Wheelchair Seating Interventions
Interpreting Pressure Images & Pressure Data

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Wheelchair Seating Interventions: Interpreting Pressure Images & Pressure Data

In clinical settings, pressure imaging and mapping can help validate an individual seating strategy for wheelchair users and assess how the selected seating solution impacts the user’s interface pressures. Wheelchair seating strategies will impact Pelvic Loading Areas (PLAs). PLAs can be defined as loading zones located at or around the ischial tuberosities, sacrum/coccyx, greater trochanters, and femurs which will be impacted by loading the seat surface. For each wheelchair seating strategy, a specific wheelchair seating product or seating intervention may be selected. The aim of these seating strategies is to:

- Distribute loading evenly on one or several PLAs
- Offload one or several PLAs
- Add firmness to one or several PLAs

Does My Seating Intervention Do What I Expected It To Do?

1. **Protecting Tissues at One or Several PLAs**

Research on etiology of pressure ulcers using animal models demonstrated that the damaging effects of pressures are related to both its magnitude and duration (1, 2). Although the etiology of pressure ulcers is multifactorial, leading hypotheses suggest that tissue ischemia and tissue deformation are linked with tissue necrosis (3-5). Mechanical loading prevents arterial vessels from supplying tissues with nutrients and oxygen, leading to ischemia and necrosis. Mechanical loading causes deformation at a cellular level, which may lead to cell death and tissue necrosis. The link between mechanical loading and tissue necrosis has prompted the evaluation of seating surfaces in terms of optimizing interface pressure distributions (6-9).

Several values can be looked at when assessing loading on tissues that give an overview of interface pressure values on the entire sensor and therefore the entire loading area:

- Peak Pressures – The highest pressure value on the sensor
- Average Pressures – The average of all pressures on the sensor
- Total Contact Area – The total loading area on the sensor

To get a better understanding of the loading behavior of a specific PLA, the Peak Pressure Index (PPI) and Dispersion Index (DI) can provide further insights. The PPI is the sensel average within a 9 cm² area (approximately the contact area of an ischial tuberosity and other bony prominence) of the peak pressure sensel (10). PPI can help to evaluate the magnitude and pressure distribution over a PLA. The DI is the percentage of pressure distributed of a sensel relative to the total pressure on the seat (11). DI is determined as:

\[ DI = \frac{A}{A+B} \text{ where } A = \text{PLA and } B = \text{Pressures outside the PLA} \]

This value helps assess the pressure distribution properties of a PLA as compared to the rest of the seating surface.
Image 1 (Below): Comparing images of a wheelchair user (T.) sitting on a gel cushion (top-left), hybrid foam + air cushion (top-right), medium density foam cushion (bottom-left), and air cushion (bottom-right).
Image 2 (Below): T. medium density foam cushion markers.
2. Maintaining Postural Alignment

When the goal is to maintain postural alignment of the user and to prevent postural changes from happening, increasing the loading on specific PLAs may be a strategy:

- Pre-ischial loading, where a ridge or an area of contour placed anterior to the ischial is selected with the intent to limit forward movement of the ischial tuberosities and posterior pelvic tilt.
- Sub-trochanter loading, intended to prevent movements of the pelvis in the frontal plane.
- Medial thigh loading, intended to provide contact at the adductor region of the thighs and to provide alignment of the femurs.
- Lateral thigh loading, intended to provide contact at the abductor region of the lateral thighs, with the intention to align the femurs and provide lateral stability to the lower extremities.
3. **Accommodating or Correcting a Deformity**

When the goal is to accommodate or correct a pelvic obliquity or a range limitation of a pelvic to thigh angle, asymmetric loading of the thighs, sub-trochanter areas, or ischial areas may be a strategy. A pressure mapping image can help to determine if the loading location and behavior of the seating system is meeting expectations.

**What about Wheelchair Adjustments?**

Pressure mapping can help visualize the loading effect on PLAs of common wheelchair set-ups like tilt in space, back support recline, elevating leg supports, foot support adjustments, and seat angle selection. The effect of these adjustments on the loading behavior of the PLAs can be measured and quantified and different set-ups can be compared. An additional sensor pad, measuring interface pressures at the back support can be added to better understand and compare both the loading behavior of the seat and back support with different wheelchair set-ups.
Image 5 (Below): T. adjusted vs. non adjusted foot supports (too high).
Validation of Palpation Skills and Seating Techniques

Bottoming out can occur on most seating surfaces. It is safe practice to frequently check seating surfaces for signs of bottoming out. The most common technique is to palpate the lowest bony prominence and check if there is enough material between the cushion and the seat base. Checking for bottoming out may be difficult for unexperienced caregivers. Pressure mapping can provide visual feedback and help link tactile information from the palpation with visual information of the location and loading of a lowest bony prominence on the sensor.

Documentation and Motivation of Wheelchair and Seating Interventions to Funding Sources

Pressure mapping can help document, validate, and motivate seating selection and/or wheelchair set-ups with funding sources by showing the loading behavior of the selected seating strategy for wheelchair users.
How Does Pressure Imaging Benefit the Wheelchair User?

Education plays an important role in managing the pressure ulcer risk of a wheelchair user. Caregivers have a role in educating and raising awareness of the pressure ulcer risk to users and caretakers.

Wheelchair users are instructed to reposition during the day to preserve tissue. When sensory information is lacking, pressure imaging can provide visual information about the relevance and the best technique to adequately execute an offloading strategy. In addition, the pressure imaging data can help to inform wheelchair users why a seating intervention was recommended and reinforce the correct use of equipment.

Image 7 (Below): The effect of wallet in the right-back pocket.

Understanding What Happens Outside of the Wheelchair – 24/24 Approach

Wheelchair users do not spend all of their time sitting in wheelchairs. Pressure imaging can also help to visualize loading when seated on different seating systems during ADLs (Activities of Daily Living), transfers, and 24-hour postural care:

- Car seat vs. wheelchair cushion
- Shower and commode seats
- Assess transfers and transfer techniques
Wheelchair Seating Interventions:
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- Assess loading patterns during wheelchair propulsion, tilt, recline, etc.
- What happens in supine

It can also show loading effects during nighttime positioning or what happens when lying on support surfaces.

Pressure imaging has multiple uses in clinical settings which can benefit the wheelchair user, the seating teams, caregivers, and funding sources.

References:


About the Author:

Bart Van der Heyden has specialized in the field of seating, wound care, and mobility for over 25 years. After studying Physical Therapy in Gent, Belgium, he gained experience in Germany providing seating and therapy for children with Cerebral Palsy. After working in a rehab setting in the USA, he began offering clinical consultations to wheelchair users, clinicians, and manufacturers worldwide.

A foremost expert in his field, Bart has developed numerous training courses and workshops globally on skin management, seating assessment, seating techniques, and interventions. He is an engaging, much sought-after speaker with a multi-disciplinary view of clinical practice and seating.

Bart works with XSENSOR in Europe and is the owner of a private physical therapy practice in Belgium, SuperSeating Clinical, R&D, and Regulatory Services, providing seating, wheelchair mobility, and wound management services internationally.

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