

PRESSURE ULCER/INJURY RECURRENCE

Seating and devices for individuals with a spinal cord injury: Information for healthcare providers



General/Purpose

Information in this resource is adapted and primarily taken from Wounds UK (2019)¹ and All Wales Tissue Viability Nurse Forum et al. (2019)² unless otherwise stated.

The provision of poor seating is a major cause of pressure ulcer incidence, in spinal cord injury (SCI) persons.³

A seating assessment is recommended for individuals who sit for prolonged periods of time to assess posture and appropriately prescribe specialist chairs/seating including wheelchairs, that will improve and maintain function for the individual. The assessment should be person-centred. The individual needs to understand why specialist equipment is required, the potential impact on their lifestyle and benefits such as the prevention of pressure ulcers equipment abandonment is more likely if these discussions do not take place.⁴

Many healthcare professionals are appropriately trained to conduct a specialist seating assessment and prescribe suitable equipment, such as occupational therapists, physiotherapists, rehabilitation engineers, and clinical scientists. This assessment is often in collaboration with the multidisciplinary team which may include a doctor, tissue viability nurse⁵ and community nurses. Referrals to other services may be required following the assessment.

Relationship between posture and pressure

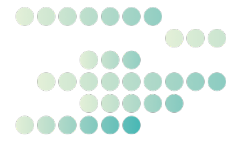
Posture and pressure ulcers are inextricably linked. The principle of correct seating is to redistribute the weight by reducing the pressure under a risk area by increasing the pressure under other areas.

When a person sits in an abnormal posture, their weight may not be taken equally through the pelvis. This leads to higher pressure on vulnerable sites such as the Ischial tuberosity (IT)/sitting bones or the sacrum, therefore increasing the possibility of a pressure ulcer occurring.

By maximising the amount of contact the patient can have with the wheelchair through the pelvis, thighs, feet, arms and back, you are ensuring that pressure is being evenly distributed throughout the body, thus reducing the amount of pressure through any given part of the body.

Poor posture and positioning due to inadequate seating can result in increased risk of skin breakdown, reduced mobility/activity, fatigue, discomfort and negative impact on breathing and ability to swallow reducing digestion.

The seating support surface should provide a safe, stable and comfortable means of supporting the forces exerted by the person. To remain upright, a seated person is required to maintain a stable position and counteract the forces of gravity. The ability to do this is compromised for people who are acutely ill, frail or have a neurological impairment.⁶



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An ideal posture when sitting consists of a stable pelvis allowing even interface contact with the seat (as shown in Figure 1) and the head is positioned above the hips and both feet are supported. This posture may not always be possible. However, seating equipment can be provided to help individuals achieve an optimum posture within their limits and functional needs.

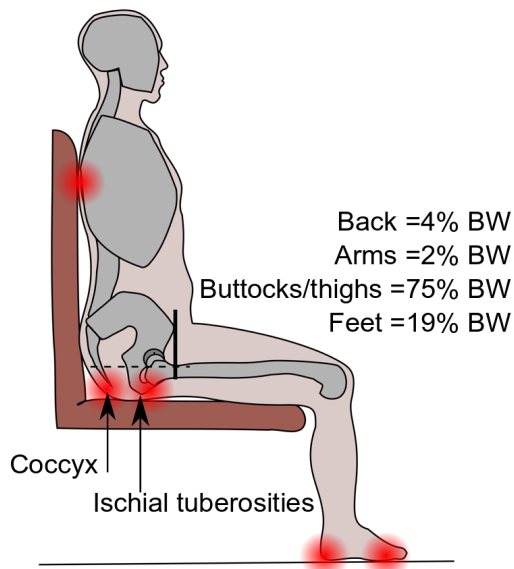
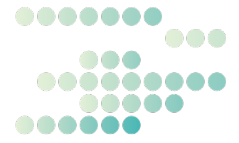


Figure 1. Estimated proportion of body weight support by a seat (adapted from Collins⁶).
Red spots highlight common locations of pressure ulcers that occur in the seated individual.
BW = Body weight.

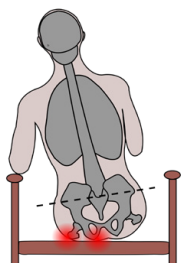
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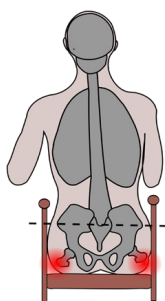
Seating setup considerations

Seat width – too wide



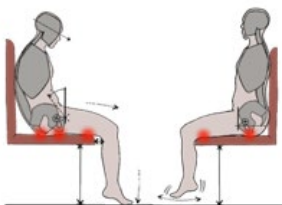
This results in the individual leaning to one side to support themselves on the armrests. This can cause fatigue if the position is held for long periods of time without support. This leads to increased pressures to one buttock (the side they are leaning towards) and increases the risk of pressure damage to that buttock. Elbows are also at greater risk of skin breakdown when leaning to one side. Over time, postural complications such as scoliosis (spine curvature) can develop.

