Temperature and Humidity at the Buttock-Wheelchair Cushion Interface

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Introduction

- Skin microclimate has been linked to tissue health
- Relative humidity affects friction and skin's ability to withstand loads
- Increased tissue temperature increases metabolic demand and may affect tissue integrity
- Clinicians need to prescribe wheelchair equipment that is tailored to the needs of the individual

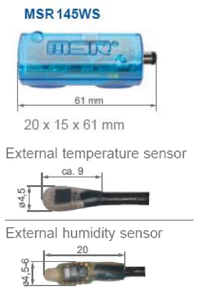
Objectives

- Investigate relationship between temperature and relative humidity in controlled tests
- Monitor the same parameters in everyday use and assess the impact of user functionality
- Compare measurements taken at skin and cushion surfaces to validate cushion measurements

Methods

MSR logger

- Temperature sensor, 0.1 C
- Relative humidity sensor, 2%
- Occupancy switch



Controlled Test

- Same subject, clothes & chair,
- consistent ambient conditions
- Sensor located 2-3 cm forward of the ischial tuberosity on the skin
- Additional sensors attached to cushion surface in an analogous location
- Cushions monitored for 45 min duration, some with 60 sec pressure reliefs every 15 minutes

Everyday use test

- Attached logger and sensors inside cushion cover
- Logged data for approximately 1 week

Data Analysis

- Bout of sitting: threshold set at 10 minutes
- Steady-state: initially defined as <1/2 C/30 min

