Pressure Imaging Tools: The Missing Clinical Link

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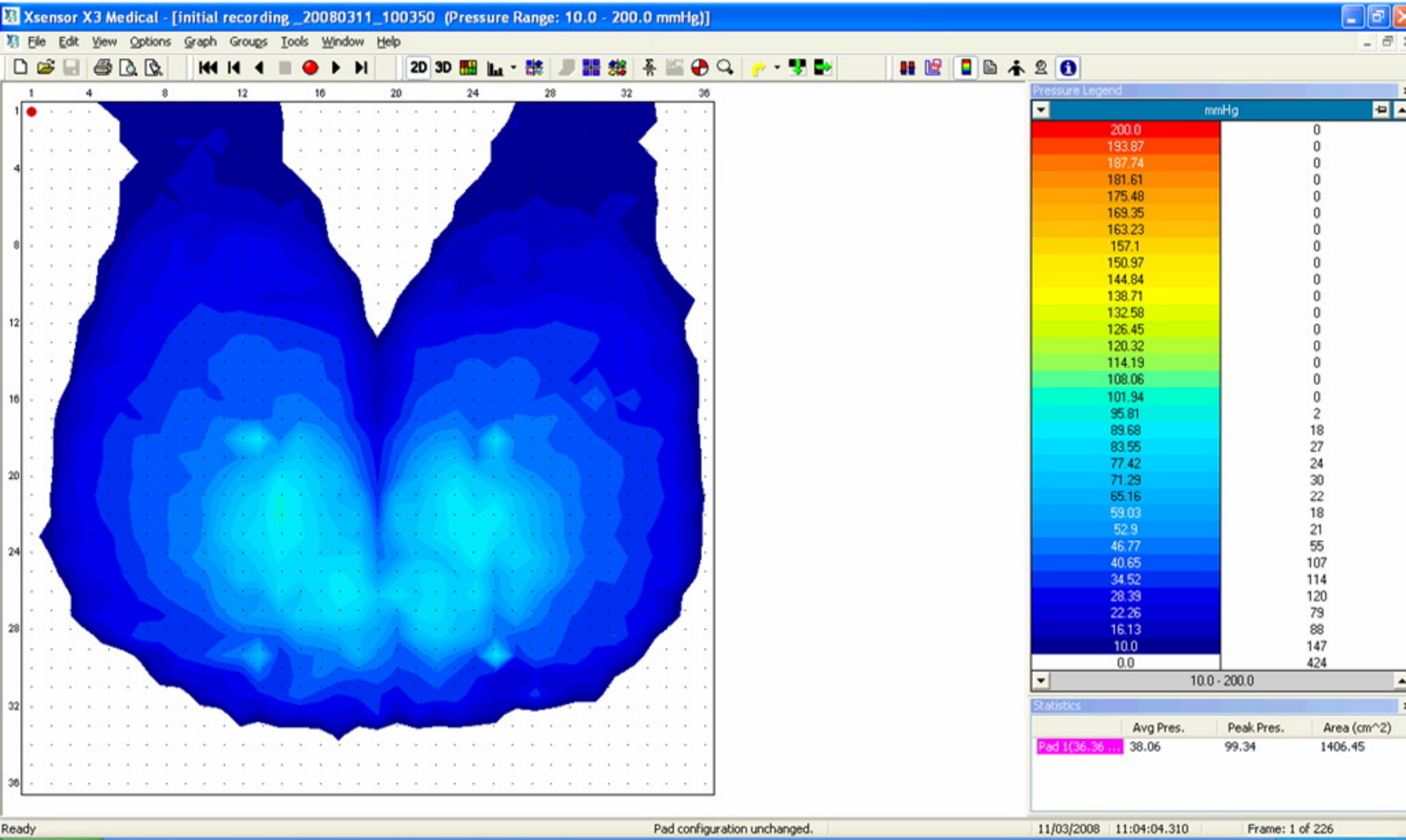
What is Pressure Imaging For?

- Clinical tool to help assess and modify positioning – absolute pressures values are an irrelevance
- Clinical tool to aid in improving an individual's functionality
- NOT an engineering tool for measuring pressures

