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Citation for published version:

Macintyre, L 2019, 'Pressure garment: material matters', Paper presented at 52nd British Burn Association Annual Meeting, Leeds, United Kingdom, 8/05/19 - 10/05/19.

Link:

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Pressure garment: material matters

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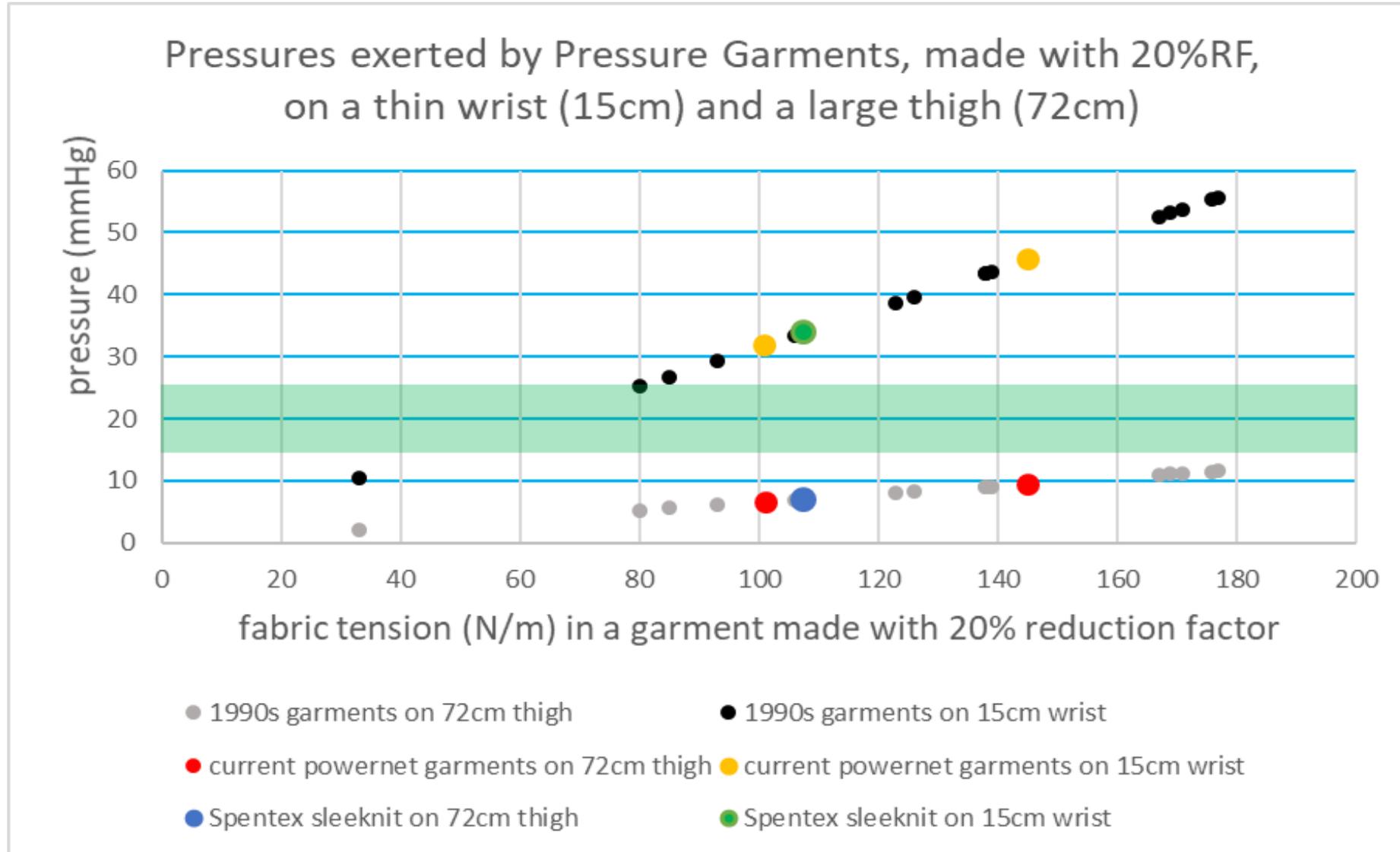
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- Patients are normally measured for pressure garments (PGs) after wound closure and before discharge from hospital.
- Most are made to measure from elastic fabrics (can be off-the-shelf). They can be made in-house or ordered from specialist suppliers.
- Garments are made smaller than the body they are designed to fit, the difference between body and garment size is the 'reduction factor'.
- The reduction factor can be calculated using a **standard % reduction** on all bodies regardless of size/fabric or the **Laplace Law** and fabric tension profile to calculate specific reduction factors.

