ORIGINAL ARTICLE

Influence of wheelchair footrest height on ischial tuberosity pressure in individuals with paraplegia

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Objective: To describe the effect of wheelchair footrest height on sitting pressures in persons with paraplegia.

Methods: Seventeen manual wheelchair users with paraplegia underwent a seat pressure examination while footrests were elevated from the initial position with the thighs parallel to the seat (p0), by 10% (position p10) and by 20% of the fibula length (position p20). We analyzed average pressure (AP), the contact surface of the body with the seat (CS), pressures on the ischial tuberosities—left (LIP) and right (RIP)—and average pressure on both ischial tuberosities (AIP).

Results: A gradual increase in footrest elevation was accompanied by significant increases in AP (p0: 57.24 ± 14.31 ; p10: 60.65 ± 14.85 ; p20: 62 ± 15.3 mm Hg; Kendall coefficient of concordance $W=0.962$), AIP (p0: 159.35 ± 54.95 ; p10: 176.35 ± 53.3 ; p20: 184.26 ± 54.09 mm Hg; $W=0.896$), LIP (p0: 165.24 ± 54.05 ; p10: 183 ± 52.08 ; p20: 193.18 ± 56.32 mm Hg; $W=0.751$) and RIP (p0: 153.71 ± 71.23 ; p10: 167.35 ± 72.19 ; p20: 175.35 ± 70.84 mm Hg; $W=0.524$) and a significant decrease in CS (p0: 1218.2 ± 100.8 ; p10: 1131.8 ± 134.6 ; p20: 1065 ± 142.6 cm²; $W=0.985$). There was a moderate correlation between the relative increase in LIP and RIP between p0 and p10, and between p10 and p20 (Pearson's correlation coefficient for LIP $r=0.66$; $P=0.04$, for RIP $r=0.77$; $P=0.003$), and a high correlation between relative changes in AIP ($r=0.87$; $P<0.0001$).

Conclusion: Wheelchair footrest elevation caused a steady rise in AIP; however, left to right side pressure differences changed variably, suggesting that the risk of pressure ulcers may increase disproportionately with footrest elevation.

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INTRODUCTION

Pressure ulcers are severe and expensive complications of spinal cord injuries (SCIs).¹ The annual incidence of pressure ulcers among individuals with SCI has been estimated at 20–31%, whereas prevalence at 10.2–30%.² According to Yarkony and Heinemann, the prevalence of pressure ulcers in the population of people with SCI reaches 8% at 1 year after discharge from the rehabilitation department, 9% after 2 years and 32% after 20 years.³

Among the many factors that have a role in the development of pressure ulcers, such as immobility, malnutrition, incontinence, comorbidities, decreased blood circulation, poor hygiene, low adherence to skin protective behaviors, advanced age, severity of SCI or shear forces,^{1,2} the primary cause is tissue compression over bony prominences.^{3–5} The development of serious tissue breakdown at pressure points such as the ischium and coccyx is associated with prolonged sitting.^{6–8} Because of the multiplicity of the risk factors, it is difficult to determine a safe sitting pressure on ischial tuberosities. According to the literature threshold values for pressure sore risk are between 20 and 80 mm Hg.^{9,10} Optimal selection of the wheelchair parameters reduces the risk of pressure ulcers, improves stability of body position, comfort and ergonomics of motion, grip and manipulation by the person with SCI.^{6,11–13} Few studies have focused on the role of design and position of the wheelchair footrest for safety of the user with SCI.

Peterson and Adkins recommend adopting an appropriate footrest position by elevating it by approximately half an inch from the position where the heels barely rest against the footrest.⁹ Recent guidelines¹⁴ advocate a footrest position ensuring good support for both feet and thighs and a parallel positioning of thighs relative to the seat to achieve lower limb stability and prevent excessive ischial pressures. In our experience, the most frequent causes of inappropriate positioning of the wheelchair footrest are failure to follow the manual's instructions and lack of verification of wheelchair parameters by an appropriate health-care professional.