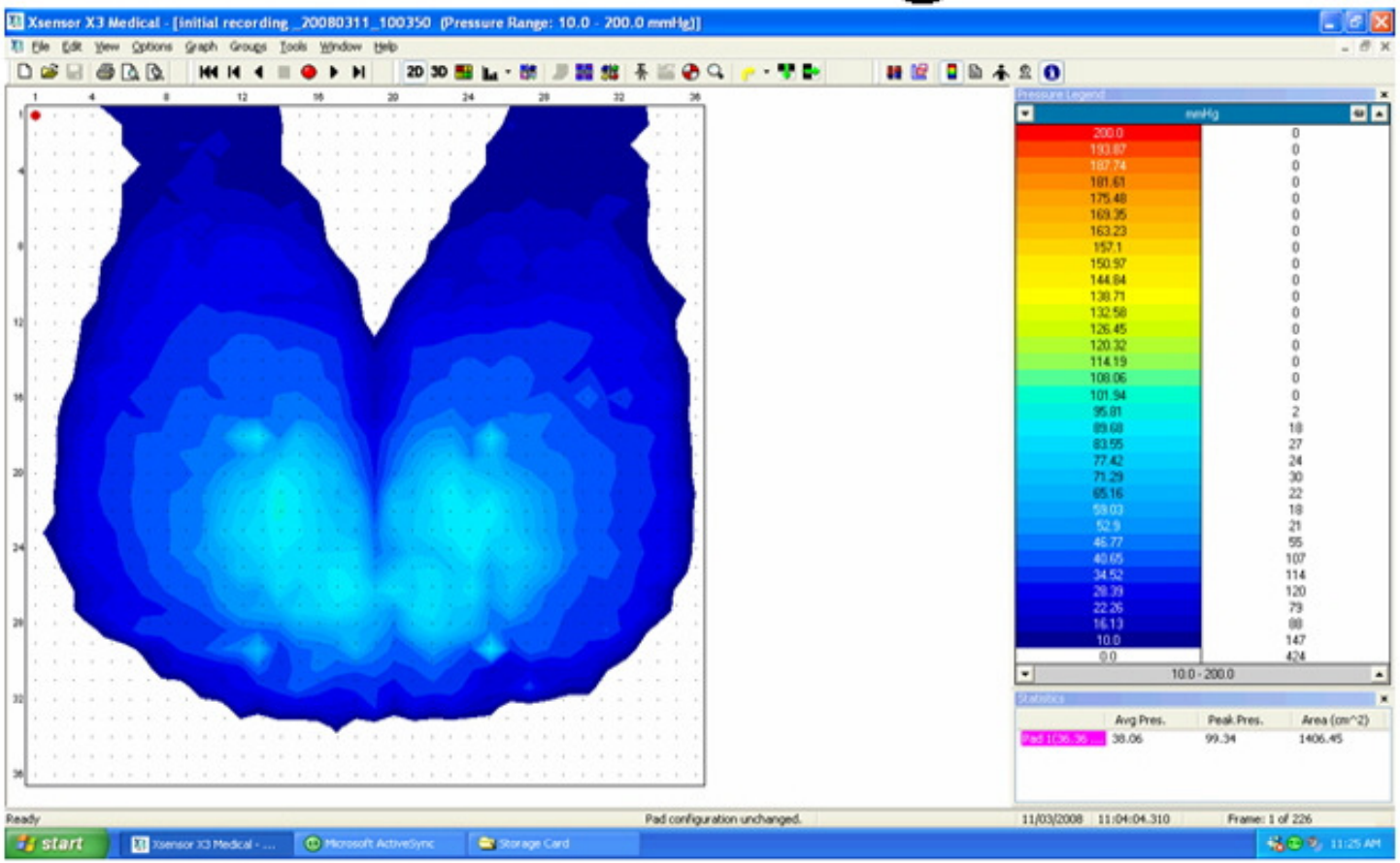
Pressure Imaging Tools

- In the past there has been research conducted on the accuracy of Pressure Imaging tools, but how relevant is this data in a clinical setting?
- Not much work has been carried out on:
  - How to collect relevant data
  - How to interpret data
- Systems are not always used correctly – for example:

Mr C

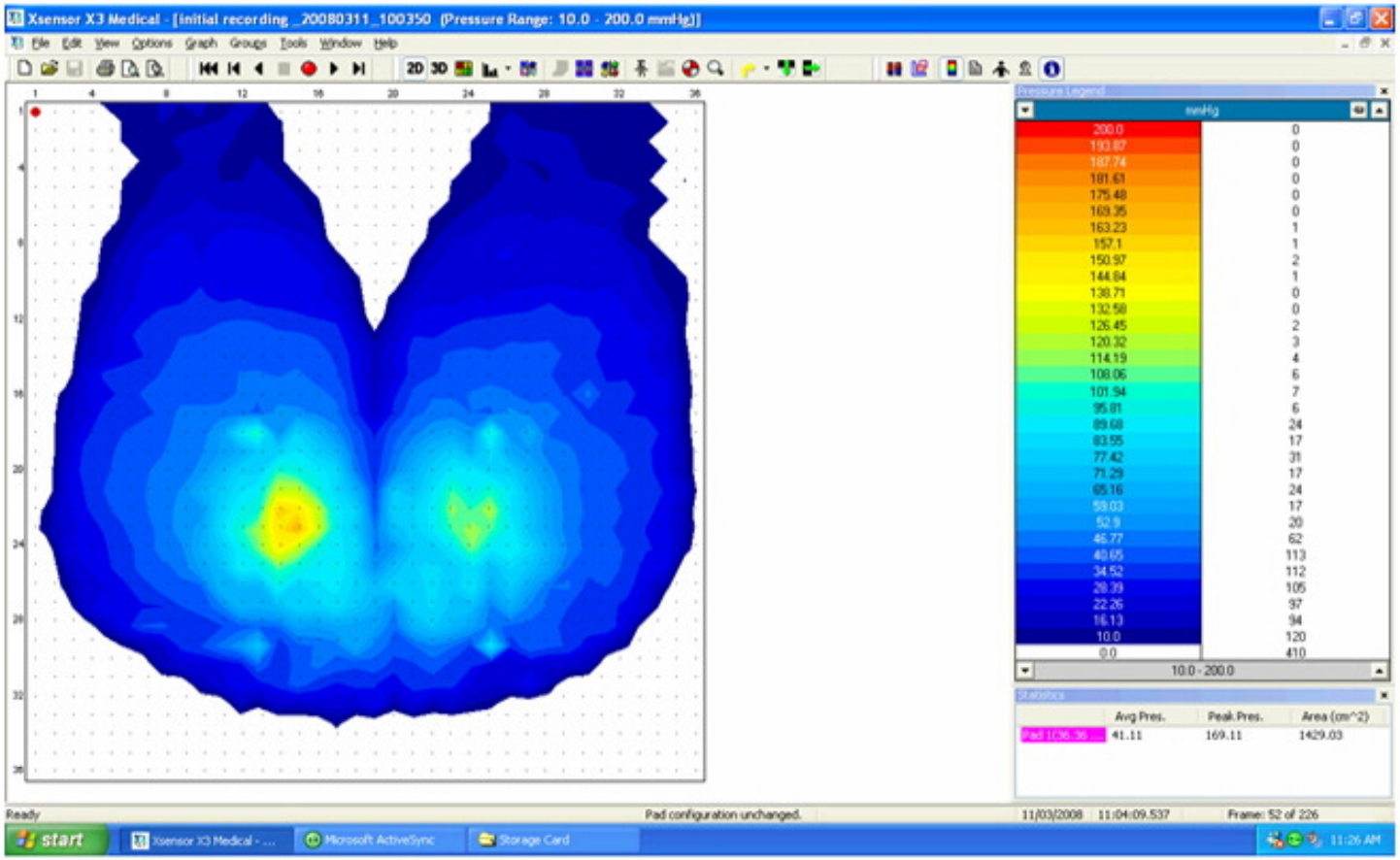

Xsensor X3 Medical - [initial recording _20080311_100350 (Pressure Range: 10.0 - 200.0 mmHg)]
File Edit View Options Graph Groups Tools Window Help
2D 3D
Pressure Legend
mmHg
200.0 0
193.87 0
187.74 0
181.61 0
175.48 0
169.35 0
163.23 0
157.1 0
150.97 0
144.84 0
138.71 0
132.58 0
126.45 0
120.32 0
114.19 0
108.06 0
101.94 0
95.81 2
89.68 18
83.55 27
77.42 24
71.29 30
65.16 22
59.03 18
52.9 21
46.77 55
40.65 107
34.52 114
28.39 120
22.26 79
16.13 88
10.0 147
0.0 424
10.0 - 200.0
Statistics
Avg Pres. Peak Pres. Area (cm^2)
Pad 1(36,36 ... 38.06 99.34 1406.45
Ready
Pad configuration unchanged.
11/03/2008 11:04:04.310
Frame: 1 of 226

Mr C Pressure Image Frame 1



- Initial recording of a resting position.
  - Peak 99 mmHg
  - Average 38 mmHg
  - Surface 1406 cm2
  - Symmetry good
  - Pressure index

