Slings: Should they stay or should they go?

The impact of hoist sling materials on interface pressure in a disabled population

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Introduction

People with restricted mobility, who use a hoist to transfer, are at high risk of gluteal pressure ulcers. Current guidelines recommend the removal of hoist slings between transfers to reduce this risk (1,2) but evidence supporting this is lacking and anecdotal evidence supports that people are often left sitting on hoist slings for ease of the carer, time restraints or at the request of the client themselves. There is no objective evidence on the effects of sling materials on gluteal pressures to support or refute these recommendations.

Study Aims:

To investigate and compare the effect of three types of hoist sling materials on :

- **A Pressure exerted across the gluteal area (buttocks and thighs)**
- **B Peak pressure "hotspots" at ischial tuberosities**
- **C Wheelchair Users perception of comfort whilst sitting on these slings**

Background to the study

There are over 200 devices to redistribute pressure while sitting on the market(3) .Most devices, such as pressure-relieving cushions, aim to distribute compressive forces evenly across their surface. In practice, cushions are often covered to protect the surface and maintain cleanliness. However, fitting a cover can produce a 'hammock effect' which increases compressive forces at the bony prominences, such as the ischial tuberosities (IT's) (4)(Figure 1). Materials with two-way stretch are typically used for the cushion covers to overcome this effect.
For many people with restricted mobility, the pressure-relieving properties of cushions could be further disrupted by the use of a hoist sling.

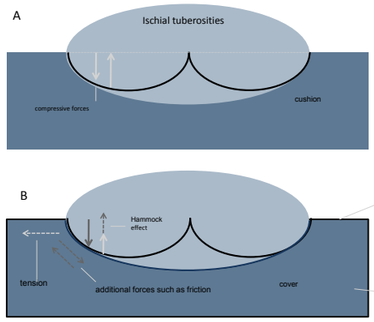


Figure 1 Theoretical model of hammock effect in wheelchair cushion.
(A) The situation without a cushion cover,
(B) The situation with a cushion cover. Friction from the cover develops causing additional tension along the cushion surface producing forces known as the hammock effect (Iizaka et al ,2009)

The cost of pressure ulcers

Across Europe approximately 18% of in-patients have a pressure ulcer at any one time, with the sacrum and heels most commonly affected(5). Four percent of National Health Service expenditure in the United Kingdom (U.K) (£1.4 – £2.1 billion each year) is spent managing pressure ulcers (5) As well as the financial cost and burden on health services, pressure ulcers have physical and psychological consequences to the person affected, interfering with activities of daily living and quality of life (6).

UK £1.4 - £2.1 billion per year
(Around 5% of total NHS expenditure)
(Bennett et al, 2004)

USA $13 billion per year
(average charge of $40,381 for a hospital stay)

Method

Participants:

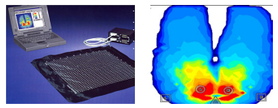
32 volunteers recruited from Salford and Stockport Wheelchair Services, varying levels of disability/ diagnosis

17 men and 15 women ages 24 – 78
BMI range 18.9 – 49.6

Exclusion criteria - any existing pressure ulcer and a bodyweight greater than the safe working load of the adjustable height chair (18 stones / 114kg) or track hoist.

Four occasions of pressure mapping as indicated below, conditions randomised:
Control – Seated on the chair with the pressure mapping mat underneath the gluteal area
Condition A – Seated on the chair with the pressure mapping mat underneath a sling in polyester fabric (a warp knitted heatset polyester).
Condition B - Seated on the chair with the pressure mapping mat underneath a sling in slipfit fabric (a plain ripstop, woven parachute silk fabric from high tenacity nylon 66 yarn).
Condition C – Seated on the chair with the pressure mapping mat underneath a sling in spacer fabric (a warp knitted polyester, similar to the plain polyester but with a monofilament 'spacer' yarn separating the two sides of the cloth).

Data is recorded as colour coded maps of pressure distribution as well as peak and mean pressure readings recorded in mmHg.



