

Alternating Ischial Support as a Method of Preventing the Instance of Pressure Ulcers

Makhsous, M., Lin, F., Zeigler, M., Hartwig, D., Taylor, S., Pedersen, J.

Sensory Motor Performance Program, Rehabilitation Institute of Chicago,
Depts of Physical Medicine & Rehabilitation, Northwestern University

18th Annual Clin
Symp On Adv in
Skin & Wound
Care, Chicago, IL
Oct. 16-19, 2003
#116

INTRODUCTION

Those who are confined to wheelchairs are highly vulnerable to pressure ulcers (PU) [1] as the results of long time high pressure on the ischia. Pressure-induced insufficient tissue perfusion and high skin temperatures elevation in and around the sitting area cause tissue breakdown [2]. Sitting pressure relief is crucial to preventing PU and accelerating PU healing.

Objective: To evaluate the effects of the new automated alternating sitting pressure release design (Fig. 1) as a measure of preventing PU with regards to improving tissue perfusion and preventing skin temperature elevation in and around the sitting area.

Hypothesis:

Sitting with programmed periodic ischial pressure release (**Alternate**) will redistribute the contact pressure in a cyclic pattern, reduce skin temperature elevation, promote tissue perfusion around the sitting area better than usual sitting plus **Push-ups**.

METHODS

- Subjects:** 20 healthy subjects (age: 36.6 ± 13.2 ; height: 179.3 ± 13.5 cm; weight: 71.9 ± 17.7 kg).
- Sitting Conditions:** With (**Normal**) and without ischial support combined with adjustable lumbar support (**WO-BPS**). Adjustments are automatically controlled through a motor, pump, and programmable logic controller.
- Study Design:** The seat and back pressure distribution, skin temperature, and transcutaneous oxygen ($tcPO_2$) and carbon dioxide ($tcPCO_2$) at and around the ischial tuberosities (IT) were measured

Table 1. Tissue perfusion changes during pressure relief from Normal to WO-BPS and pressure rise from WO-BPS to Normal posture during 1 hour Alternate sitting postures at the IT. Data are given as Mean \pm SE. The significant level (P) is given for difference between Normal and WO-BPS postures.

Perfusion (IT)	$tcPO_2$ (mmHg)	$tcPCO_2$ (mmHg)
Pressure relief		
Normal	1.4 ± 0.8	84.4 ± 15.8
WO-BPS	86.0 ± 10.60	39.6 ± 8.0
P	<0.001	<0.001
Pressure rise		
WO-BPS	84.3 ± 15.4	41.6 ± 5.6
Normal	1.8 ± 0.3	94.8 ± 31.4
P	<0.001	<0.001

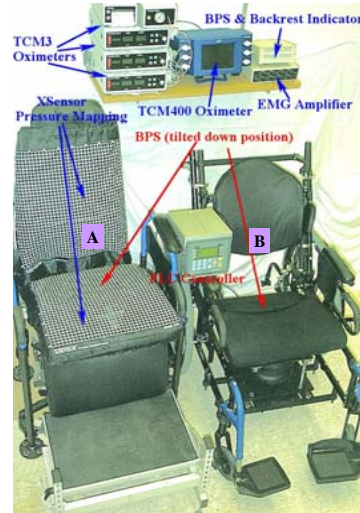


Fig. 1. The seat of the chair consists of two parts, i.e. the front part of the seat, which is fixed and the back part of the seat (BPS), which can be tilted downward or upward by $\theta = \pm 20^\circ$. The shape of the low back support can be adjusted using an inflatable air-filled cushion built into the lower backrest. A) The chair is equipped with strain gauges, a six-axis force sensors (JR3) and a pressure-mapping device (Xsensor). The controller (Vision 230) and oximeters are shown in the picture. B) The wheelchair designed for this study.

