

EFFECTS OF USING A DYNAMIC CUSHION FOR THE TISSUE HEALTH OF PERSONS AT-RISK

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SUMMARY

A multi-factorial approach was used to determine the tissue health of persons at-risk of developing a pressure ulcer (PrU). Persons with spinal cord injury (SCI) used either a standard cushion or a dynamic cushion that assists in weight-shifting. There is a significant decrease in transcutaneous oxygen (TcPO₂) and microvascular blood flow (BPM2) with the use of a dynamic cushion although there is no significant difference in interface pressures. Weight shifting with the dynamic cushion compared to use of a standard cushion produced larger positive relative changes in TcPO₂. In a longitudinal case study, TcPO₂ measurements were significantly higher for the standard cushion compared to all cases of repeated use of the dynamic cushion. There was no significant difference in TcPO₂ measurements over time with use of the dynamic cushion except at 6 months.

INTRODUCTION

Pressure ulcers are a major secondary risk factor for patients with SCI [1]. Physiological changes such as decreased blood flow in microvasculature and muscle atrophy lead to poor tissue health. Furthermore, loss of sensation and mobility contribute to prolonged high pressures on bony prominences such as the ischial tuberosities and sacrum. The use of a multi-factorial assessment of tissue health provides a useful tool in the development and assessment of approaches to PrU prevention [2].

METHODS

Persons with SCI had an initial multi-factorial assessment using their own standard cushions followed by repeated assessments with the dynamic cushion (Aquila Corp, Holmen, Wisconsin, USA) after two-week periods of use. A total of six assessments are done with the dynamic cushion every 3 months.

The multi-factorial assessments includes: 1) *Seating interface pressures* (CONFORMat, Tekscan Inc, South Boston, Massachusetts, USA). 2) *Transcutaneous oxygen* (TcPO₂) (TCM4, Radiometer, Copenhagen, Denmark). 3) *Blood perfusion dynamics*, i.e. flow, volume and velocity, (LaserFlo BPM2, Vasamedics LLC, St Paul, Minnesota, USA).

The assessment protocol includes: having the study participant side-lying for 20 minutes to obtain steady-state TcPO₂ or BPM2 measurements, followed by a sitting period where interface pressures are observed concurrently with TcPO₂ or BPM2 measurements. The sitting period is divided into a period of quiet sitting and a period of active sitting where weight shifting is performed either by the participant or via the dynamic cushion. Measurements are taken in the region over the ischial tuberosity. Constant temperature and humidity were maintained in the laboratory for all assessments.

Simple descriptive statistics such as means and standard deviations were performed using MS Excel (Microsoft Corp., Redmond, WA). Repeated measures analysis of variance (ANOVA) was performed using SPSS 13.0 (IBM Corp, Somers, NY). The repeated measures ANOVA was used to compare changes in variables of interest with the use of the standard and dynamic cushions. Additionally, a longitudinal case study was performed to determine changes in TcPO₂ over a 15 month period.

RESULTS AND DISCUSSION

A repeated measures ANOVA was used to compare tissue health measurements taken with the use of a standard cushion to that of a dynamic cushion for 4 study participants. A significant main effect due to the use of different cushions was seen in both TcPO₂ and BPM2 while no significant change was seen in interface pressures over the ischial region. TcPO₂ measurements with the standard cushion (M=47.55) were significantly higher than for the dynamic cushion (M=29.65), p<0.05. BPM2 measurements with the standard cushion (M=3.947) were significantly higher than for the dynamic cushion (M=1.623) p<0.05. Interface pressures were not significantly different between standard cushion (M=34.21) and dynamic cushion (M=32.32).

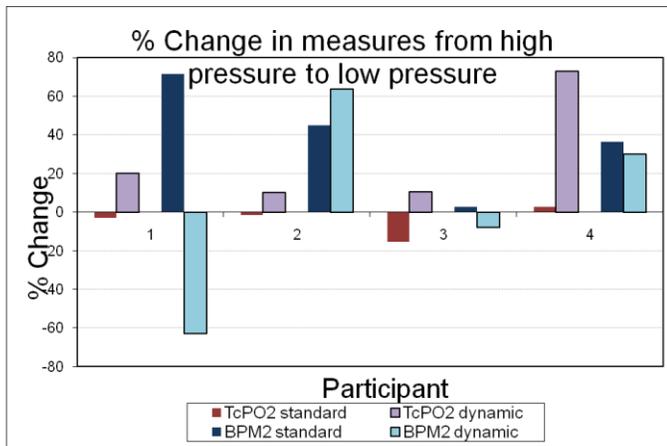


Figure 1: Comparison of the relative changes (%change) in TcPO₂ and BPM2 as weight is shifting from high pressure to low pressure with use of either standard or dynamic cushion.

When comparing the %change from a high pressure to low pressure due to a weight shift (Figure 1) the standard cushion did not produce consistent changes in TcPO₂ while the dynamic cushion produced a positive %change in TcPO₂ measurements for all 4 participants. There was up to 25% relative change in BPM2 measurements for all conditions in all participants except participant #3. This could be due to the pressure relief maneuvers performed by all 4 participants (except #3 who only inclined) on standard cushions included moving side-to-side or leaning forward; this movement greatly affects BPM2 measurements.

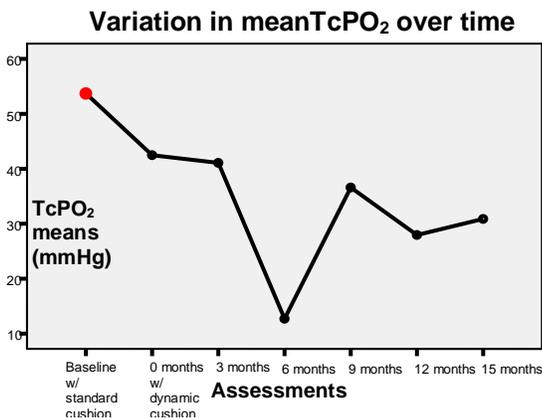


Figure 2: Variation in mean TcPO₂ for a single individual over a 15 month period. ● = standard cushion, ● = dynamic cushion

In the longitudinal case study (Figure 2) TcPO₂ measurements with the standard cushion (first assessment, M=53.71, SD=1.12) were significantly higher than all dynamic cushion measurements (M=42.48, 41.08, 12.72, 36.6, 27.95, 30.88), p<0.05. There was no significant difference in the dynamic cushion TcPO₂ measurements except at 6 months (M=12.72, SD= 5.88), p<0.05.

CONCLUSIONS

The multi-factorial tissue health assessment protocol indicated differences between use of a standard cushion with pressure relief maneuvers and the dynamic cushion with variable inflation. Both TcPO₂ and blood flow measurements were higher for all study participants with the standard cushion, although there was no significant change in interface pressures. Long term use of the dynamic cushion did not significantly change tissue perfusion. Furthermore, TcPO₂ measurements were significantly higher for the standard cushion. This implies that standard cushions with appropriate pressure relief maneuvers may provide better sitting conditions for tissue health.

The cyclic inflation of the dynamic cushion had an immediate effect on interface pressures and TcPO₂ while patient-initiated pressure relief maneuvers affected blood flow measurements more. It is known that individuals with SCI may exhibit both impaired and delayed tissue recovery [3]. Thus the standard inflation/deflation cycle of dynamic cushions may require adjustment in order to provide effective tissue reperfusion for at-risk individuals with SCI.

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This study has a target subject group of more than 15 participants.

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