Gilsdorf *et al.* noted that lowering the footrest reduced pressure on the ischial tuberosities.⁷ Gutierrez *et al.*¹⁵ found that in a sitting position, pressure in the buttock area is distributed in persons with SCI across an almost twofold smaller area compared with able-bodied subjects. Janssen-Potten *et al.*¹¹ showed the influence of stable footrests on stability of body position during activities involving the upper limbs in subjects with complete paraplegia. Although the impact of excessive footrest elevation on increased risk of pressure ulcers in the ischial tuberosities is widely known,^{8,9} this correlation has never been analyzed in detail. To date, there is a dearth of literature regarding asymmetrical static sitting in persons with SCI.

The objective of this prospective cross-sectional study is to describe how elevating the wheelchair footrest influences the magnitude and symmetry of pressure on the ischial tuberosities in individuals with paraplegia.

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MATERIALS AND METHODS

The study group was recruited among the participants of a social reintegration program organized by the Foundation for Active Rehabilitation, currently the leader in nongovernmental organizations providing community follow-up of persons with SCI in Poland. The group comprised 17 adult subjects (eight females and nine males) with paraplegia (AIS A or B according to the standard neurological classification of SCI) following SCI more than 1 year prior to the study entry who used the wheelchair in everyday life but had independent transfer abilities. All participants gave their informed consent before study entry. Exclusion criteria comprised the presence of pressure ulcers or a history of pressure ulcers during the previous year, the range of the knee and hip joint flexion below 120 degrees and an asymmetry of fibula length exceeding 1 cm. The characteristics of the study group are presented in Table 1. Data were collected between June and November 2012.

We analyzed the magnitude of pressure exerted by the subject's body on the seat of a standard wheelchair fitted with a 5 cm thick standard foam cushion. We chose to use the Panthera U2 wheelchair as it is a standard model widely available to SCI individuals in Poland. The Panthera U2 is an easily adjustable wheelchair available in versions differing in seat width. Other characteristics (seat length, tilt, backrest angle and height) do not differ between the models. Table 2 shows the details of the wheelchair used in the study. The pressure value was calculated as the averaged results of measurements registered for 2 min at a frequency of 1 Hz. We took into account the contact surface (CS) of the subject's body with the seat, averaged pressure (AP) over the entire CS, left ischial pressure (LIP) and right ischial pressure (RIP) where the values were averaged readings from the sensors, which detected maximal pressure in the ischial region and the 8 surrounding sensors. We defined averaged ischial pressure (AIP) calculated according to the formula $AIP = (LIP + RIP) / 2$ to eliminate a random factor resulting from observed variable changes of pressure distributions between the ischial tuberosities (we decided to use AIP because RIP and LIP values were of similar magnitude, and correlations of changes of RIP and LIP associated with raising the footrest were not statistically significant). CS and force distribution in the ischial regions are reliable measurements, whereas the reliability of AP varies with cushion type,¹⁶ which justifies the choice of a relatively thin foam cushion for experimental purposes. The seat width and the footrest position were adjusted individually before each measurement. The initial position of the footrest was determined so that the thighs were parallel to the seat. The SKIL 0515 AB cross-line laser (Skil Europe BV, Breda, The Netherlands) was used to ensure that the wheelchair seat was in horizontal position, adjust the backrest at an angle of 90° to the base, and later ensure that the wheelchair's steady position did not change during the measurements. Pressures were measured with a Xsensor X3 set (XSENSOR Technology Corporation, Calgary, AB, Canada), consisting of an XSENSOR

pressure sensor matrix model LX100:36.36.02, an XSENSOR X3 Display computer and an XSENSOR X3 SPK interface. Details of the equipment are presented in Table 2.

To elevate the footrest, we used 5 mm thick mats placed under the feet that enabled gradual adjustment of the footrest height. Pressures were measured with the patient in a sitting position with his/her back on the backrest and arms outstretched over the thighs, after a 10-min rest on the wheelchair, in the following positions:

- 'p0'—initial position with the thighs parallel to the seat.
- 'p10'—the footrest elevated by 10% of fibula length (FL), measured between the fibula head and the apex of the lateral ankle.
- 'p20'—the footrest elevated by 20% of FL.

The subjects did not leave their wheelchairs between separate measurements with the feet on the footrest at different heights. Each measurement was taken once and was preceded by the patient sitting still for 5 min. Measurements were taken in the positions p0, p10 and p20.