- Reduction factor: the higher the reduction factor the higher the pressure exerted on a body.
- Fabric/material: you CANNOT tell how much pressure a fabric will exert by feeling it. Fabrics can look the same but have very different pressure delivering properties, tension profiles should be measured.
- Body circumference: the bigger the body the lower the pressure (if fabric and reduction factor are the same).... and
- Body shape: less pressure is exerted on flatter areas than areas with low radius of curvature.

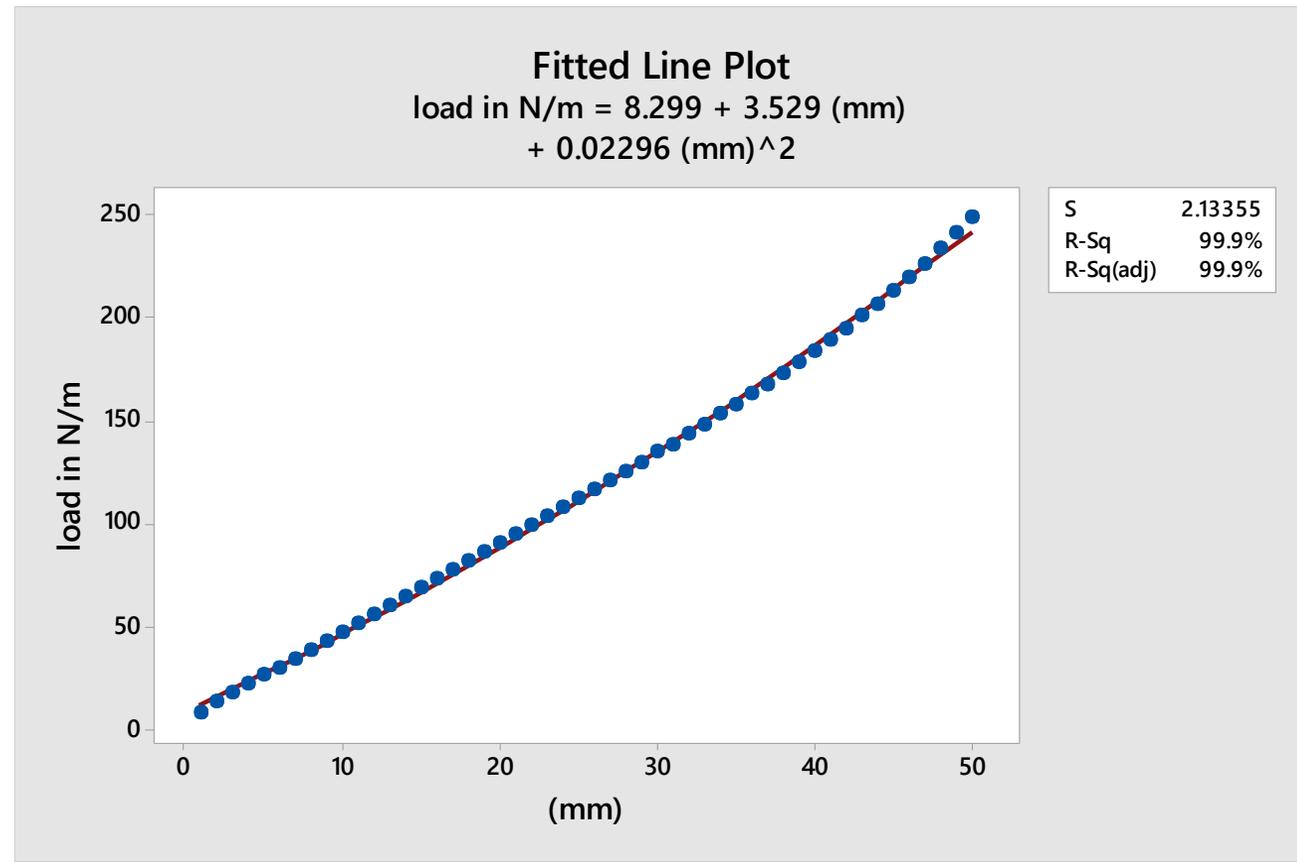
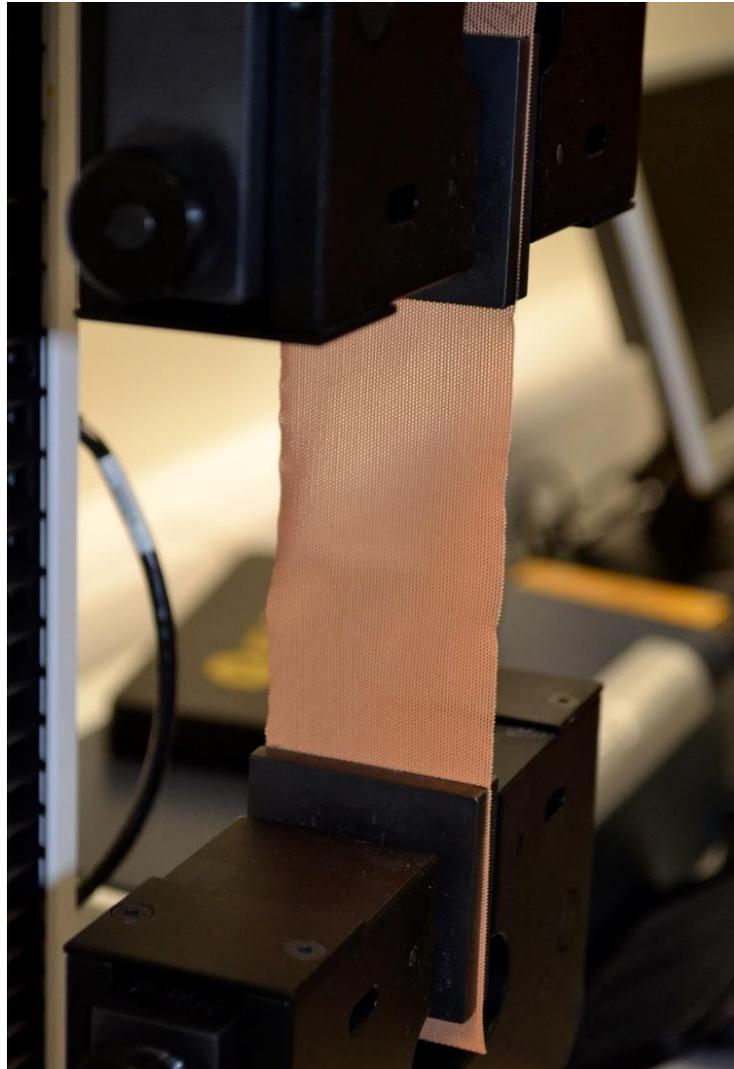
Impact of fabric and body size on pressure exerted (with standard reduction factor)