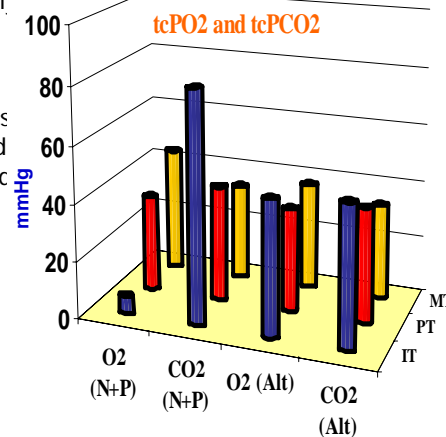


Fig. 2. The overall average values of the $tcPO_2$ and $tcPCO_2$ for one hour sitting time for the Alternate (Alt) and Normal+Push-up (N+P) trials at ischial tuberosity (IT), posterior thigh (PT), and middle thigh (MT).

RESULTS

- During the **Alternate** sitting protocol, more O_2 was conserved and less CO_2 accumulated, than those of the **Normal+Push-ups** protocol (Fig. 2).

Normal \rightarrow WO-BPS:

Average Pressure at the IT: 79.87 ± 8.83 \rightarrow 33.72 ± 5.51 mmHg ($P < 0.001$)

Normal \rightarrow WO-BPS: (Table 1)

- O_2 was increased at the IT with 55.87 ± 21.73 mmHg ($P < 0.001$) at a slope of -1.87 ± 1.09 ($R^2 = 0.94 \pm 0.04$).
- CO_2 was decreased at the IT with 22.49 ± 13.03 mmHg, $P < 0.001$ at a slope of 0.77 ± 0.89 ($R^2 = 0.89 \pm 0.11$)

WO-BPS \rightarrow Normal:

- O_2 was decreased at the IT with 54.68 ± 18.38 mmHg ($P < 0.001$) at a slope of -3.02 ± 0.87 ($R^2 = 0.98 \pm 0.14$).
- CO_2 was almost constant at 0.22 ± 0.95 mmHg ($P = 0.32$) with a slope of 0.01 ± 0.55 ($R^2 = 0.55 \pm 0.31$)

- The recovery time for $tcPO_2$ and $tcPCO_2$ were **156.8 \pm 29.0** and **162.7 \pm 33.4** seconds, respectively. The average time achieved by each push-up was only **48.5 \pm 15.4** seconds.

- Skin temperature increases were significantly ($P < 0.001$) less under the IT in **Alternate** sitting versus **Normal+Push-ups**. (Fig. 3)

SUMMARY

Alternate posture:

Brings forth a dynamic redistribution of the sitting pressure.

Conserves more O_2 and expelles more CO_2 than those of **Normal+Push-ups**.

Keeps skin temperatures lower compared to **Normal+Push-ups**.

CONCLUSIONS:

Push-up is far from adequate to recover tissue perfusion

Periodic ischial pressure relief may largely reduce the risk factors of PU in wheelchair riders.

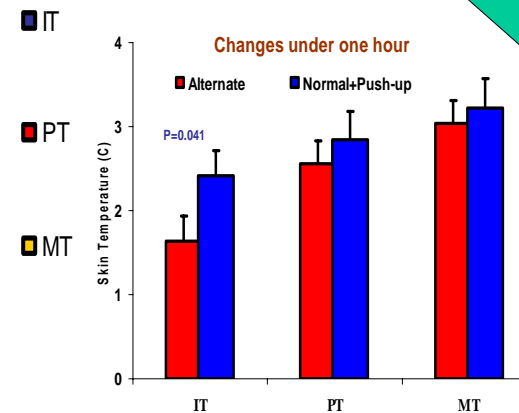


Fig 3: Skin temperature change during one hour Normal+Push-up and Alternate sitting protocols at the IT, posterior thigh (PT) and middle thigh (MT).

References

- Hobson, D.A. R.E. Tooms, *Seated lumbar/pelvic alignment. A comparison between spinal cord-injured and noninjured groups.* Spine, 1992. 17(3): p. 293-8.
- Baldwin KM. Transcutaneous oximetry and skin temperature as objective measures of pressure ulcer risk. Adv Skin & Wound Care. 2000;14:26-31.

Acknowledgements: The project was supported in part by Falk Medical Research Trust, PVA Award #2321-01, and the R24: Rehab Network.