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MEDIFLEX & KCI AtmosAir 9000

An evaluation of Pressure distributing properties of pneumatic surfaces

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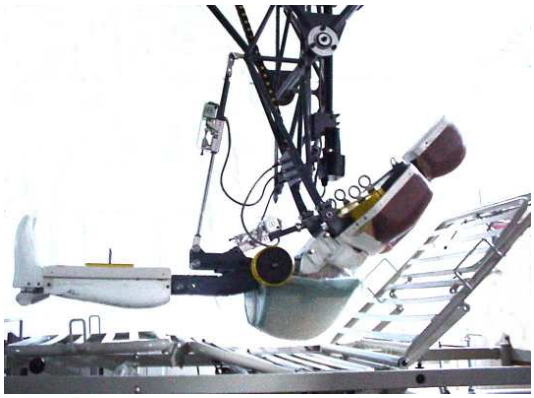
MATTRESS EVALUATION

Pressure distributive properties



UCL Phantom

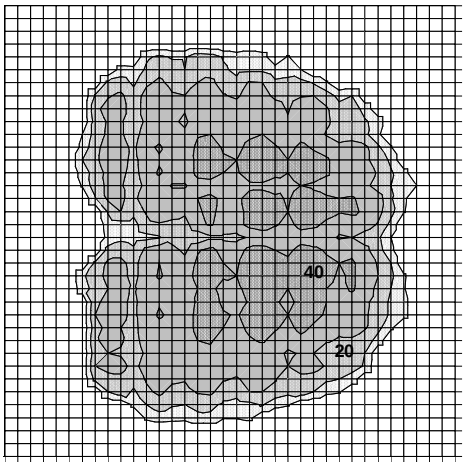
These are assessed using the UCL Phantom (developed by the RAFT Institute), a full technical description of which is published in the scientific literature.[1]. This is a life-sized articulated dummy with soft tissues, and bony prominences within. The Phantom has an automated positioning system, which places it in exactly the same way on every mattress. Pressure measurements are made using a highly flexible pressure-mapping array, to locate the peak pressures (which occur in different anatomical regions on different mattresses).

The surface of the Phantom is warmed to 35 °C using special heated and temperature-controlled skin.

Tests are performed with the mattress on a 4-section profiling bed in standard position according to EPUAP draft guidelines, with the backrest inclined to 45°, the gatch section elevated to 20°, and made up with a loose sheet. The phantom is lowered onto the mattress in standard 45° rigid attitude, and then the hip and knee joints are released.

The phantom is left to dwell for 10 minutes on the mattress, to allow for initial stabilisation of the mattress.

Multiple measurements are made, to obtain confidence intervals for the peak pressures in the pelvic and heel regions. Low peak interface pressure is deemed to be the most valid measure of pressure reducing properties according to current evidence at the time of publication.[2]



Pressure Map

Pressure maps reveal visually much information besides peak pressure about the way pressure is distributed. A picture of the pressure map is therefore also provided with a sidebar scale to the colour map.

All mattresses were used in a static (non-dynamic) mode. In the case of mattresses provided with a pumping unit, "static" setting was selected, and pressure levels were set to mid-range to reflect the mid-range weight of the phantom.

[1] Bain DS, Nicholson N, Scales JT. A Phantom for the Assessment of Patient Support Systems. Journal of Medical Engineering and Physics. 21 (1999).293-301

[2] Bain D, Ferguson-Pell M, McLeod A. Evaluation of mattresses using interface pressure mapping. Journal of Wound Care Vol 12, No. 6, June (2003) 231-235.