Collection of data

Height adjustable chair with X-sensor pressure mat in situ

Pressure readings were recorded every 30 seconds for ten minutes in each condition with a one minute "rest" inbetween to allow tissue perfusion recovery prior to repositioning.
Questionnaire to rate the comfort of the fabric on a five point scale of (1 = very uncomfortable; 2 = uncomfortable; 3 = adequate; 4 = comfortable; and 5 = very comfortable) and also whether sweating occurred (yes/no)

In addition to this participants were also asked for any other comments and ranked each fabric in order of their preference (1,2 or 3 with 3 being the least preferred)

Data analysis

Data were analysed using one way repeated measures analysis of variance (ANOVA) with Bonferrroni adjustment for multiple testing to determine whether:

- There were any differences between the control condition and each of the three sling fabrics in terms of;
  - surface area,
  - average gluteal interface pressure
  - peak pressures at (i) the right and left ischial tuberosities, (ii) right and left greater trochanters and (iii) coccyx
- Any sling fabric increased area and reduced interface pressure more effectively than others
- Comfort ratings for fabrics were compared to each other using Friedman's ANOVA. Cochran's Q test was used to determine whether there were any differences in perceived occurrence of sweating between fabrics.

Results

Results identify statistically significant difference between Prism spacer fabric and Prism slipfit at 95% confidence level.
Compared to the results from the healthy population study (Mellson and Richardson, 2012) , coccyx peak pressure was over twice as high in this group identifying a significantly higher risk of PU development due to sacral sitting and lack of core stability.

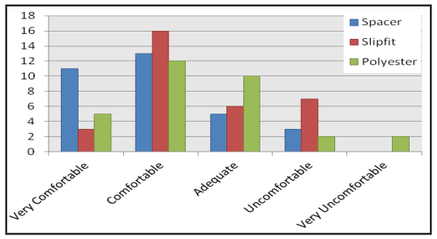
Results

	Control (mean, SD)	Spacer Fabric (mean, SD)	Slipfit Fabric (mean, SD)	Polyester Fabric (mean, SD)
Gluteal Area (cm2)	1570.85 (194.27)	**1613.54 ά** (181.67)	1594.47 (200.70)	1589.75 (179.94)
Gluteal Interface Pressure (mmHg)	43.06 **36.33** (6.56) (3.41)	**41.81 βέ 35.32** (6.01) (3.15)	43.06 **36.10** (6.15) (3.34)	43.06 **35.72** (6.79) (3.50)
Peak pressure at left ischial tuberosity (mmHg)	94.94 **66.87** (36.54) (16.85)	82.66 β **60.00** (29.44) (14.44)	94.41 **67.88** (36.95) (17.58)	1.59 **66.18** (39.48) (21.37)
Peak pressure at right ischial tuberosity (mmHg)	91.88 **64.70** (39.24) (16.29)	82.31 **58.02** (30.62) (13.62)	91.94 **65.68** (35.41) (18.28)	84.88 **64.23** (39.47) (19.27)
Peak pressure at left greater trochanter (mmHg)	31.97 **19.15** (7.67) (3.72)	31.03 **18.42** (7.55) (2.95)	30.66 **18.00** (6.68) (3.51)	30.53 **18.54** (7.95) (3.18)
Peak pressure at right greater trochanter (mmHg)	30.28 **18.63** (7.09) (3.95)	31.13 **19.02** (6.49) (4.86)	31.47 **18.79** (7.89) (4.84)	29.75 **19.56** (7.95) (4.65)
Peak pressure at Coccyx (mmHg)	84.10 **32.07** (43.96) (10.15)	**74.71 β 30.88** (47.06) (9.22)	97.94 **31.16** (56.41) (11.49)	82.77 **31.48** (52.02) (9.33)

ά= compared to control condition significant at p<0.005;
β= comparison between spacer fabric and slipfit fabric significant at p<0.005
έ= comparison between spacer fabric and polyester fabric significant at p<0.005

Figures in green from previous pilot study with healthy volunteers: demonstrates significantly higher interface pressure with disabled population under same conditions, particularly at coccyx due to sacral sitting.

Service users perception of comfort



Overall preference was for the Prism spacer, followed by the Prism polyester and lastly the Prism slipfit.

Conclusion

Results show that sling fabrics can, contrary to clinical expectation, increase surface contact area across the gluteal region. The expected detrimental effect predicted by some clinical guidelines was not found.

Results suggest that if a sling has to be left in situ the Prism spacer fabric is more likely to reduce the risk of pressure ulcer development, than the Prism slipfit. Further research indicated to investigate the impact of slings over pressure reducing cushions.

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