The correlations between all the parameters (AP, AIP, CS, LIP and RIP) and the footrest height were examined using a nonparametric repeated measures analysis of variance (the Friedman test).

In order to examine correlations between changes in LIP, RIP and AIP associated with gradual elevation of the footrest by a given quantity, we compared differences, expressed as percentages of initial pressure, between pressures measured at p0 and p10 (ΔLIP_{10} , ΔRIP_{10} and ΔAIP_{10}) with differences of pressures measured at p10 and p20 (ΔLIP_{20} , ΔRIP_{20} and ΔAIP_{20}). Pearson's correlation coefficient was used for that purpose.

The data were processed with the STATISTICA program Version 10 (StatSoft Inc., 2011, Tulsa, OK, USA) and the R (Bell Laboratories, Murray Hill, NJ, USA) software packages.

RESULTS

The Shapiro–Wilk test revealed compatibility with a normal distribution for AP, AIP and CS and statistically significant incompatibility with normal distribution in sets of RIP and LIP pressure values. The distributions of differences of LIP and RIP between positions 0 and 10 and 0 and 20 were found to be normal.

Table 3 shows pressure values and CS at all study positions. Statistically significant differences were found between the values of the study parameters at three different positions of the footrest for all variables. A hypothesis that medians of each parameter corresponding to p0, p10 and p20 are equal was tested using the Friedman test (one

Table 1 Characteristics of the study group

	Number	Percentage (%)
<i>Level of neural deficit</i>		
Th1–Th7	6	35.3
Th8–L5	11	64.7
<i>Sex</i>		
Male	9	52.9
Female	8	47.1
Past pressure ulcers	13	76.5

	Average value	s.d.	Range
Age in years	39.9	9.6	24–61
Time from the occurrence of disability (years)	19.3	9.35	5–38
Body weight (kg)	70.7	15.6	50–95
Body height (cm)	174.3	11.3	153–196
BMI	23.1	3.3	16.1–28.7

Abbreviation: BMI, body mass index.

Table 2 Characteristics of the used equipment

<i>Xsensor X3 set</i>	
Range of the measured pressure	10–250 mm Hg
Sensitivity	± 3.5 mm Hg
Speed of the reaction	20 Hz
Maximum frequency of data register	60 Hz
Calibration stability	95% at 100 000 cycles; ± 2% per 5 years
<i>Wheelchair panthera U2</i>	
The seat width	Individually selected for the user: 36 cm, 39 cm, 42 cm
The seat length	35 cm
The seat tilt	7°
The backrest angle	90° from the base
The backrest height	30 cm
<i>Foam cushion (panthera standard)</i>	
Thickness	5 cm

Table 3 Pressure values of the user's body on the wheelchair seat

	Position 0	Position +10	g10	Position +20	g20	W	χ^2	P
AP	57.24 (s.d.:14.31)	60.65 (s.d.:14.85)	-0.234	62 (s.d.:15.3)	-0.381	0.962	32.71	<0.0001
AIP	159.35 (s.d.: 54.95)	176.35 (s.d.: 53.3)	-0.314	184.26 (s.d.: 54.09)	-0.457	0.896	30.47	<0.0001
LIP	189 (65-222)	204 (88-254)	-0.374	221 (90-255)	-0.501	0.751	25.52	<0.0001
RIP	174 (37-252)	190 (39-255)	-0.190	205 (35-255)	-0.305	0.524	17.82	<0.0001
CS	1218.2 (s.d.: 100.8)	1131.8 (s.d.: 134.6)		1065 (s.d.: 142.6)		0.985	33.52	<0.00001

Abbreviations: AP, averaged pressure; AIP, averaged ischial pressure; LIP, left ischial pressure; RIP, right ischial pressure (mm Hg) and contact surface (CS) in the examined positions of the foot (cm²); W, values of the Kendall coefficient of concordance; χ^2 , the value of the Friedman statistic in the test of its statistical significance (Kendall's W test); g10, value of Hedges' g size effect for the difference between position 0 and +10; g20, value of Hedges' g size effect for the difference between position 0 and +20.