Results

1) Meditec Mediflex

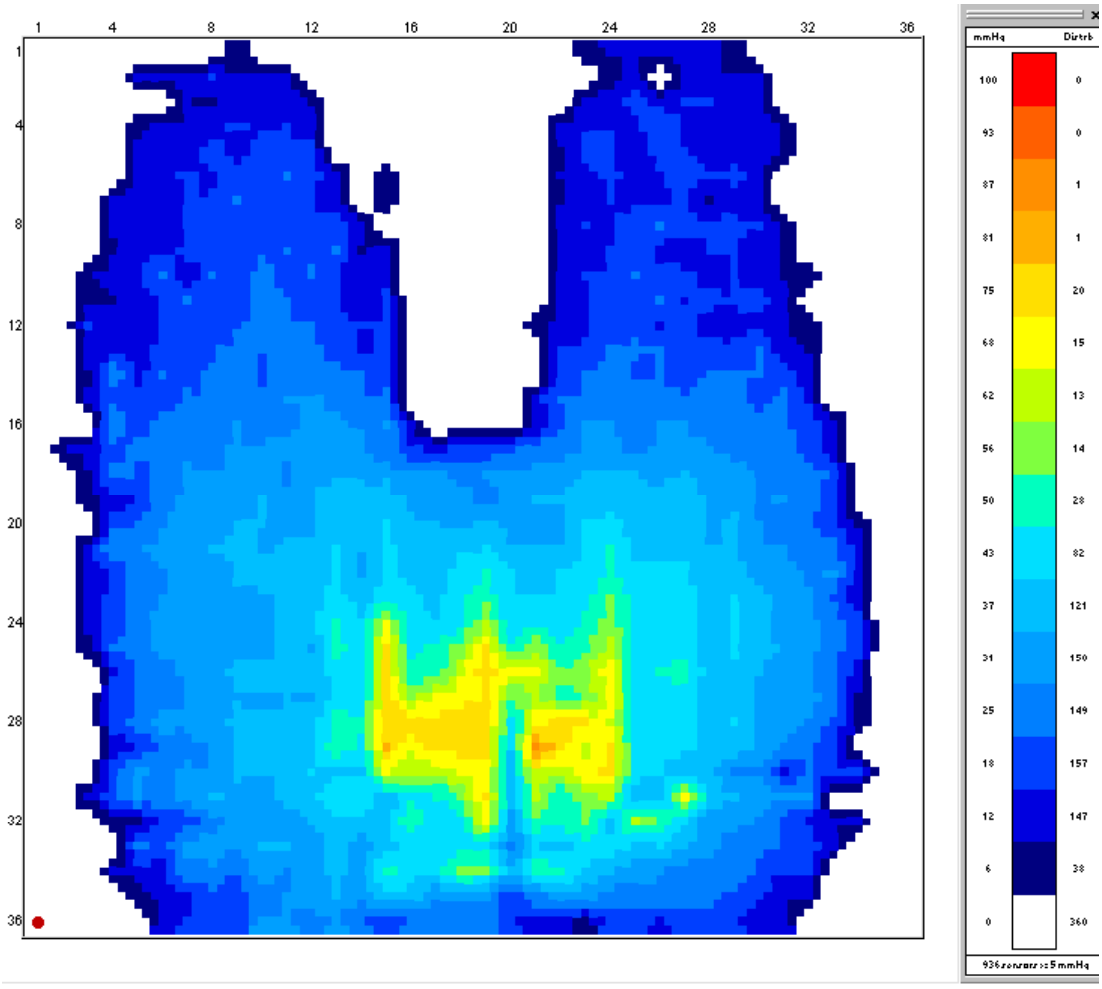


Figure 1: Pressure Map, Mediflex

Peak Interface Pressure (pelvis)	**88**	+/-6	mmHg
Peak Interface pressure (heels)	**91**	+/-8	mmHg

Referring to the pressure map in figure 1, it can be seen that this surface gives good envelopment of the seat area, allowing a large surface contact area. However, interface pressures are still high in the sacral/ischial region. Measurement of penetration depth revealed that this was not a result of 'bottoming out' due to inadequate pressure. Investigation by sliding a hand underneath the mattress confirmed this. More likely, this results from

membrane tensions in one of the intermediate layers of the mattress, leading to a ‘hammock effect’ at a certain depth of penetration.