Results

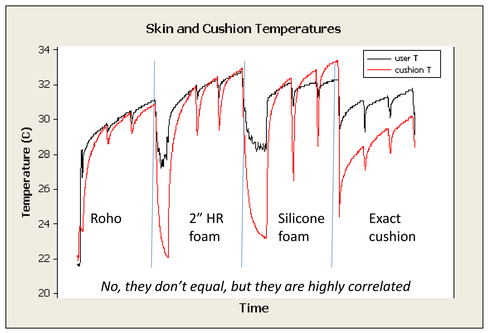
Controlled Testing

Silicone-impregnated foam

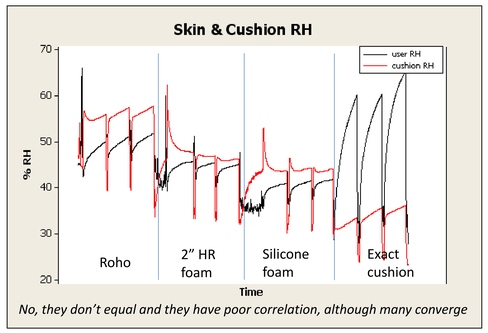
2" HR70 foam

Roho HI Profile

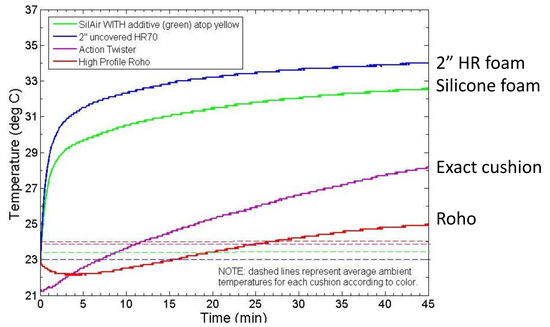
Action Exact



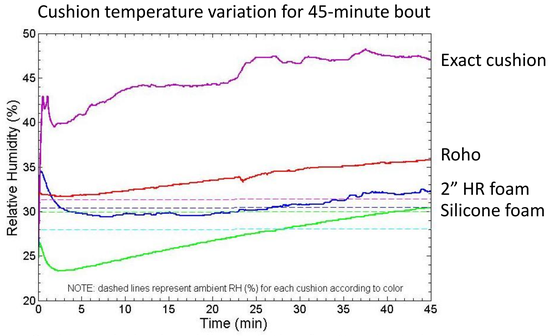
Skin and cushion temperature comparison



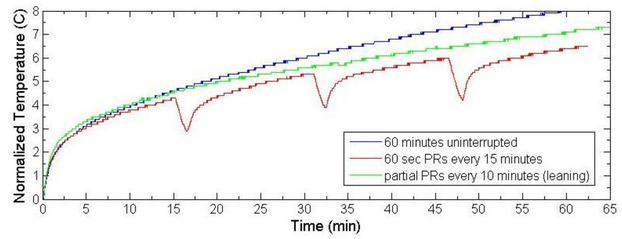
Skin and cushion relative humidity comparison

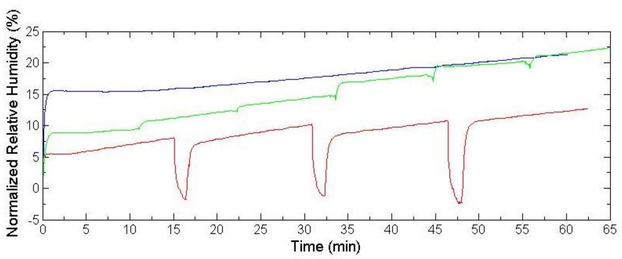


Cushion temperature variation for 45-minute bout



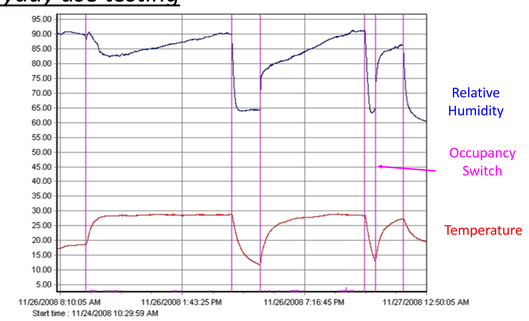
Cushion relative humidity variation for 45-minute bout



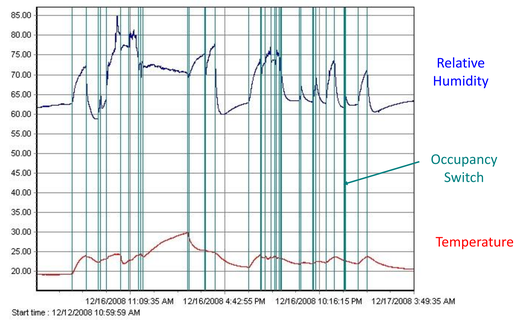


Skin-mounted temperature and relative humidity data (Exact cushion) to characterize the effect of movement

Everyday use testing



Temperature and RH results over one day (long bouts)



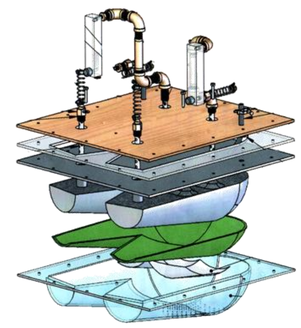
Temperature and RH results over one day (short bouts)

Conclusions

- Correlation between skin and cushion measurements
  Temperature: R > 0.9 Relative Humidity: R < 0.4
- Cushion-mounted sensors suitable for temperature, but not relative humidity measures
- Difference in skin and cushion temperatures after 45 minutes
  Roho: 0.3°C 2" HR70 foam = 0°C
  Silicone foam = -1.1°C Exact cushion = 1.5°C
- Movement is a good way to dissipate heat and alter shear and normal loading; can be facilitated through education, positive reinforcement
- Controlled tests did not reach steady-state, while most real-world bouts reached steady-state after approx. 90 minutes

Future Work

- Increase sample size to increase reliability of results
- Use subject debriefing to better contextualize data
- Inform modifications to current standardized heat & humidity test method
- Compare results of human and lab tests to assess validity



Exploded view of buttocks model used in standardized lab tests

Acknowledgements

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