Designing better pressure garments

- For the most consistent pressure garments the Laplace Law should be used to calculate the specific reduction factor for each particular body part, to exert a particular mean pressure on the patient's body.
- Some, but not all, commercial pressure garment manufacturers use Laplace Law to calculate garment dimensions (PGD tool or proprietary).
- Some test every batch of fabrics used to ensure the most accurate prediction of pressure. Some order fabrics to a specification that 'matches' their software.

PGD tool, step 1: 5 specimens of each fabric are tested, mean results are plotted on load/elongation graphs, line of best fit equations are calculated and tested to ensure accurate predictions, the most accurate equation(s) are selected and built into PGD tool.



PGD tool step 2: Equations are hidden before sending to the user. There are spreadsheets for: arms, legs and 'other' garments. There is a standard tool and another for graduated compression.

1	enter the pressure you want to deliver	<input type="text"/>	mmHg				
2	enter your seam allowance in cm	<input type="text"/>	cm				
		Input patient length below	Input patient circumference below	full pattern width including seam allowance	pattern width if cut on the fold including seam allowance	pressure delivered or 'not possible' warning	
	length from wrist to armpit	cm					
	length from wrist to elbow	cm					
	length from elbow to armpit	cm					
3	circumference at point A: wrist*		cm	0.0 cm	0.0 cm	not possible	
	distance between A and B	cm					
4	circumference at point B		cm	0.0 cm	0.0 cm	not possible	
	distance between B and C	cm					
5	circumference at point C		cm	0.0 cm	0.0 cm	not possible	
	distance between C and D	cm					
6	circumference at point D		cm	0.0 cm	0.0 cm	not possible	
	distance between D and E	cm					
7	circumference at point E		cm	0.0 cm	0.0 cm	not possible	
	distance between E and F	cm					
8	circumference at point F		cm	0.0 cm	0.0 cm	not possible	
	distance between F and G	cm					
9	circumference at point G: elbow*		cm	0.0 cm	0.0 cm	not possible	
	distance between G and H	cm					

PGD tool step 3: The user selects the appropriate PGD tool for the fabric they intend to use and enter the pressure they want to exert.

enter the pressure you want to deliver		25	mmHg			
2 enter your seam allowance in cm			cm			
		Input patient length below	Input patient circumference below	full pattern width including seam allowance	pattern width if cut on the fold including seam allowance	pressure delivered or 'not possible' warning
	length from wrist to armpit	cm				
	length from wrist to elbow	cm				
	length from elbow to armpit	cm				
3	circumference at point A: wrist*		cm	0.0 cm	0.0 cm	not possible
	distance between A and B	cm				
4	circumference at point B		cm	0.0 cm	0.0 cm	not possible
	distance between B and C	cm				
5	circumference at point C		cm	0.0 cm	0.0 cm	not possible
	distance between C and D	cm				
6	circumference at point D		cm	0.0 cm	0.0 cm	not possible
	distance between D and E	cm				
7	circumference at point E		cm	0.0 cm	0.0 cm	not possible
	distance between E and F	cm				
8	circumference at point F		cm	0.0 cm	0.0 cm	not possible
	distance between F and G	cm				

PGD tool step 4: The user can enter the seam allowance they want to use (if they want that added on to each side of the calculated pattern dimension)

1 enter the pressure you want to deliver		25	mmHg				
enter your seam allowance in cm		0.5	cm				
		Input patient length below	Input patient circumference below	full pattern width including seam allowance	pattern width if cut on the fold including seam allowance	pressure delivered or 'not possible' warning	
	length from wrist to armpit	cm					
	length from wrist to elbow	cm					
	length from elbow to armpit	cm					
3	circumference at point A: wrist*	cm		1.0 cm	0.5 cm	not possible	
	distance between A and B	cm					
4	circumference at point B	cm		1.0 cm	0.5 cm	not possible	
	distance between B and C	cm					
5	circumference at point C	cm		1.0 cm	0.5 cm	not possible	
	distance between C and D	cm					
6	circumference at point D	cm		1.0 cm	0.5 cm	not possible	
	distance between D and E	cm					
7	circumference at point E	cm		1.0 cm	0.5 cm	not possible	
	distance between E and F	cm					
8	circumference at point F	cm		1.0 cm	0.5 cm	not possible	
	distance between F and G	cm					
9	circumference at point G: elbow*	cm		1.0 cm	0.5 cm	not possible	

PGD tool step 5: User enters the patient dimensions in grey cells, length dimensions are noted on the form but are not active/altered.

1	enter the pressure you want to deliver		25 mmHg				
2	enter your seam allowance in cm		0.5 cm				
		Input patient length below	Input patient circumference below	full pattern width including seam allowance	pattern width if cut on the fold including seam allowance	pressure delivered or 'not possible' warning	
	length from wrist to armpit	51 cm					
	length from wrist to elbow	24 cm					
	length from elbow to armpit	27 cm					
3	circumference at point A: wrist*		15 cm	1.0 cm	0.5 cm	not possible	
	distance between A and B	cm					
4	circumference at point B		cm	1.0 cm	0.5 cm	not possible	
	distance between B and C	cm					
5	circumference at point C		cm	1.0 cm	0.5 cm	not possible	
	distance between C and D	cm					
6	circumference at point D		cm	1.0 cm	0.5 cm	not possible	
	distance between D and E	cm					
7	circumference at point E		cm	1.0 cm	0.5 cm	not possible	
	distance between E and F	cm					
8	circumference at point F		cm	1.0 cm	0.5 cm	not possible	
	distance between F and G	cm					
9	circumference at point G: elbow*		cm	1.0 cm	0.5 cm	not possible	

PGD tool step 6: when circumferential measurements are 'entered' the pattern dimensions are calculated in purple cells, full and 'on fold' dimensions are shown.

