The Effect of Temperature on Skin Ulcer Development

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This study explored test methods for measuring the wheelchair seat cushion's effect on skin temperature and relative humidity over a period of 1 to 2 hours of sitting in a wheelchair.

Literature Review and Test Parameter Specifications
The test durations used in previous studies to assess the wheelchair seat cushion's effect on skin temperature and/or relative humidity range between 15 minutes and 120 minutes (Fisher et al., 1978; Stewart et al., 1980; Cochran, 1985; Seymour & Lacefield, 1985; Ferrarin & Ludwig, 2000). The results of these studies suggest that the use of 30-minute test duration for viscous fluid cushions is sufficient for determining its effect on lowering skin temperature, however temperature increases due to heat accumulation required 60-120 minute sitting times to reach steady-state for the viscous fluid. For air-filled cushions, skin temperature over the ischial tuberosities was shown to have monotonic increases through 60 minutes of monitoring.

The measurement sites chosen for this experiment are those sites prone to the development of pressure ulcers, (ischial tuberosities), and those sites shown to be prone to relatively large temperature increases, (posterior thighs). The skin temperatures over the lateral aspect of the greater trochanters were used as reference values. In previous studies, skin temperature under the posterior thighs was shown to have a greater increase as compared to over the ischial tuberosities (Fisher and Kosiak, 1979 and Ferrarin and Ludwig, 2000).

Test Procedure / Protocol
Four test trials consisted of three wheelchair cushions; a viscous fluid, a flexible fusion bonded honeycomb and a contoured foam with powered air circulation. The cushion with air circulation has two operating modes, Fan-ON and Fan-Off. It was tested in both configurations.

Each test trial consisted of sitting with normal comfortable posture on the cushion for a continuous period of time from 60 to 120 minutes. There was a minimum of 30-minute rest between each trial. Each participant completed four trials using the same wheelchair.

Results

Data from the one-hour trial demonstrated that temperature and humidity readings were still increasing after one hour of sitting on each cushion. Data from the two-hour trial showed temperature and humidity readings was still increasing for some participants on some cushions.

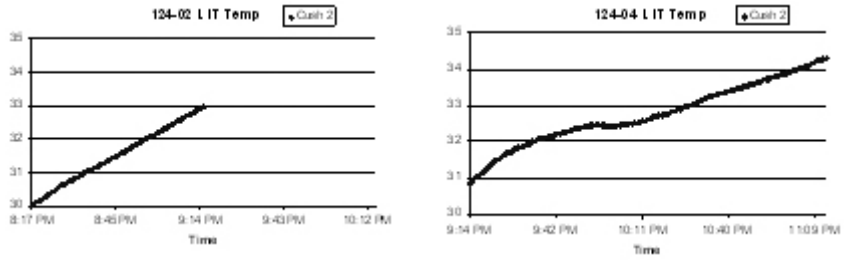

Figure 1. Participants 124-02 and 124-04 Left IT Temperature (L IT) scaled to a two-hour period.

Discussion

Preliminary data demonstrated that one-hour trial periods were not long enough for the temperature and humidity to stabilize at the buttocks to cushion interface of the participants. Data collected over two-hour trial periods did plateau for some of the test sites on some of the cushions tested. Although the data suggest that longer testing trials may be needed to obtain stable temperature and humidity data, this may not be tolerable for human participants.

These data demonstrate that humidity changes can be detected while ambient and trochanter humidity remain stable. Preliminary data also suggest that humidity while using cushion 3b decreases over time while it rises in the other cushions tested.

No trends were noted in the temperature data across the four trials. Longer trial periods, possibly 2.5 hour trials, should be investigated in a more controlled room temperature environment. Changes observed at the test sites were often within the variance of the room temperature. In addition, temperature was still rising at most test sites.

This study was performed in a static environment where the test participants were sitting quietly. Temperature and humidity at the buttocks to cushion surface interface should be investigated while performing normal daily activities in the wheelchair and during wheelchair sports.

Conclusions

This study demonstrated that humidity differences while sitting on different 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 although results on some subjects suggest that cushion function has an impact on skin temperature. Further research with a more subjects is needed.

References

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