Figure 1 Plots illustrating increases of averaged pressure (AP), averaged ischial pressure (AIP), right ischial pressure (RIP) and left ischial pressure (LIP) between the positions p0, p10 and p20.

way nonparametric analysis of variance). *Post hoc* tests were performed. Hedges' g size-effect calculation revealed low to medium size effect of ischial pressure increase for RIP, LIP, AP and AIP when changing the footrest from p0 to p10 and medium size effect for the change from p0 to p20. Size effect was greater when elevating the footrest to p20 in all the analyzed parameters (Table 3).

The Friedman test (and subsequent *post hoc* tests using the Wilcoxon test with Bonferroni correction) revealed significant differences between the values of AP, AIP, LIP and RIP at the positions p0, p10 and p20 (Figure 1).

In the case of AP and CS, a high value of Kendall coefficient of concordance (W) reflects a high similarity of positional changes between the subjects. LIP, RIP and AIP correlated significantly with footrest position ($P < 0.0001$ for all three parameters, see Table 3). The lower values of Kendall W in the case of LIP ($W = 0.751$) and RIP ($W = 0.524$) with a high value of the W coefficient for AIP ($W = 0.896$) mean that gradually elevating the footrest induced variable changes in the distribution of pressure between the right and left ischial tuberosity, with relatively constant increments of AP values.

Pressure changes between p0 and p10 and between p0 and p20 correlated moderately well for RIP and LIP with a Pearson's

Figure 2 Correlation of relative changes in pressures on the left ischial tuberosity between the footrest position 0 and +10 ($\Delta LIP10$) and 0 and +20 ($\Delta LIP20$). Pearson's correlation coefficient $r = 0.66$ ($P = 0.04$).

correlation coefficient $r = 0.66$ ($P = 0.04$) for LIP and $r = 0.77$ ($P < 0.003$) for RIP (Figures 2 and 3). At the same time, there was high correlation of increments in AP of the right and left ischial tuberosity (AIP; Pearson's correlation coefficient $r = 0.87$; $P < 0.0001$;

Figure 3 Correlation of relative changes in pressures on the right ischial tuberosity between the footrest position 0 and +10 (ΔRIP10) and 0 and +20 (ΔRIP20). Pearson's correlation coefficient $r=0.77$ ($P=0.003$).

Figure 4 Correlation of relative changes in averaged pressures on the ischial tuberosities between the footrest position 0 and +10 (ΔAIP10) and 0 and +20 (ΔAIP20). Pearson's correlation coefficient $r=0.87$ ($P<0.0001$).

Figure 4). The weaker correlation of relative LIP and RIP increments between these positions suggests that random changes of pressure on individual ischial tuberosities and a gradual elevation of the footrest add up and result in a steady rise of AP.

DISCUSSION

To our knowledge, this is the first study describing the relation between footrest elevation and independently analyzed pressures on left and right ischial tuberosities. Other authors investigating the influence of footrest position on sitting parameters in individuals with SCI analyzed AP (Peterson and Adkins⁹), AP and vertical and shear forces (Gildorf *et al.*⁷) or CS (Bush⁸).

We found that, despite of a proportional rise of AP, the pressure of right and left ischial tuberosities measured separately underwent random changes. Our results stress the importance of proper footrest positioning as the effects of footrest elevation may bring about unpredictable increase in pressure ulcer risk. These results confirm the presence of a correlation between the footrest position and AP and AIP in subjects with paraplegia. In a study of a group of able-bodied

subjects, Gildorf *et al.*⁷ found that when a stiff seat was used, depressing the feet below a standard position resulted in decompression of the ischial area. Stinson *et al.*¹⁷ discovered a positive relationship between elevating the feet on the footrest and AP in the ischial tuberosities in various positions of the seat.

Because of differences in sitting patterns, the results of studies of able-bodied subjects do not adequately reflect the phenomena that occur in individuals with SCI.^{15,18} Individuals with SCI commonly adopt kyphotic postures of the thoracolumbar spine in their wheelchairs, which transfers the center of gravity of the trunk backwards. This improves stability of the trunk and allows manipulation with the upper extremities.^{12,18} This position leads to retroversion of the pelvis, which results in increased pressure of the seat on the ischial tuberosities and coccygeal bone.⁶ Hastings *et al.*¹² and Janssen-Potten *et al.*¹¹ observed similar consequences as a result of increased hip joint flexion that accompanies elevating the wheelchair footrest. Our study did not address changes of pressures at the coccygeal region.