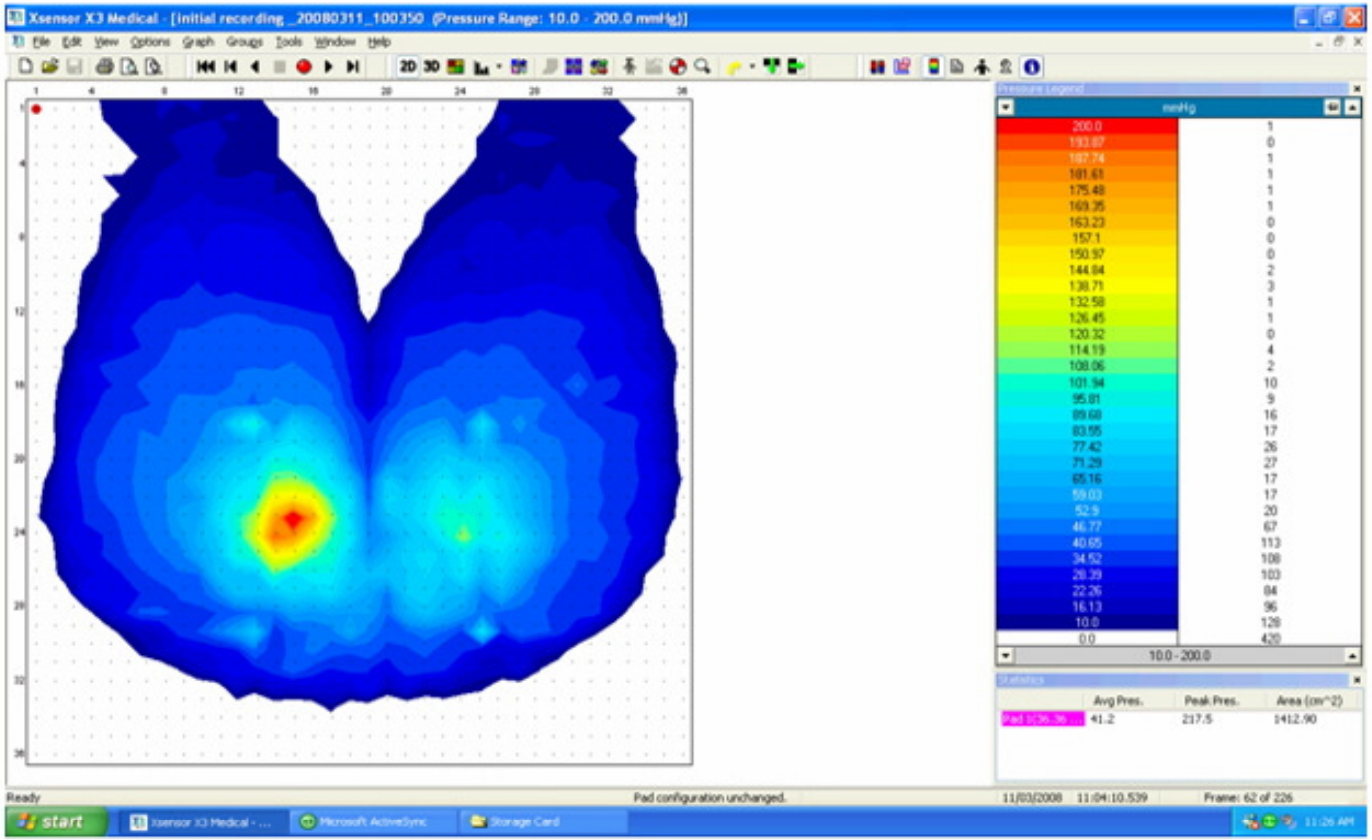
Mr C Pressure Image Frame 52



5 SECONDS LATER

- Peak 169 mmHg
- Average 44 mmHg
- Surface 1429 cm2
- Symmetry poor
- Pressure index

