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WHITE PAPER

AireRx™ AireFlow™ SPC and AireFlow™ SPPC Cushions
Temperature and Humidity Management

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Skin Ulcers Formation

Ulcers in the buttocks area are prevalent among wheelchair users that have limited mobility, decreased sensation or both. Additionally, many wheelchair users tend to sit on their cushions for extended periods of time. Historically, high pressures at the buttocks to cushion interface and extended sitting times have been identified as the principle contributing factors in causing skin ulcers. As a result, cushion designs have been focused on decreasing overall and peak pressures during sitting.

New data shows that skin temperature and relative humidity at the buttocks/cushion interface may be as important as pressure in preventing the formation of skin ulcers. A recent study on swine used temperature controlled skin indenters to apply pressure with forces ranging from 10-150 mmHg. It was demonstrated that indenters at 25° C did not produce any skin damages over 10 hours; while the indenters at 35° C produced deep tissue damage after only 5 hours (Iaizzo, 2004). Higher temperatures produced both cutaneous and deep tissue damage.

AireRx™ AireFlow™ Technologies

Technical Design Elements for Minimizing the Levels of Temperature Buildup and Moisture Retention at the Buttocks/Cushion Interface

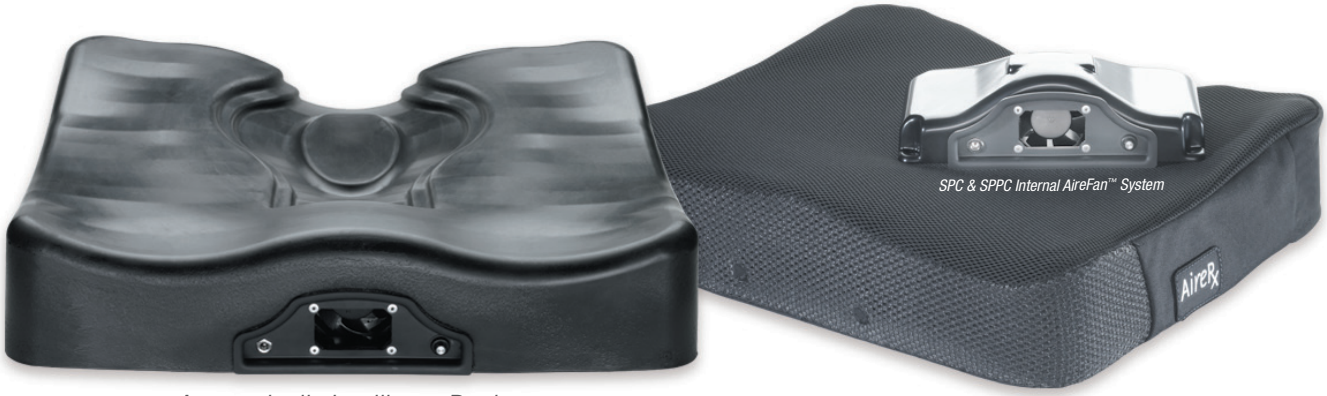
AireRx™ cushion designs incorporate elements for the management of postural stability and pressure relief (Anatomically Intelligent Design™). AireRx™ designs also incorporate advanced features intended to assist in reducing retained heat and lowering moisture retention levels at the patient cushion interface (page 2, figure 1.1). Excessive build up of heat and moisture (humidity) levels are known to be contributors to skin ulcer development (Iaizzo, 2004).

Excessive heat buildup is moderated in the AireRx™ cushion by the use of:

- A new type of Dual Density Spacer Fabric in the exterior cover and in additional internal layers located in areas of high skin ulcer risk.
- Increased air flow at areas of highest skin ulcer risk (with the use of engineered air chambers and passages) are designed into the cushion structure.
- Actively circulated air (via an internal fan with rechargeable batteries) available on some models, which actively draws ambient room temperature air into the cushion, directing air under and around the buttocks/cushion interface area while actively moving heated air away from the body and out the rear of the cushion.