The results of the present study confirm the observations made by Bush,⁸ namely, that elevating the footrest leads to elevating the thighs, thus reducing the CS. Although elevating the footrest above the recommended position results in a proportional rise of AP and AIP, it may not cause an actual increase in the risk of pressure sores in the ischial regions, as pressure ulcer risk results from multiple factors.⁵ Persons with SCI frequently adopt oblique positioning of the pelvis.¹⁸ Pelvic obliquity may result from spinal deformations, neurological deficits (depending on their type and extent), limitation of joint mobility, secondary disturbances of spatial orientation or individual habits or it may be caused by the model and configuration of the wheelchair used in everyday life.^{13–15} Gutierrez *et al.*¹⁵ found that individuals with paraplegia had greater asymmetry of ischial pressures, center of force and contact area compared with able-bodied persons, although there were no differences between persons with neural deficit at T1–T8 and T9–T12 levels. Alm *et al.*¹⁹ noted that changing from an individually adjusted wheelchair to a standardized sitting surface decreased the symmetry of trunk alignment in persons with paraplegia. An asymmetric position of the pelvis (for example, when sitting with legs crossed) increases pressure on the ischial tuberosities, even when one returns to sitting with legs parallel, as noted by Lee²⁰ in a study of able-bodied subjects. Elevating the footrest may alter the position of the pelvis in multiple planes. Asymmetric load of the ischial tuberosities and pelvis rotation may increase the risk of pressure ulcers in persons with SCI.^{4,15}

In addition, this phenomenon may be caused by an asymmetric structure of the pelvis and ischial tuberosities in people with SCI, as noted by Park.¹³ Their small radius of curvature is a significant factor that increases the risk of pressure ulcers of the ischial tuberosities.¹⁹ Therefore, elevating the footrest may result in an unpredictable change in the shape of the area in contact with the wheelchair seat, exposing bony prominences to pressure, and the increasing risk of pressure ulcers.

Study limitations

The study does not provide responses to all clinically important questions concerning the consequences of inappropriate footrest positioning in a wheelchair designed for an individual with SCI and warrants further investigations.

To begin with, we analyzed the relationship between footrest height and pressure distribution and magnitude, although many other factors also contribute to pressure distribution. We did not measure pelvis obliquity, hip rotation, ischial tissue adiposity or muscle mass. Further

studies should take into consideration the correlation between the level of disproportion of pressure changes and the position or structural asymmetry of the pelvis.

All measurements were also performed on a 5 cm thick foam cushion. The use of a standard and relatively hard foam cushion may have intensified the effect of pelvic asymmetries on pressure distribution. The results might be different with other types of cushions commonly used by persons with SCI. The choice of an appropriate cushion and adjustment of its characteristics such as envelopment or immersion may significantly influence pressure distribution and change the effect of footrest elevation. Future research needs to consider the use of different cushions to examine their influence on pressure distribution at different footrest heights.

Thirdly, the study population was a small and relatively homogeneous sample of persons with complete paraplegia. Our findings are not applicable to all persons with SCI, particularly those with incomplete motor deficit and with tetraplegia. A larger sample including individuals with cervical and incomplete injury should be analyzed to verify our results.

Differences in size effects of pressure change noted in p10 and p20 suggested that somewhere between these positions might be a threshold, above which AP and AIP increase abruptly. Methodology of further investigation should allow for identification of the threshold value.

CONCLUSION

In persons with paraplegia, elevation of the wheelchair footrest from the optimal position by 10 and 20% of fibula length resulted in significant increases in AP on the seat and pressure in the ischial tuberosities significantly increases, whereas the CS between the body and the seat was reduced. Changes in pressures on the left and right ischial tuberosity did not follow a proportional pattern, which implies that the risk of pressure ulcers in the ischial tuberosities may increase disproportionately, relatively to the degree of elevation of the wheelchair footrests.