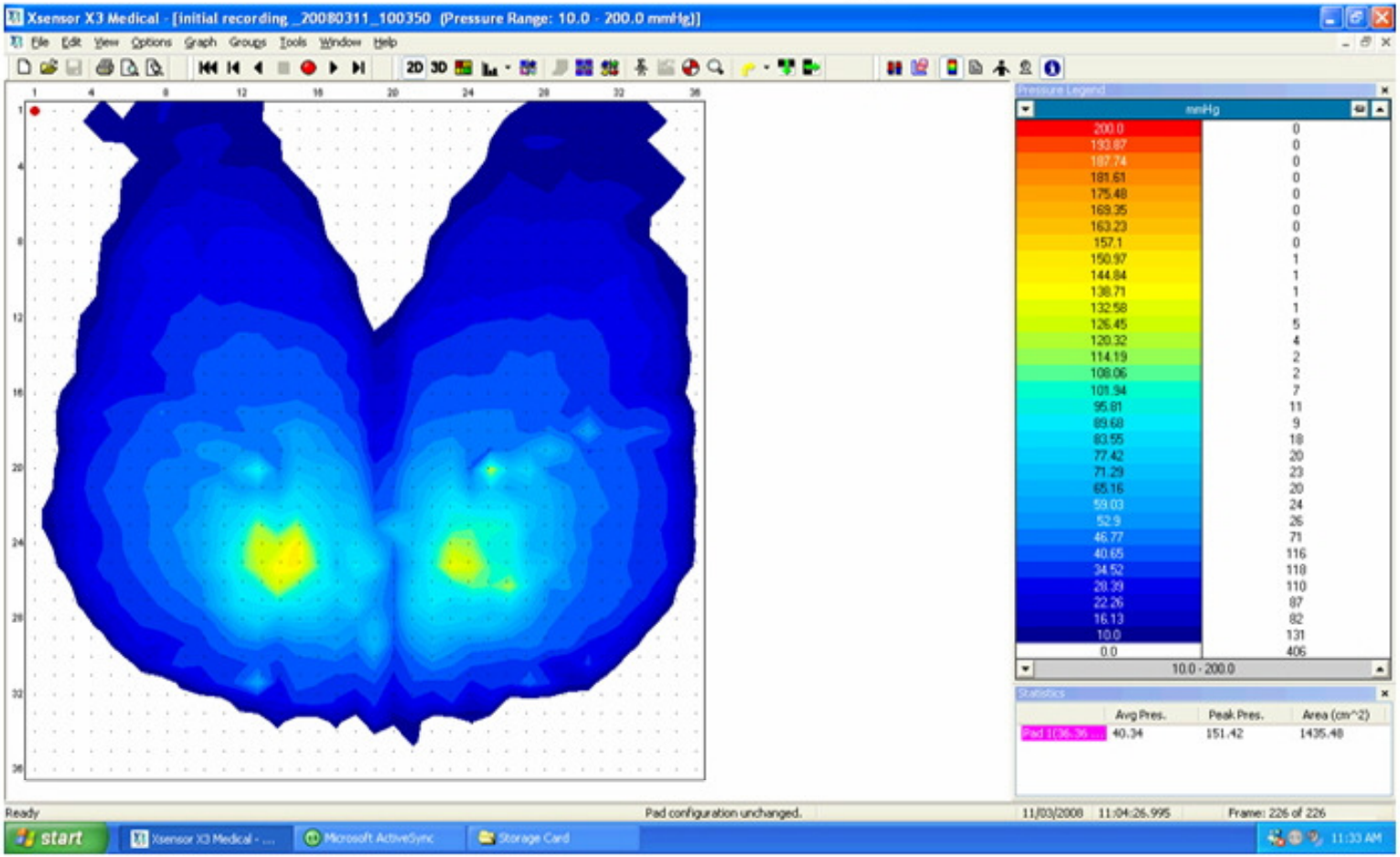
Mr C Pressure Image Frame 62



1 MORE SECOND LATER

- Peak 227 mmHg
- Average 41 mmHg
- Surface 1412 cm2
- Symmetry poor
- Pressure index