1 enter the pressure you want to deliver			25 mmHg				
2 enter your seam allowance in cm			0.5 cm				
		Input patient length below	Input patient circumference below	full pattern width including seam allowance	pattern width if cut on the fold including seam allowance	pressure delivered or 'not possible' warning	
	length from wrist to armpit	51 cm					
	length from wrist to elbow	24 cm					
	length from elbow to armpit	27 cm					
3	circumference at point A: wrist*		15 cm	13.7 cm	6.9 cm	25.0	
	distance between A and B	cm					
4	circumference at point B		cm	1.0 cm	0.5 cm	not possible	
	distance between B and C	cm					
5	circumference at point C		cm	1.0 cm	0.5 cm	not possible	
	distance between C and D	cm					
6	circumference at point D		cm	1.0 cm	0.5 cm	not possible	
	distance between D and E	cm					
7	circumference at point E		cm	1.0 cm	0.5 cm	not possible	
	distance between E and F	cm					
8	circumference at point F		cm	1.0 cm	0.5 cm	not possible	
	distance between F and G	cm					
9	circumference at point G: elbow*		cm	1.0 cm	0.5 cm	not possible	

PGD tool step 7: Ignore un-necessary cells. Red column confirms pressure or flag problems. Tools can be saved as a patient/garment dimension record.

1	enter the pressure you want to deliver		25 mmHg				
2	enter your seam allowance in cm		0.5 cm				
		Input patient length below	Input patient circumference below	full pattern width including seam allowance	pattern width if cut on the fold including seam allowance	pressure delivered or 'not possible'	
	length from wrist to armpit	51 cm					
	length from wrist to elbow	24 cm					
	length from elbow to armpit	27 cm					
3	circumference at point A: wrist*		15 cm	13.7 cm	6.9 cm	25.0	
	distance between A and B	5 cm					
4	circumference at point B		17.2 cm	15.2 cm	7.6 cm	25.0	
	distance between B and C	5 cm					
5	circumference at point C		19.8 cm	17.0 cm	8.5 cm	25.0	
	distance between C and D	5 cm					
6	circumference at point D		22.3 cm	18.6 cm	9.3 cm	25.0	
	distance between D and E	5 cm					
7	circumference at point E		23 cm	19.0 cm	9.5 cm	25.0	
	distance between E and F	n/a cm					
8	circumference at point F		n/a cm	#VALUE! cm	#VALUE! cm	#VALUE!	
	distance between F and G	4 cm					
9	circumference at point G: elbow*		22.9 cm	19.0 cm	9.5 cm	25.0	
	distance between G and H	0 cm					
##	circumference at point H: elbow at 90° angle*		24.2 cm	19.8 cm	9.9 cm	25.0	

