through Variable Pressure Foaming (VPF) and Surface Modification Technology (SMT). These technologies are designed specifically to produce mattresses with superior pressure reduction and redistribution.

SMT allows for different levels of pressure redistribution within one piece of foam, contributing to better weight distribution and reduction of shear and friction forces. Open cell technology through VPF allows better breathability, thus helping to reduce extended and excessive exposure of skin to moisture. It also provides a more durable mattress.

The combined technologies of VPF and SMT provide mattresses with proven lower average and maximum whole body pressure compared to traditional foam mattresses. In addition, Bodyzone provides decreased pressure to ulcer-prone areas, such as the trochanter major. Finally, Bodyzone increases envelopment, contributing to superior pressure, shear and friction reduction compared to traditional mattresses. All of this translates to increased patient comfort.

## REFERENCES

1. Lyder CH. Pressure ulcer prevention and management. *JAMA* 2003;289(2):223-6.
2. Reddy M, Gill SS, Rochon PA. Preventing pressure ulcers: a systematic review. *JAMA* 2006;296(8):974-84.
3. Russo C, Elixhauser A. Hospitalizations related to pressure sores, 2003. Agency for Healthcare Research and Quality, Statistical Brief #3. April 2006.
4. Salcido R, Donofrio JC, Fisher SB, LeGrand EK, Dickey K, Carney JM, et al. Histopathology of pressure ulcers as a result of sequential computer-controlled pressure sessions in a fuzzy rat model. *Adv Wound Care* 1994;7(5):23-4, 26, 28 passim.
5. Fife C. *Towards a new understanding of an old problem*. Flagstaff, AZ: Best Publishing, 2007.
6. Bourdel-Marchasson I, Barateau M, Rondeau V, Dequae-Merchadou L, Salles-Montaudon N, Emeriau JP, et al. A multi-center trial of the effects of oral nutritional supplementation in critically ill older inpatients. GAGE Group. Groupe Aquitain Geriatrique d'Evaluation. *Nutrition* 2000;16(1):1-5.