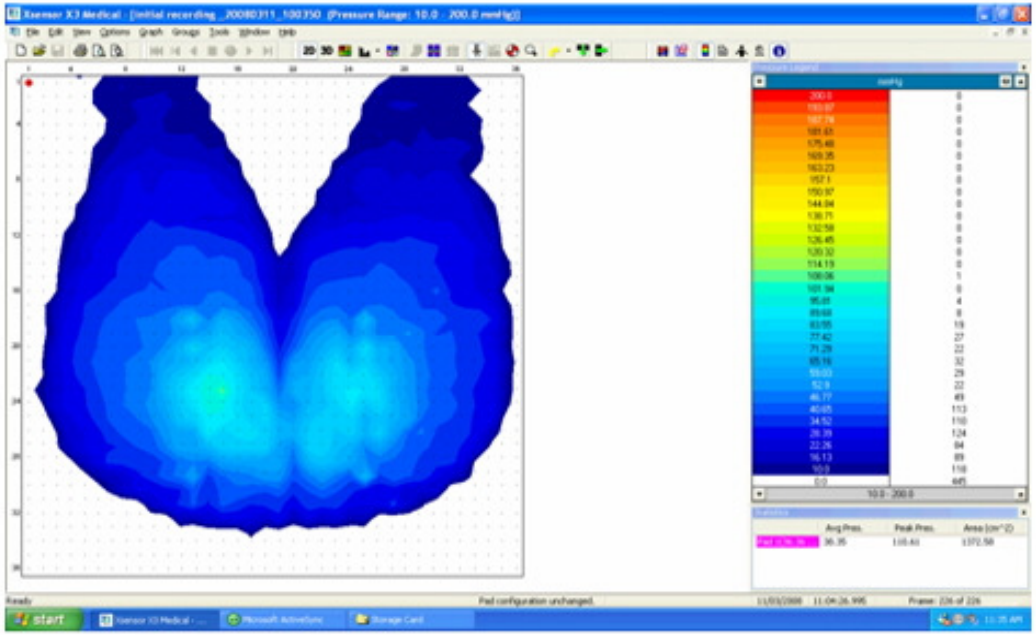
Mr C Pressure Image Frame 226

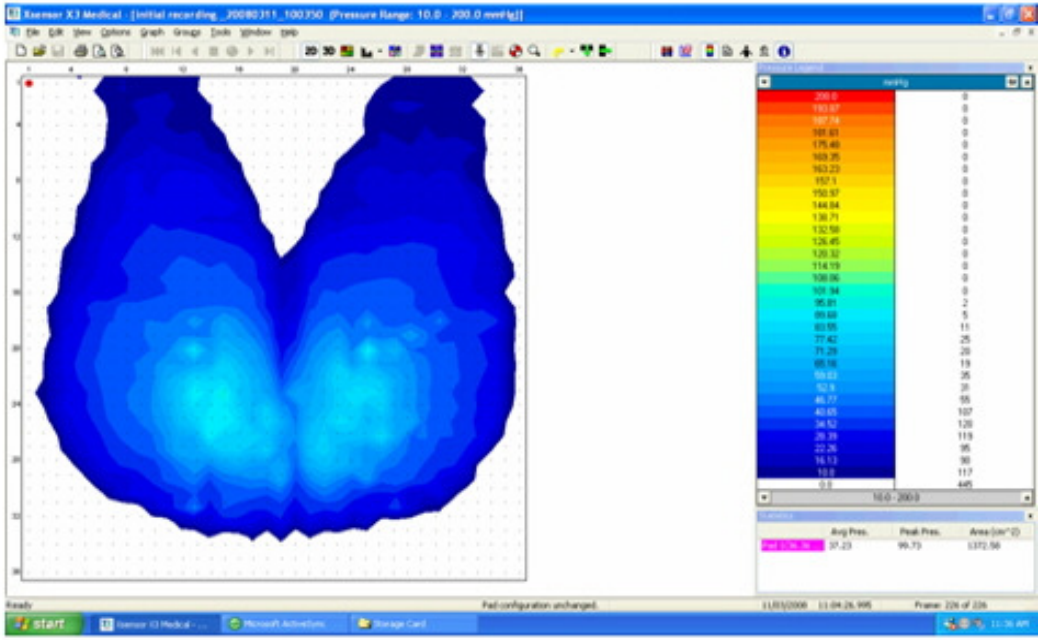


A FURTHER 16 SECONDS LATER

- Peak 151 mmHg
- Average 40 mmHg
- Surface 1435 cm2
- Symmetry good
- Pressure index

WHAT DOES AN AVERAGE MEAN?





Average frame 1- 226

Peak = 110 mmHg

Average = 38 mmHg

Surface = 1372 cm2

Average frame 100 – 226

Peak = 99.73 mmHg

Average = 37 mmHg

(Mr C was aware of being recorded)

So where do we go?

- We can get whatever we want from a collection of images, so how do we use pressure imaging to give us clinically useful data?
- First: what has an impact on a resting posture?
- Secondly: how might we assess dynamic posture?

How to create a Relevant Resting Position?

- What is a Posture / Position?