PGD tool for calculating dimensions

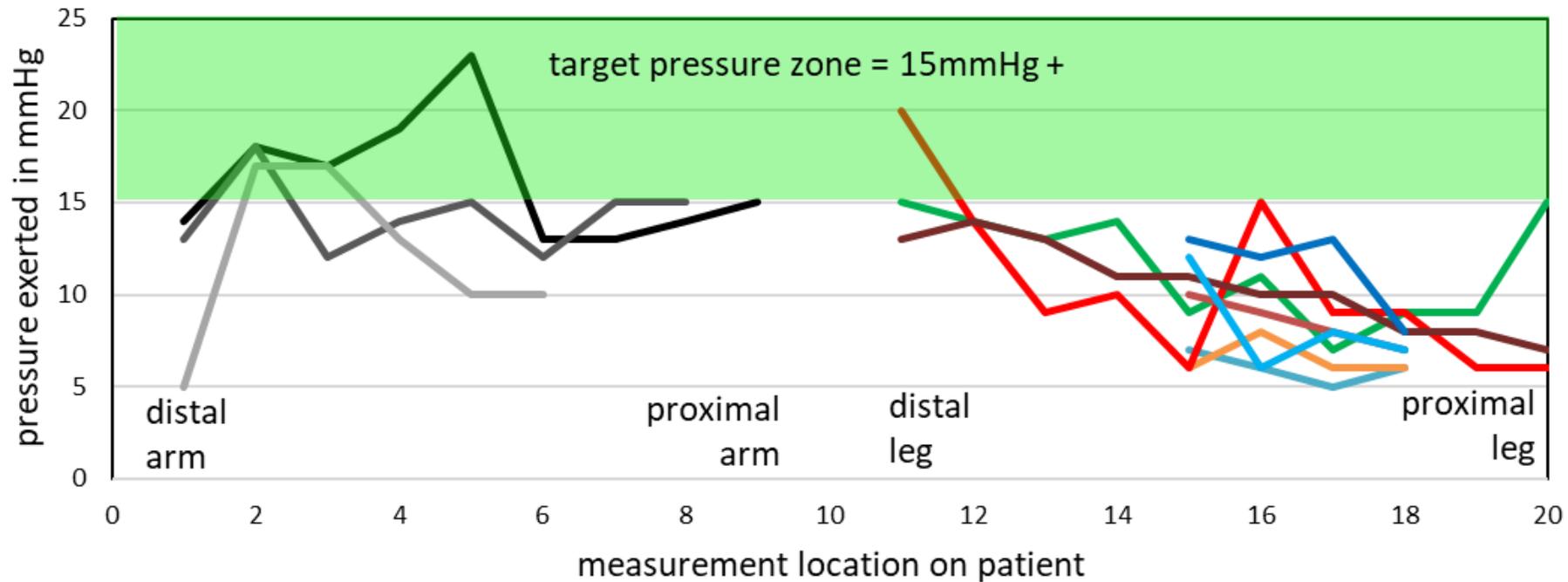
- Pressure Garment Design (PGD) Tools have been available since 2012.
- These are used by several companies to calculate the dimensions of their garments.
- Spentex (fabric suppliers to NHS) supply PGD tools with all their fabric to enable therapists to calculate the mean pressure exerted by garments using the traditional 'standard reduction factor method' of pressure garment construction. AND PGD tools to enable garments to be made that will exert known/chosen pressures 'Laplace Law method'.

Current state of affairs and how to change practice...

- ‘Acceptance’ in companies and among therapists that use of a standard reduction factor (RF) results in inconsistent pressures being exerted on patients, but there is reluctance to change.
- Makers ‘compensate’ for deficiencies in RF method by amending garments based on experience.

Pressures calculated retrospectively for garments made for patients' arms (3) and legs (8) in a UK hospital (surveyed in 2012). Staff used a 10% reduction factor on powernet fabric.

pressures exerted on patients at hospital X using 10% reduction factor



- Patient K
- Patient F
- Patient I
- Patient A
- Patient B
- Patient C
- Patient D
- Patient E
- Patient G
- Patient H
- Patient J

Current state of affairs and how to change practice...

- ‘Acceptance’ in companies and among therapists that use of a standard reduction factor (RF) results in inconsistent pressures being exerted on patients, but there is reluctance to change.
- Makers ‘compensate’ for deficiencies in RF method by amending garments based on experience.
- Laplace Law is still not used to make ALL pressure garments (with PGD tool or company proprietary software).
- Dawn Syron-Jones, occupational therapy technician and self-taught computer user, undertook a study to evaluate how easy the PGD tool was to use in the construction of pressure garments in a clinical environment.

Evaluation of PGD tool in Sheffield Children's hospital

- Ethics approval was granted by the West of Scotland Research Ethics Service (REC 17/WS/0246) and Sheffield Children's Hospital Health Research Authority (IRAS 227861)
- An audit of pressures exerted on children's limbs historically was undertaken.
- A pilot study to evaluate how easy the tools are to use in a clinical environment was also undertaken.
- The results of both of these pieces of work will be the subject of a paper currently in preparation ... watch this space!

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