2) AtmosAir, Kinetic Concepts inc.

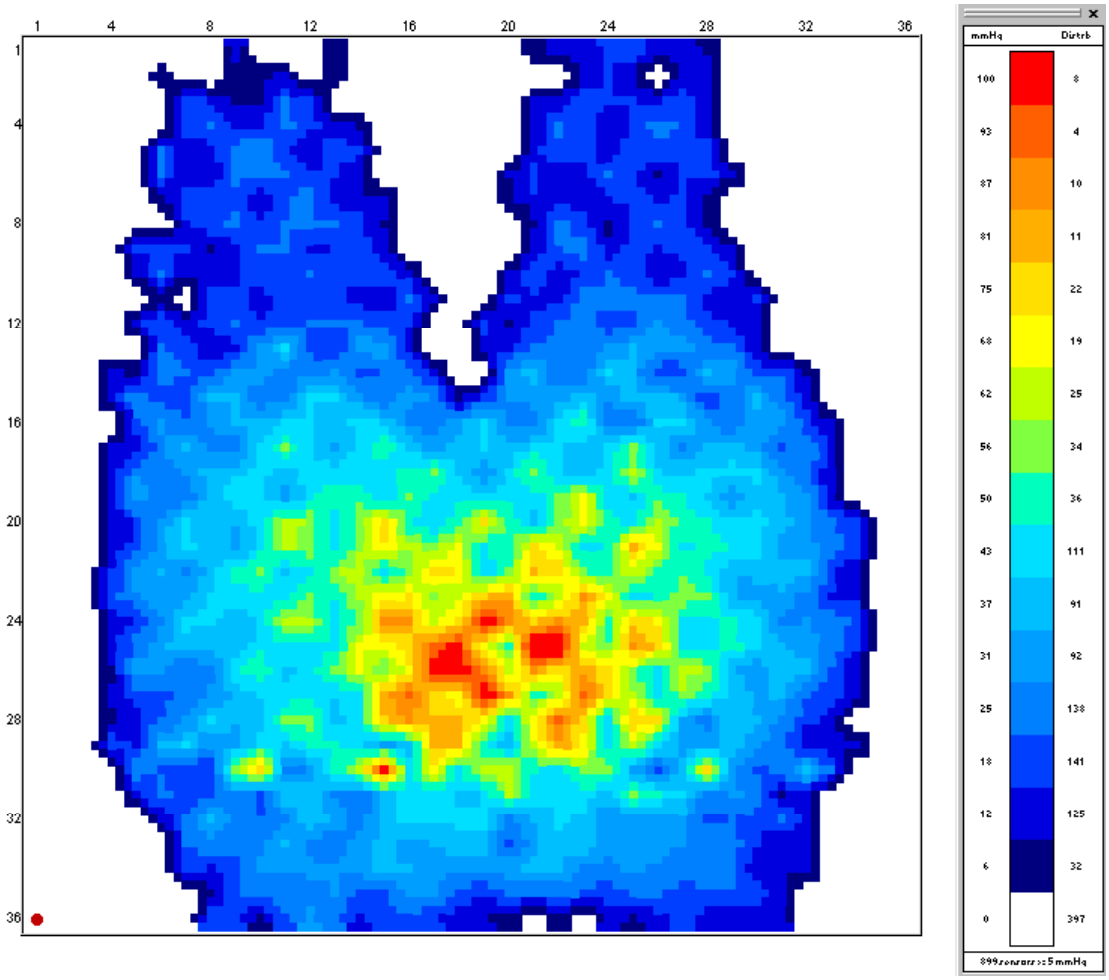


Figure 2: Pressure Map, AtmosAir

Peak Interface Pressure (pelvis)	**116** +/-7	mmHg
Peak Interface pressure (heels)	**90** +/-8	mmHg

As with the Mediflex, the AtmosAir exhibits very satisfactory envelopment, and corresponding distribution of pressure over a large contact area. However, referring to figure 2, it also suffers from high interface pressures in the sacral area. In this case, we can see that the high pressure topography follows a geometric pattern corresponding to the profile of the foam layer, as opposed to corresponding to bony anatomical landmarks. This suggests that beneath the top layer of profiled foam is a harder, less deformable layer. The pattern would be consistent with, for example, over-inflation of the pneumatic component within the mattress.