  - Capacity to maintain a defined arrangement of the body segments against disturbing forces (Nashner)
  - Lasting situation in which the physical forces that can be controlled by the central nervous system can oppose modifications of reciprocal relations between the various segments of the skeleton that external forces to which the body is exposed try to create (Scott)

Background

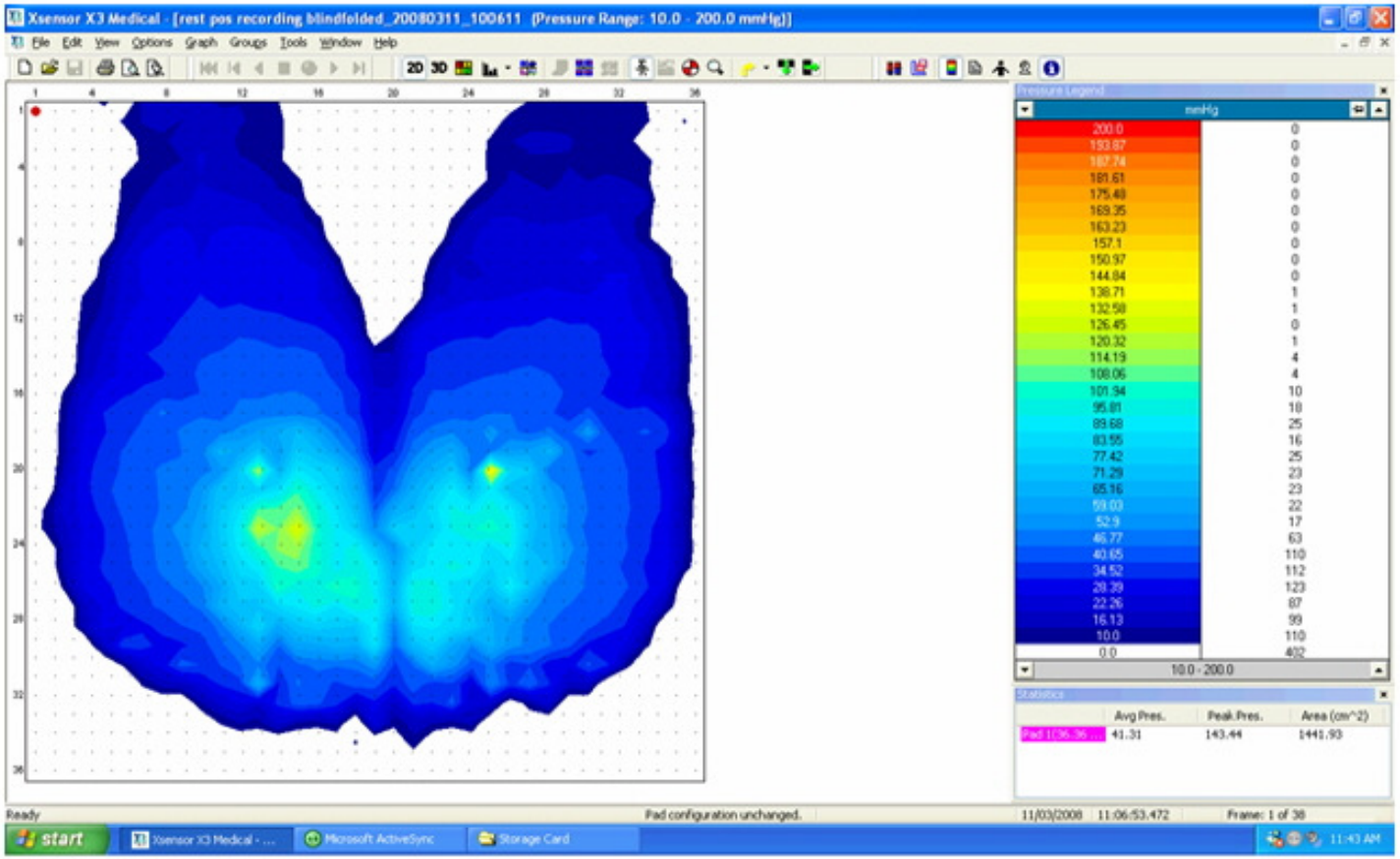
- Postural control depends on input from:
  - vision
  - vestibular system
  - proprioception (joint sense and sense of position)
- Visual input is key to maintain postural control with many wheelchair users.
- There seems to be a link between **defects in proprioception** and the development of scoliosis.