Seat width – too narrow



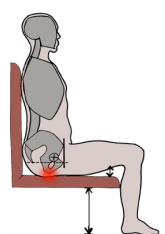
This can be restricting for an individual leading to a reduction in function and inability to perform pressure-relieving exercises. The outer aspects of the hips are at greater risk of pressure damage. To reduce this risk there should be a 2.5cm gap between the outer aspect of the hip and the inside of the chair's thigh supports/armrests. Run your hand between the outside of the user's thighs and the sides of the wheelchair. Your hand should fit comfortably without being pinched.

Seat height – too high



This results in the individual's feet being unsupported and the individual's weight supported only by the seat surface. This position also results in sliding in the chair for the individual to feel 'grounded' to provide a more stable sitting position. This increases the shear forces (acting in a direction parallel) to the buttocks increasing the risk of pressure damage, specifically at the sacrum and coccyx.

Seat height – too low



This results in high pressures going through the buttocks, specifically under the ischial tuberosities and feet.

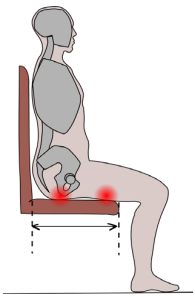
The thighs are a good area of the body to distribute pressure, due to a larger surface area with a lack of bony prominences. The seat height should be adjusted to allow for this.

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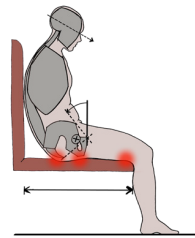
Seat depth – too shallow



This results in a reduced contact area between the thigh and the seat surface. This will cause poor distribution of pressure throughout the buttocks and upper leg. The ischial tuberosities are at higher risk of pressure damage due to the reduced seat depth.

The set-up of the seat will need to be adjusted to reduce this risk. 2.5 cm is recommended between the back of the knee and the front edge of the seat. You should be able to fit 3-4 fingers between the front edge of the seat and the back of your knee.

Seat depth – too deep



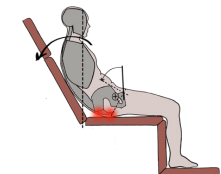
This can have an impact on a person's overall posture and pressure ulcer risk. The individual will not be able to sit all the way back, causing them to lean backwards and resulting in shear forces at the interface of the buttocks. The pressures at the sacrum and coccyx will be higher in this position due to the altered position of the pelvis. To reduce this risk, the set-up of the seat will need adjustment.

Wheelchair

Postural supports

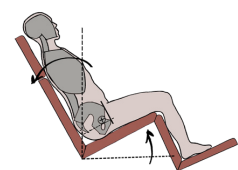
Where postural support is required, this can be provided through a specially designed backrest or additional devices may be attached to the chair such as lateral supports, pelvic belts/chest harness. It is important that these devices are fitted and positioned correctly and securely.

Recline



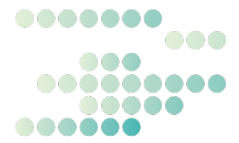
Some wheelchairs have a recline mechanism which allows the backrest to be tilted back for comfort or postural needs. It is important to note when in recline the pelvis is tilted forward so more pressure is exerted to the sacral region (sacral sitting).

Tilt in space



A wheelchair which allows Tilt in Space positioning can have great benefit for pressure relief (shifts the weight and pressure to relieve pressure from the pelvis and prevent shear from). In tilt the pressure is moved from the pelvis towards the back. The spinal prominences should be monitored for signs of pressure when this position is used for prolonged periods.

Images: Reproduced with permission from PUPIS, 2019.¹



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Usage can also improve physiological function e.g. respiratory function, digestion, enhance functionality and reduce fatigue caused by sitting.

Research shows that 45° tilt “maximises the potential for significant blood flow increases and pressure reduction” by allowing the patient to completely off-load their pelvis and allow re-oxygenation of the tissue.⁷

Armrest position and height should be set up to provide support for the upper body and enable effective self-repositioning.

If the armrest is positioned too low, then it may cause a patient to gravitate towards it for stability or function to use a powered mechanism especially if they have poor core strength or trunk control. This can lead to a side leaning position which can cause pelvic obliquity. The effect of this will cause abnormal loading through the ischial tuberosities and long-term postural problems e.g. scoliosis.

If the armrest is too high, then the shoulders are not in an aligned position leading to discomfort.

In both instances it is also more difficult for the patient to perform small weight shifts so reduces ability and effectiveness from self-repositioning.

Footplates

Well supported feet can take 19% of a person’s bodyweight thus reducing pressure to more vulnerable areas such as the pelvis. Footplates which are too low can cause a patient to slide forward in their chair resulting in increased shear and sacral sitting.

Foot plates too high can increase pressure to the ischial tuberosities as little weight is loaded through the thigh area.

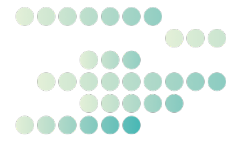
In some patients there may be a discrepancy in leg length which can mean one footplate is needed to be lower than the opposing side to ensure both feet are supported.

