Interface Pressure Mapping (IPM)
Clinical Use of the Literature

Laura Titus OT Reg.(Ont.), PhD Student,
Jan Miller Polgar PhD, OT Reg.(Ont.), FCAOT

SJHC-Parkwood Seating Program
London Ontario
Faculty of Health and Rehabilitation Sciences,
University of Western Ontario
Objectives

1) Participants will be able to discuss and explain the current literature of interface pressure mapping as it applies to clinical practice.

2) Participants will be able to apply literature findings to clinical practice.

3) Participants will discuss and network regarding clinical use of the IPM.
The real objectives

1. Share information about clinical use of interface pressure mapping from the literature.
2. Discuss the benefits and limits we experience clinically with IPM.
3. What else needs to be done in this area to help clinicians use IPM with confidence?
Outline of presentation

• Discuss

• Learn from each other

• Network

• Decide if there are next steps
Background of the literature search

• Searched using variations of interface pressure mapping, with wheelchairs and/or seating.
• Reviewed all articles regardless of dates but noted dates for changes in recommendations/methods of use.
Limitations

• Clinical bias in review of articles
• May not have captured every single article yet.
• Did not systematically review quality of the studies.
• Not an expert on IPM – have just read a lot of articles and used IPM clinically.
Clinical Uses identified in the literature

1. Education of client

2. Relative comparisons on different cushions for the same person

3. Relative pressure changes with different body orientations in space (e.g. tilt, squeeze, reach).

4. Relative pressure changes with different body postures such as leaning or pelvic obliquity
Clinical Uses identified in the literature

1. Education of client.
   - visual display provides feedback
     • impact of pressure
     • pressure changes with weight shifting and other pressure relieving techniques

2. Relative pressure comparisons on different cushion for the same person.
   - Comparisons are not absolute, can only make relative comparisons.
   - Suggested that IPM is more useful to identify inappropriate cushion choices rather than identifying appropriate cushions.
   - Consider all sitting surfaces – it is not always the cushion.
Clinical Uses identified in the literature

3. Relative pressure changes with different body orientations in space (e.g. tilt, squeeze, reach).
   - The IPM is useful to assist in determining effectiveness of changes in body posture or orientation in space on pressure management.

4. Relative pressure changes with different body postures such as leaning or pelvic obliquity
   - Posture/positioning impact pressure distribution and pressure peaks
Issues with IPM use

• Different goals between researchers and clinicians therefore each use different approaches
  – Variations in method of use across clinicians
  – Variations in interpretation of data

• No standard methodological protocol for use
Issues with IPM use

• Reliability of pressure reading values differs
• Differences between the IPM systems themselves limit ability to compare findings
• No absolute values – can only use relative comparisons.
Issues with IPM use

Hammocking

– Hammocking, or bridging, support surfaces contours may effect the pressure distribution being measured so the mat itself may effect pressure readings
Issues with IPM use

Hysteresis and creep

• Hysteresis = tendency for sensors to under read when loads are applied and over read when loads are reduced

• Creep = pressure values increase over time under constant load
4 key underlying themes

• Be consistent in all aspects of IPM use.
• Understand what you are measuring with IPM.
• Use IPM as part of a full assessment, not the only part.
• Use the image and the numbers to get the most out of interpretation.
Consistency of Use:
Reliability

• Reliability – who needs it? – you do
• Reliability = consistency of use
  – Process
  – Settling time
  – Data collection
• Allows greater confidence in results of one session for one person
Consistency of Use: Protocols


ISO Working Group Clinical Guidelines

FSA Point Form Clinical Protocol (courtesy of Jean Minkel MS,PT)
Consistency of Use: Reliability

• Reliability – who needs it? – you do
• Reliability = consistency of use
  – Process
    – Settling time
    – Data collection
• Allows greater confidence in results of one session for one person
Consistency of Use:
Settling Time and Creep

• Creep = pressure values over time under constant load
  – cushion creep
  – client tissue creep
• How long to settle: minimum and maximum
  – 6-8 minutes from literature – limitations of studies
  – Expert opinion – when values ‘stabilize’; use consist settle time per person to compare cushions
  – No maximums noted – impact of creep over long time?
Consistency of Use: Reliability

• Reliability – who needs it? – you do
• Reliability = consistency of use
  – Process
  – Settling time
  – Data collection
• Allows greater confidence in results per person per session.
Consistency of Use: Calibration

- Reduces effect of sensor creep
- Determines accuracy of values/colours
- Full versus quick calibration
- Reduces the effect of hysteresis
Understand what you are measuring with IPM (and what you are not measuring)

• Pressure

• Tissue tolerance
Measuring with IPM:
Pressure

• Pressure = force/area (magnitude) x time (duration)
• Highest over bony prominences
• Highest proportion of body weight is through pelvis when sitting
• Short duration & high load = long duration and low load
• Deep, interface, shear, friction
Measuring with IPM: Pressure