DATA ARCHIVING

There were no data to deposit.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

- 1 Guihan M, Bombardier CH. Potentially modifiable risk factors among veterans with spinal cord injury hospitalized for severe pressure ulcers: a descriptive study. *J Spinal Cord Med* 2012; **35**: 240–250.
- 2 Byrne DW, Salzberg CA. Major risk factors for pressure ulcers in the spinal cord disabled: a literature review. *Spinal Cord* 1996; **34**: 255–263.
- 3 Yarkony GM, Heinemann AW. Pressure ulcers. In: Stover SL, DeLisa JA, Whiteneck GG (eds). *Spinal Cord Injury: Clinical Outcomes from the Model Systems*. Aspen Publishing: Gaithersburg, MD, USA, 1995, pp 100–119.
- 4 van Geffen P, Reenalda J, Veltink PH, Koopman BF. Decoupled pelvis rotation in sitting: a passive motion technique that regulates buttock load associated with pressure ulcer development. *J Biomech* 2009; **42**: 1288–1294.
- 5 Gefen A. Risk factors for a pressure-related deep tissue injury: a theoretical model. *Med Biol Eng Comput* 2007; **45**: 563–573.
- 6 Maurer CL, Sprigle S. Effect of seat inclination on seated pressures of individuals with spinal cord injury. *Phys Ther* 2004; **84**: 255–261.
- 7 Gilsdorf P, Patterson R, Fisher S, Appel N. Sitting forces and wheelchair mechanics. *J Rehabil Res Dev* 1990; **27**: 239–246.
- 8 Bush CA. Study of pressure on skin to the ischial tuberosities and thighs during sitting. *Arch Phys Med Rehabil* 1969; **50**: 207–213.
- 9 Peterson MJ, Adkins HV. Measurement and redistribution of excessive pressures during wheelchair sitting. *Phys Ther* 1982; **62**: 990–994.
- 10 Hamanami K, Tokuhiko A, Inoue T. Finding the optimal setting of inflated air pressure for a multi-cell air cushion for wheelchair patients with spinal cord injury. *Acta Med Okayama* 2004; **58**: 37–44.
- 11 Janssen-Potten YJ, Seelen HA, Drukker J, Spaans F, Drost MR. The effect of footrests on sitting balance in paraplegic subjects. *Arch Phys Med Rehabil* 2002; **83**: 642–648.
- 12 Hastings JD, Fanucchi ER, Burns SP. Wheelchair configuration and postural alignment in persons with spinal cord injury. *Arch Phys Med Rehabil* 2003; **84**: 528–534.
- 13 Park UJ, Jang SH. The influence of backrest inclination on buttock pressure. *Ann Rehabil Med* 2011; **35**: 897–906.
- 14 Dicianno BE, Arva J, Lieberman JM, Schmeler MR, Souza A, Phillips K *et al*. RESNA position on the application of tilt, recline, and elevating legrests for wheelchairs. *Assist Technol* 2009; **21**: 13–22.
- 15 Gutierrez EM, Alm M, Hultling C, Saraste H. Measuring seating pressure, area, and asymmetry in persons with spinal cord injury. *Eur Spine J* 2004; **13**: 374–379.
- 16 Sprigle S, Dunlop W, Press L. Reliability of bench tests of interface pressure. *Assist Technol* 2003; **15**: 49–57.
- 17 Stinson MD, Porter-Armstrong A, Eakin P. Seat-interface pressure: a pilot study of the relationship to gender, body mass index, and seating position. *Arch Phys Med Rehabil* 2003; **84**: 405–409.
- 18 Hobson DA, Tooms RE. Seated lumbar/pelvic alignment: a comparison between spinal cord-injured and noninjured groups. *Spine* 1992; **17**: 293–298.
- 19 Alm M, Gutierrez E, Hultling C, Saraste H. Clinical evaluation of seating in persons with complete thoracic spinal cord injury. *Spinal Cord* 2003; **41**: 563–571.
- 20 Lee JH, Yoo WG. Changes in gluteal pressure and pelvic inclination angles after continuous cross-legged sitting. *Work* 2011; **40**: 247–252.