Growing evidence in support of orthotic based seating

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AT Pavilion Presentation
Quick Review

- What is postural tendency?
  - Predicted movement of pelvis at rest
- What is the only desirable postural tendency at rest?
  - Posterior
- Does the posterior postural tendency create a tendency to slide into or out of the wheelchair?
  - OUT OF the wheelchair
- How do we keep people from sliding out of their wheelchairs?
  - Apply shear AND pressure forces
- What about skin?
  - Apply shear AND pressure forces to tolerant tissue
  - Remove/off-load contact at high risk bony prominences
More review

Posterior Tendency Intervention

- 4 Key points of control
  - SEAT
    - 2
    - 4
Background Research

- **Stage I and II (Superficial)**
  - Heat and moisture at the sitting surface is believed to be the causative factor in superficial stage I and II pressure ulcers (Ferguson-Pell 2009)
  - Every 1 degree C raises metabolic demands by 10%. Stressed tissue will cause ischemia and pressure ulcer development in a shorter period of time. (Clark, Romanelli, Reger, et al. [www.woundsinternational.com](http://www.woundsinternational.com))
  - Moisture causes softening of epidermis and weakening of the collagen in the dermis
  - Weakened skin increases the risk for damage via micro-traumas
  - Superficial ulcerations constitute 58% of all pressure ulcers (Barbenel et. al., 1977)
Stage III and IV (Deep partial and full thickness)

Deep Tissue Deformation has been determined as a causative factor in deep stage III and IV pressure ulcers (Gefen 2014)

Deep Tissue Injury (DTI) occurs in tissues such as in muscle, directly under the ischial tuberosities.

DTI may not be initially visible like a bruise, but then rapidly progresses to a full-thickness pressure ulcer.
Immersive wc cushion technology
(Pressure Redistribution)

- Use of soft, immersive materials such as fluid-filled bladders or neoprene columns of air to envelope the bony prominences (ITs and coccyx) into as much as 3 inches of depth of these materials (optimally); thus reducing peak pressures at these high risk bony surfaces.
Orthotic designed wc cushion technology (Off-loading)

- As with virtually all orthotic and prosthetic devices, Orthotic designed wc cushions are designed to intentionally and selectively increase the forces of support at relatively low risk anatomy (typically the general areas of the gluteus medius and proximal bodies of the hamstring musculature) and then create areas of relief (“off-loading”) by moving contour away from the body at the relatively higher at-risk bony prominences (IT’s, coccyx/sacrum, greater trochanters).
Research Conducted By:

- Interface Pressure/Dispersion Index and Stability research*
  Primary Investigator = Barbara Crane, PhD, PT, ATP/SMS
  University of Hartford, Hartford, CT

- Deep Tissue Deformation and Microclimate research*
  Primary Investigator = Evan Call, MS, CSM-NRM
  Weber State University, Ogden, UT

* Ride Designs provided research materials for testing, provided subject reimbursement and logistical support.
Interface Pressure Mapping Study

Methodology

- 10 subjects with SCI, paraplegic
  - Average age 44.8 years
  - WC user x 20 years (average)
  - Range 3 years to 42 years post injury.
- Interface pressure measurements completed per accepted industry protocol.

Primary Investigator = Barbara Crane, PhD, PT, ATP/SMS under an IRB granted to Evan Call Weber State University, Ogden, UT
Interface Pressure Mapping Study

• Objective: Compare interface pressure measures between an orthotic and an 4” air cushion.

• Test conditions:
  • Orthotic Cushion
    1. Off-loaded with or without additional CAM wedges as needed
    2. With top well insert
    3. With top well insert and spacer
    4. Properly inflated 4” air cushion

• Interface pressure measurement parameters examined:
  • Right Ischial Tuberosity Average Pressure
  • Left Ischial Tuberosity Average Pressure
  • Sacrum Average Pressure
  • Dispersion Index
Results –
Ischial Tuberosity (IT) Average Pressure

Average Left IT pressure = 37 mmHg on orthotic cushion #1
= 71 mmHg on 4” air cushion
Dispersion Index (Sprigle, et al 2008)

Dispersion Index (DI) = 

sum of pressures in the region containing the ITs and sacrum

sum of pressures over the entire interface pressure mat

Lower DI means better protection of high risk areas!
IPM Study Results – Dispersion Index

Average Dispersion Index = 11% on orthotic #1 off-loaded configuration
= 23% on 4” air cushion
Modified Functional Reach Study

- **Objective**
  - Compare sitting stability between an orthotic (3 different configurations) and a properly inflated air cushion.

- **Methodology**
  - Same 10 subjects used in IPM Study
  - Right, left and forward reach were measured.
  - Five trials each direction were completed.
Results – Modified Functional Reach

- Right and left lateral reach was significantly longer with the orthotic-style cushion than with air inflation cushion.
- Forward reach had no statistically significant difference.
Java Cushion MRI
Research Summary

Objective

- Compare deep tissue deformation below IT’s under three conditions:
  - Properly inflated 4” air cushion
  - Orthotic-style cushion
- Ten different subjects:
  - SCI, paraplegia
  - 18.4 years average time since onset, ranging from 3 to 30 years.

Primary Investigator = Evan Call, MS, CSM
Department of Microbiology,
Weber State University, Ogden, UT
Use of the orthotic-style wc cushion results in ~50% less tissue compression than a 4” air cell cushion.
Microclimate

- The term microclimate refers to the skin surface temperature (heat) and skin surface humidity (moisture) at the body-support surface interface.
Microclimate & immersive cushion design

Pressure redistribution design relies upon mechanical pressure relief for effective heat and moisture management.
Microclimate & Java Cushion

Air channels through areas of off-loading creates **passive convection** which aids in the management of heat and moisture.

Spacer fabric helps to manage heat and moisture on loaded areas.
Pilot Microclimate Study

- **Objective:**
  - Compare sitting surface temperature and humidity on an air cell and off-loading-style wheelchair cushion.

- **Methodology:**
  - Single-subject human test
  - 6 mini temperature sensors and a temperature and humidity “logger”
    - Placed between the cushion & cover at the right IT and thigh, perineum, left IT and thigh, and ambient air.
  - Data gathered over 24 hour period x 7 days each on high-profile ROHO and Java Cushion

Primary Researcher: Evan Call, MS, CSM Weber State University, Ogden, UT
Microclimate Pilot Study Results

- The cushion/user interface on the Java Cushion was 1.6°C cooler (2.88°F) than a 4 inch cell air cushion.
  - This can be equated to a 16 to 20% decrease in metabolic stress to tissue.
- The humidity data requires further analysis as it is heavily influenced by the temperature data.
- Encouraging, but is it conclusive?
  - Further studies
  - Multiple subjects
  - Multiple sites
Off-the-shelf orthotic style seating and it’s limitations…

- Pelvis needs to be able to stay positioned in the parameters of the loading and off-loading contours to remain safe and be effective.
- The cushion needs to be placed in the wheelchair correctly by the client or caregiver.
- As with any orthotic device a skin check schedule should be utilized to insure skin integrity safety.
- User and caregiver education is the key to insure successful outcomes.
- Possibly may not be the right intervention given complexity or lack of skilled fitters.
Thank you.
Questions?? – See me in booth #2

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