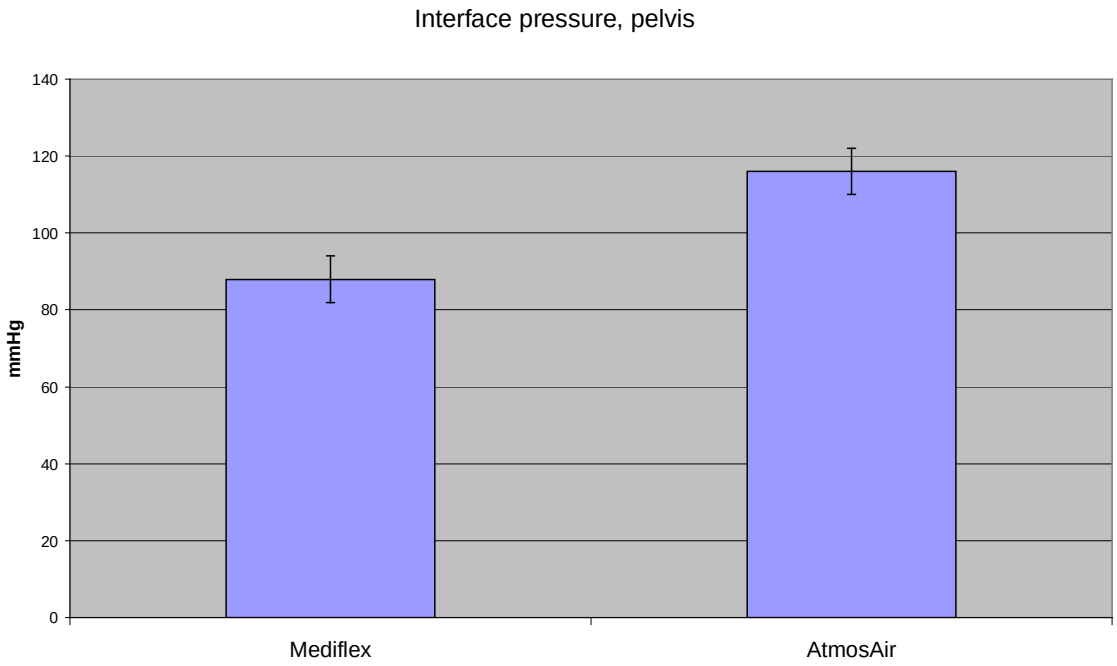


Figure 3: Summary results, peak interface pressure in pelvic area

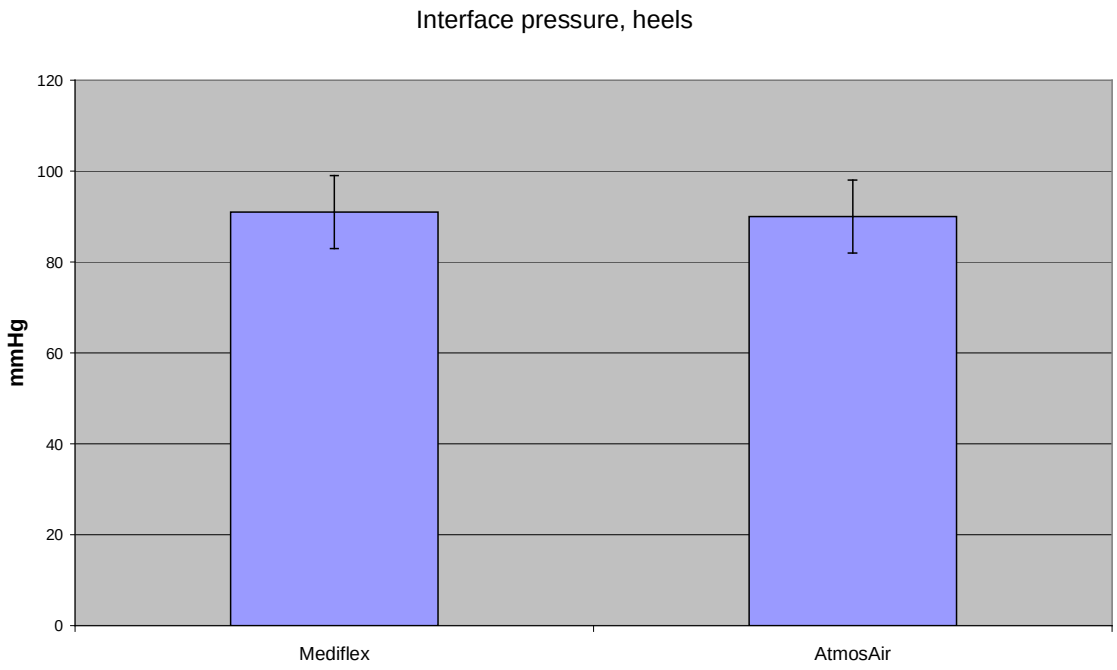


Figure 4: Summary results, peak interface pressure in heel area.

Dynamic Properties

One approach to the prophylaxis of pressure ulcers is distributing the pressure on the skin over a large area and so reducing the peak values. An alternative approach is to reduce the time duration of the skin's exposure to potentially occluding interface pressure, by changing the pressure distribution over time.

To this end, alternating pressure air mattresses (APAMs) are provided with air cells manifolded into separate groups, so that respective groups may be pressurised alternately. In this way, each area of skin is exposed to an interface pressure fluctuating over time, giving periods of possible occlusion, and periods of reperfusion.

The Mediflex is provided with an alternating pump system, with cells manifolded to provide an alternating option. The AtmosAir is intended solely for static pressure reduction, and so is not provided with the facility for dynamically alternating pressure

To examine the dynamic performance of the Mediflex support surfaces, pressure was mapped over time, to observe the typical profile of pressure relief obtained over the surface of the skin.