Excessive moisture retention is minimized in the AireRx™ cushion by:

- Minimizing heat build-up as noted above, (less sweating and less development of increased moisture retention at the skin level).
- Use of Mesh support materials that allows cooling air flow to evaporate moisture:
  - > Air exchange over the entire seat support surface promotes cooling and evaporation of moisture.
  - > Mesh support materials allow liquids to drain through preventing pooling and saturation.
- Shape of cushion provides natural drain for any liquid to the rear and away from support area.



Anatomically Intelligent Design

(AireRx™ AireFlow™ SP – Shown above with AireFlow™ cover and insert removed.)

Figure 1.1

Temperature and Humidity Testing

A clinical pilot study to determine the wheelchair seat cushion's effect on skin temperature and relative humidity was conducted by an independent test facility.

The study was conducted using 6 test subjects (4 male, 2 female). Skin temperature and humidity was measured on 3 different cushions for periods of 1 and 2 hours, the Jay2®Deep (cushion 1), the Supracor Contour® (cushion 2), and the AireRx™ SPC (cushion 3A with its internal fan in the OFF position, and cushion 3B with internal rechargeable fan in the ON position). Thermal and humidity sensors were applied to the skin surface adjacent to the ischial tuberosities, posterior thigh and lateral aspect of the greater trochanter.

The test environment was maintained at a constant temperature and humidity. The participants performed their customary periodic pressure relief strategies throughout the test trials.

Results

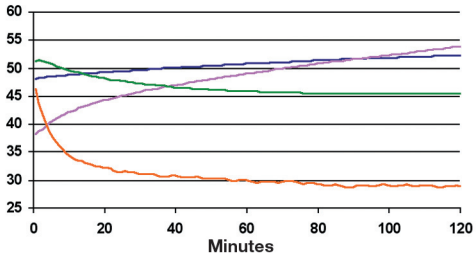
The data indicates that temperature and humidity levels had not stabilized after two hours but the rate of change slowed enough to suggest an acceptable level of stability. Data analysis indicates that test periods in excess of two hours may be required for some cushions.

Humidity

The humidity data was lowest for all participants on cushion 3B (AireRx™ SPC – Internal Fan in the ON position). Examples of the humidity testing results can be seen in figure 1.2 & 1.3. Full test results may be viewed at www.airerx.com. The test data demonstrates that humidity changes can be detected while ambient and trochanter humidity remain stable. Preliminary data also suggest that humidity while using cushion 3B (AireRx™ SPC – Internal Fan in the ON position) decreases over time while it rises in the other cushions tested.

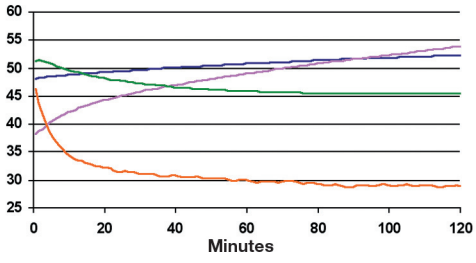
124-05 L IT Humidity

Figure 1.2



124-05 R Thigh Humidity

Figure 1.3



Cushion 1 – Jay2® Deep
Cushion 2 – Supracor Contour®
Cushion 3A – AireFlow™ SPC, Fan OFF
Cushion 3B – AireFlow™ SPC, Fan ON

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Temperature

Although no trends were noted in the temperature data across all trials, interestingly, two participants had stable temperatures using cushion 3B (AireRx™ SPC – Internal Fan in the ON position) and one participant using cushion 3A (AireRx™ SPC – Internal Fan in the OFF position) across the test trial. Longer trial periods, possibly 2.5 hour trials, should be investigated in a more controlled room temperature environment.

Conclusions

This study demonstrated that humidity differences while sitting on different commonly available commercial cushions can be detected. Preliminary data suggests that cushion types have an effect on humidity at the buttocks to cushion interface. Temperature data was inconclusive across all trials, possibly due to trail time durations. However, results on some subjects utilizing cushions 3A and 3B, (AireRx™ SPC – Internal Fan in the OFF position and AireRx™ SPC – Internal Fan in the ON position) suggest that cushion design and materials can affect skin temperature changes and humidity levels. These results point to the need for further research with a larger subject population and changes to the test duration and environment.

Wheelchair Cushion Temperature and Humidity Characteristics
Final Report Summary –
Full report available at www.airerx.com.

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