(Keessen et al, Proprioceptive accuracy in idiopathic scoliosis, SPINE, vol. 17 #2, 1992, pp. 149-55)

Relevant Resting Position

- Perception/body awareness is key for an individual to determine a resting position
- Proprioceptive and exteroceptive stimulation affect the perception of the visual vertical
- Changes in visual stimulation lead to displacements of the subjective vertical position
- Elimination of visual parameters affects body orientation - more unbiased RRP (by causing increased body sway)

Mr C's Relevant Resting Position

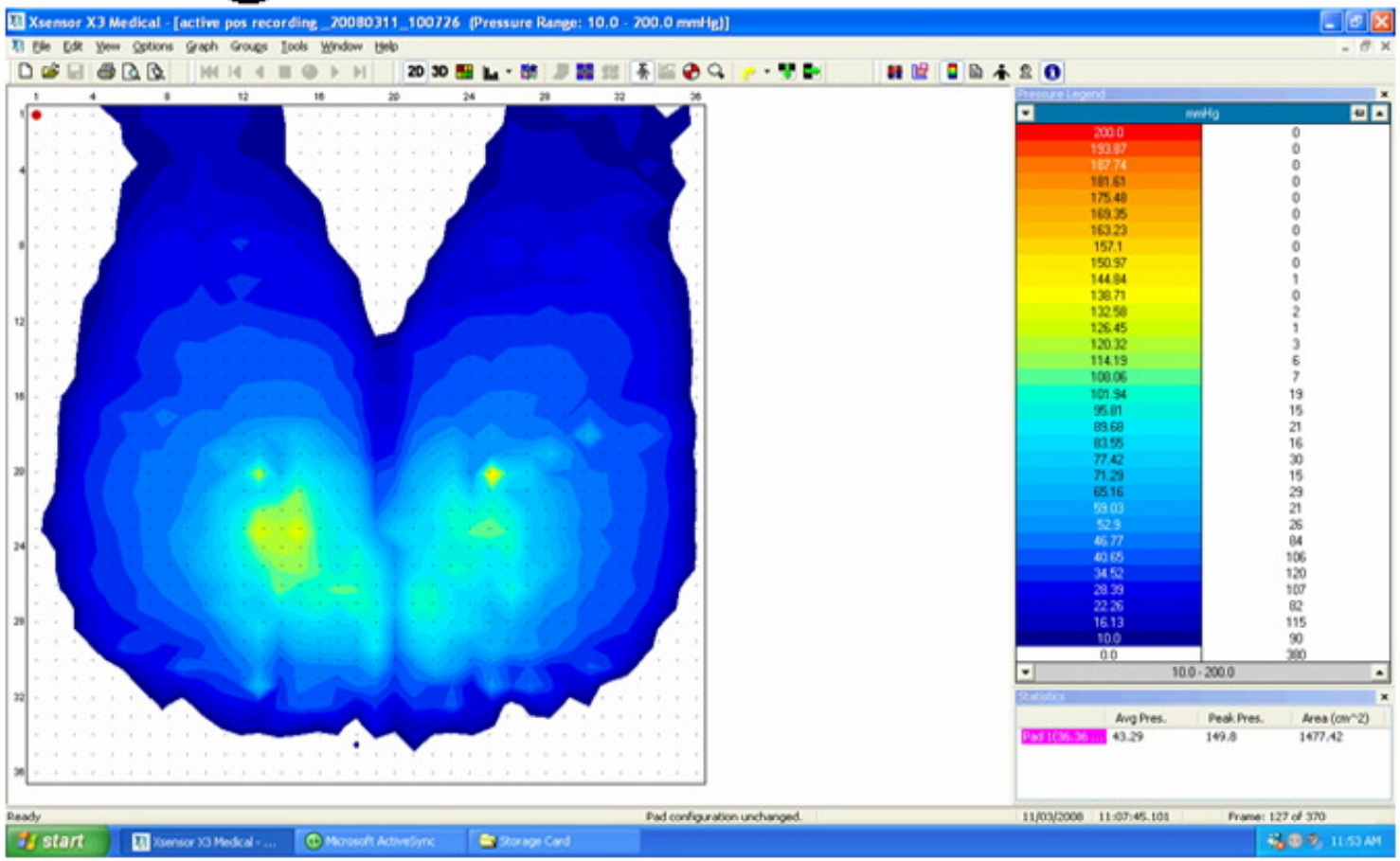


- **Blindfolded**
  - Peak = 143 mmHg
  - Area = 1442 cm2
  - Average = 41 mmHg
  - Symmetry: poor
  - Pressure Index

Relevant Active Position

- As compared with a Relevant Resting Position, achieved while blindfolded, a Relevant Active Position is achieved by performing an activity relevant for the individual.

Average RAP frames 1- 226



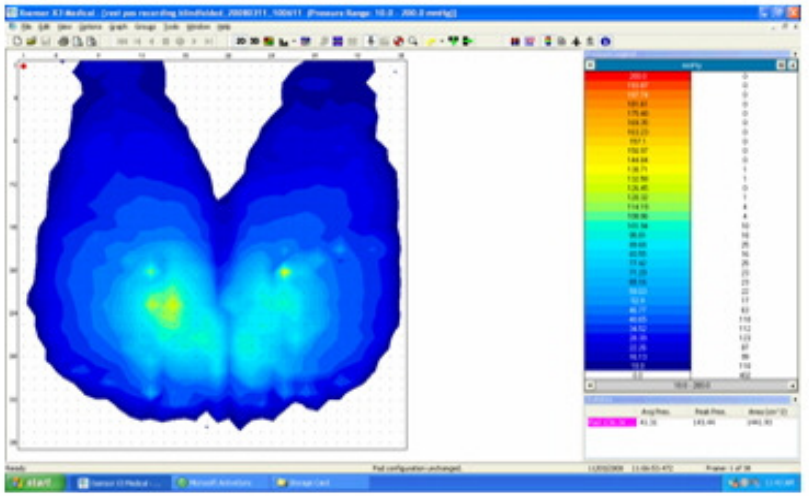
- Average Pressure = 43 mmHg
- Peak Pressure = 150 mmHg
- Surface area = 1477 cm2
- Symmetry: poor
- Pressure Index

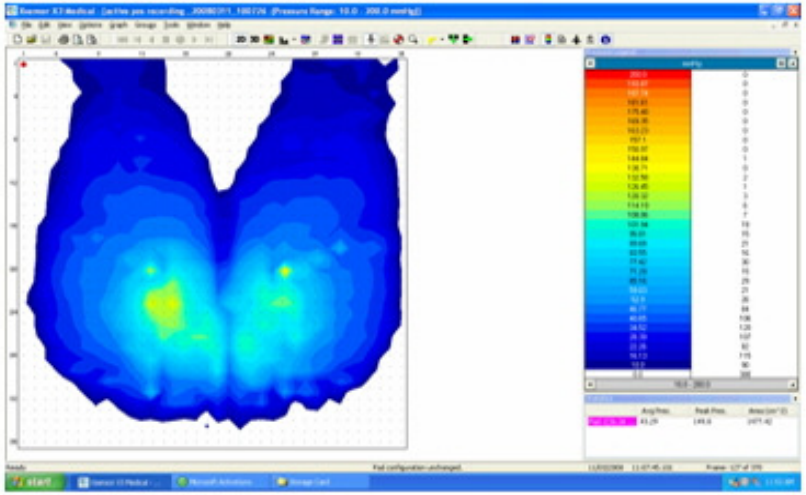
Resting Time/ Activity Time and Total Seating Time

- Estimate of the daily total Seating Time (ST)
- Estimate of the daily total Activity Time (EAT)
- Estimate of the daily total Resting Time (ERT)
- EAT + ERT = ST
- Mr C:
  - EAT = 2 hours
  - ERT = 14 hours
  - ST = 16 hours (EAT+ERT)

RRP + RAP

- Relevant Resting Position 14 hours/16 hours Total Seating Time
- Relevant Activity Position 2 hours/ 16 hours Total Seating Time
- RRP weights for 87.5 %
- RAP weights for 12.5%





Assessment Protocol Ideas

- Static

Reach tests to side, front, down

- Dynamic (same as for Smart Wheel)

Straight running

Figure of eight on the flat

Standard ramp

Conclusions

- Pressure Imaging needs to be analyzed relating to individuals' daily functional needs as well as their 'clinical' needs
- More work is needed to validate potential protocols
- Need for a focus group to set guidelines for clinical use of Pressure Imaging Systems: Volunteers?