Dynamic results

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1) Mediflex

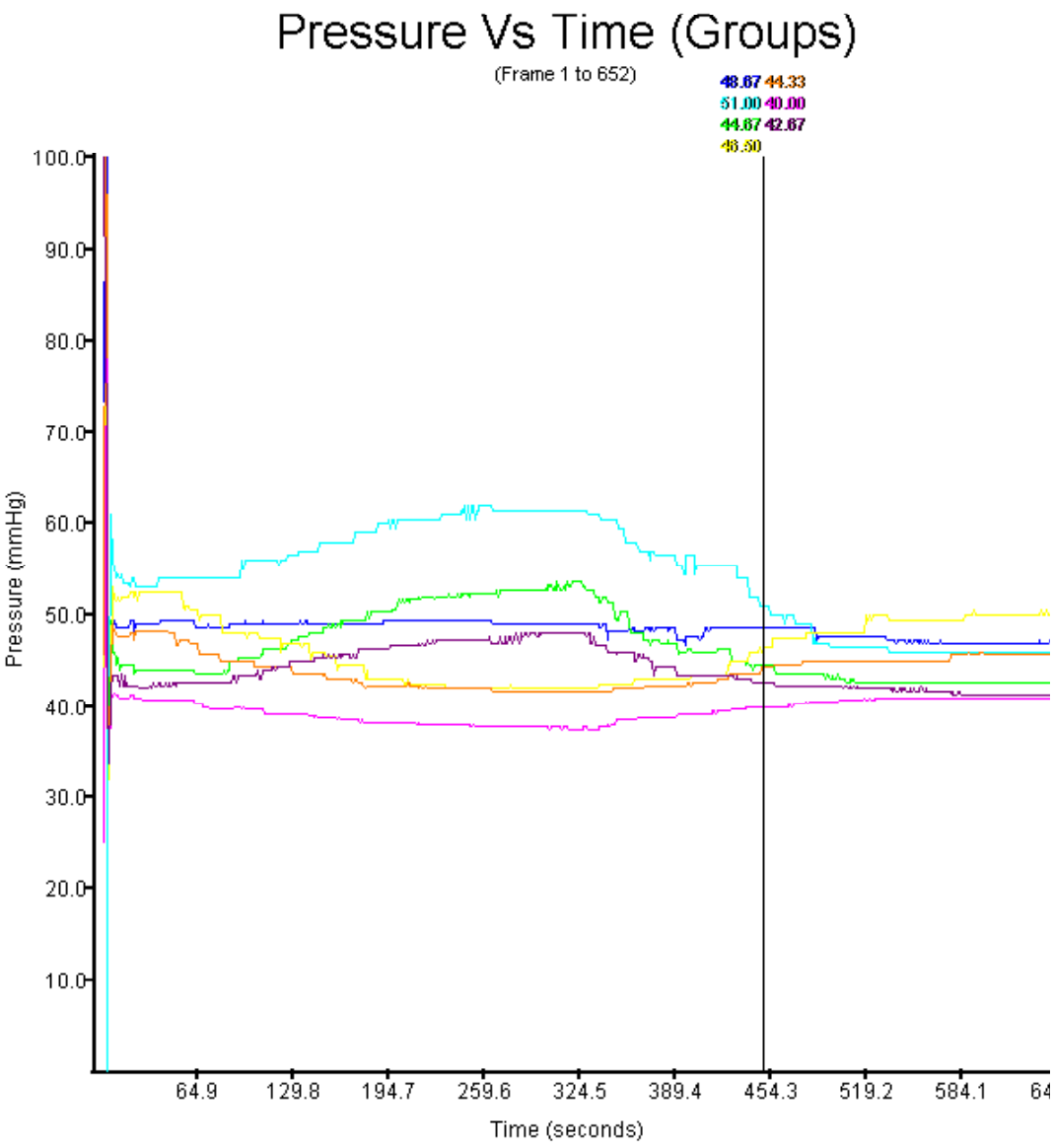

Figure 5. Dynamic pressure performance of Meditec Mediflex, 72kg subject

Referring to figure 5, some alternating behaviour is observed with the Mediflex. Each pressure trace on the graph refers to a sensor group at a different location on the supine subject. As expected, when some regions are at their minimum pressure, others are at their maximum, and vice versa at the opposite part of the cycle. Although the peak pressures never go higher than 60mmHg, which a respectable performance for a static system, the relatively small amplitude of the cycle means that the same area (sacral area, shown in light blue) never drops below 45mmHg. It is not known how low pressure must drop to deliver “pressure relief”, and it may be that 45mmHg is sufficient. Interestingly, the peak pressure in alternating mode is lower

than the peak pressure in static mode shown in figure 1. This may be explained by the fact that the static measurements were made with an articulated phantom sitting at 45 degrees, as opposed to a live subject lying flat.

It can be seen that some sensor groups experience only a small amplitude of alternating behaviour. The interface pressure on the lumbar spine, for example, shown in yellow, varies by only 10mmHg throughout the cycle. It is likely that the layer of visco foam on the top surface of the system, while generally reducing the interface pressures, also eliminates some of the alternating behaviour, giving rise to the relatively small cycle amplitudes observed.

Conclusions

Referring to the summarised results in figures 3 and 4, it is apparent that the Mediflex mattress give significantly lower peak interface pressure in the pelvic area than the AtmosAir mattresses, as measured by the anatomical phantom under static conditions.

When using a cyclic pump unit, the Mediflex mattresse also exhibit some degree of alternating behaviour, without excessive peak pressures, which may be beneficial in allowing microcirculatory perfusion.