- Tissue tolerance is the ability of tissue to tolerate different amounts of load/pressure (magnitude) over different lengths of time (duration).
- Varies across people due to:
  - differences in condition of the tissue (eg skin elasticity, muscle atrophy, vascular changes, amount of fat)
  - Age
  - Tissue location on body
  - Hydration
  - Metabolism
  - Mobility
  - sensation

Interface Pressure Mapping by Laura Titus OT Reg. (Ont.) 2009 CSMC
Measuring with IPM: Pressure

- Many factors that contribute to pressure ulcers that need to be considered
- One article indicated over 200 contributing factors for pressure ulcers
- Many identified intrinsic and extrinsic factors
- IPM measures only one factor – pressure at the interface between the sitting surface and the client
Measuring with IPM: Because of Pressure Issues

- No “safe” interface pressure threshold in seating has been determined for all people.
- Cannot compare pressure readings across people
- Cannot compare cushions across people
- Can only use IPM to make relative comparisons not definitive decisions
Measuring with IPM:
Because of Pressure Issues

"All of the pressure ulcer risk factors tend to influence the tissue's ability to withstand load. Therefore, we cannot use interface pressure to make definitive decisions on cushion effectiveness, but we can use pressures to make relative comparisons."
(Sprigle et al 2003,p50)
Use image & numbers to get the most out of interpretation.

• Using image is OK for general distribution and providing a visual of peak pressure but suggesting need to use the values as well
• However, a value at a particular site does not necessarily mean it is good or bad.
• Cannot generalize pressure mapping studies between people with and without disabilities.
Interpretation: The numbers

- Average pressure
- Peak pressure = Maximum pressure
- *Peak pressure index
- *Contact area = area of distribution
- *Gradient
- *Symmetry
- *Dispersion index
- Co-efficient of variance
- Centre of pressure
• Study by Sprigle, Dunlop & Press, (2003) looking at repeatability/reliability of some of the values being used
• ISO Working Group Clinical Guidelines
  – (reference in the proceedings)

Interpretation of the Numbers: Average pressure

The average of all non-zero sensor values

• Reliable, repeatable, stable value but little clinical worth
  – It ‘smoothes out’ large differences between sensors, masking the way pressure is distributed
  – Is not useful in comparisons as differences between values are too small to hold meaning

• Is not included in the ISO guidelines
Interpretation of the Numbers: Maximum or Peak Pressure

The highest individual sensor value

- Area of maximum pressure loading
  - Typically the ischial tuberosities

- One of the most commonly reported parameters – has been considered useful
  - not recommend for use in clinical analysis
    - Lacks of stability
    - Poor repeatability and reliability
Interpretation of the Numbers:

*Peak Pressure Index

The highest pressure within a 9-10 cm² in the ischial region or other bony prominence

- goal is to achieve the lowest possible PPI
- good or excellent test retest reliability within a single session
Interpretation of the Numbers:

*Gradient of pressure

Changes in pressures per inch or cm

- Focus on the grouping of peak sensors not individual sensors
- High peak sensor next to a low sensor indicates poor envelopment
- More important around bony prominences

- Not included in reliability study but is in ISO guidelines
Interpretation of the Numbers:

*Contact Area or distribution*

Total number of sensors under a load greater than 5 or 10 mmHg (different in different studies)

- Larger area is better to distribute body weight
- Cautioned that contact area alone cannot provide adequate information to compare different cushion goals – redistribution vs. envelopment vs. off-loading.
- Had good-excellent test-retest reliability within a single session
Interpretation of the Numbers:

*Symmetry

Optimization of pressure distribution symmetry by comparing right and left sides

- Highlights importance of integrating IPM findings into full assessment.
- Problem solving asymmetrical IPM results cannot be done without evaluating posture.
- Can use to determine effectiveness of weight shift for pressure management.
- Use to determine effectiveness of manual correction of asymmetries.
Interpretation of the Numbers:

*Dispersion index*

The sum of the pressure distribution over the IT and sacral regions divided by the sum of pressure readings over the entire mat

- Expressed as a percentage
- “unacceptable” interface pressures occurred when greater than 55% of the pressure was at the IT and sacral regions.
Interpretation of the Numbers: 
Co-efficient of Variance

How evenly the pressure is distributed over the surface
• Expressed as a percentage
• The lower the % the better
• Little in the literature
• Not in reliability study or ISO guidelines
Interpretation of the Numbers: Centre of Pressure

The position of person’s centre of gravity

- Changes with movement
- Suggestions that it can be used to assist in determining asymmetrical weight bearing
- Used for tracking reaching patterns
- Was not included in reliability study or ISO guidelines.
Use IPM as part of a full assessment, not the only part.

- Pressure factor variability per person
- Protocols include full assessment
- Interface pressure alone is not an indicator of pressure ulcer risk
- Impact of body position and body orientation on pressure distribution
Summary

“Pressure mapping devices are not intended to replace or substitute for our most valuable tools, our hands and eyes, but when used appropriately, may be used as an adjunct to information gathered during a seating assessment in support of deciding on seating interventions.”

Brienza et al (2005)
Summary

• clinicians need to be consistent in use, focus on relative comparisons and to respect your clinical mind.

Davis & Sprigle (2008)