Any foot abnormality may also require the footplate position to be tilted to help avoid high pressures over a particular area of the foot.

Elevating leg rests

Elevating leg rests allow individuals to change the leg and/or footrest angle relative to the seat to flex or extend the knee.⁸ However, it is recommended that this feature is used in combination with tilt or recline as it can increase pressure to the sacrum.

It is also important to remember that this may place the posterior heel area at risk, as the heel will be in a weight-bearing position.



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Cushion

Ideally a support surface should:

- Distribute pressure evenly; or provide frequent relief of pressure by varying the areas under pressure
- Minimise friction and shear forces
- Temperature/moisture regulation
- Doesn't unduly restrict movement
- Comfortable and acceptable to the patient
- Easily maintained
- Help prevent postural deterioration
- Maximise function.

There are many different types of pressure-redistributing cushions available to help prevent and manage pressure ulcers, such as:

- A single cushion to use on a wheelchair or chair
- An integrated cushion into a seating system (a cushion that is not removable)
- A bespoke custom-made cushion.

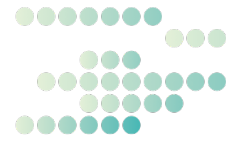
In patients deemed at risk from pressure injuries/ulcers all weight bearing parts of the chair should facilitate immersion, envelopment and support of the patient's body.

Materials

Examples of cushion types includes flat foam, segmented foam, contoured foams, water/gel-filled, honeycomb structure, and air-cell-based – powered and non-powered.

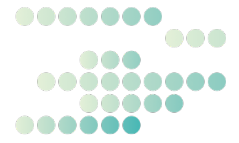
There are several factors to consider when selecting a cushion for a patient deemed at risk from pressure injuries/ulcers, but the key factors are:

- Responsive/reactive materials that reduce pressure through slight movement/repositioning
- Active materials which allow immersion/envelopment with a dynamic element usually cyclic to frequently change pressure.
- Surface contouring to adopt shape by allowing immersion of prominent parts
- Active redistribution away from vulnerable sites such as sacrum/ischial tuberosities and provide even loading
- Additional postural support through adaptation or positioning blocks within the cushion.
- Promote individual's functionality and self-repositioning
- Ease transfers to promote self-care, reduce risk from trauma, friction and/or shear
- Acceptability to the patient for comfort
- Easy maintenance for self-caring patients.



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Covers

Cushion covers should ideally be:

- Flexible/stretchable to prevent ‘hammocking’ (cover not conforming to the natural loaded shape of the surface)
- Smooth and crease free
- Minimise and manage temperature and moisture build-up
- Enable transfers
- Easy to clean
- Removable to allow inspection of the cushion
- Clearly labelled to show the correct orientation.

Avoid placing rigid materials such as continence pads, towels, slings or other coverings over cushions as this may reduce effectiveness of immersion by hammocking.

Shear and friction

The majority of PU prevention strategies target pressure force risk reduction through mechanical offloading, repositioning, and pressure redistribution support surfaces. However, the movement of repositioning may increase friction and shearing forces that may lead to PIs if not done properly.⁹

Friction is defined as the “mechanical force exerted when skin is dragged across a coarse surface,” and skin damage due to friction alone typically leads to superficial abrasions with vulnerability to PIs. Shear is a mechanical force that acts internally on the skin tissue in a direction parallel to the body’s surface.¹⁰

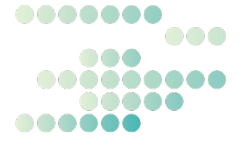
Dynamic conditions like repositioning and patient transfers may drag the skin over bony prominences, increasing both the friction and shearing forces. This increases the risk of superficial tissue injury including skin tears and blister formation.^{11,12}

How to avoid friction and shear^{9,13}:

- Keep the surface where the patient is clean, and dry;
- Use of Skin barrier products avoiding massage during the skin care;
- Friction-reducing sheets as opposed to standard cotton sheets when used during lateral patient transfers may help reduce skin drag
- Protective dressings may also be used over bony prominences during movement to help prevent skin damage during patient transfers;
- Transfer boards and slings may increase friction along the skin so proper selection of equipment based on patient size, needs, and skin features are imperative.

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- When seated, be aware that leaning forward and whenever the torso is tilted to one side shear force is present in ischial tuberosity – When making movements, lift the body and do not drag it.
- Whenever is possible using Safe Patient Handling and Mobility (SPHM) technology is beneficial.

Pressure mapping / redistributing the pressure

Pressure mapping provides a visual representation of how pressure is distributed when a person is sitting. It is a valuable educational tool for individuals with spinal cord injury (SCI) with reduced or no sensation, as it helps them understand where high-pressure areas occur and why regular pressure-relieving strategies are important.

By showing how different postures affect pressure, pressure mapping can help users and clinicians work together to:

- Identify areas at risk of pressure ulcer development
- Improve awareness of effective pressure-relieving movements and techniques
- Demonstrate the impact of poor posture on increased pressure
- Support decision-making about seating, cushions, and positioning.

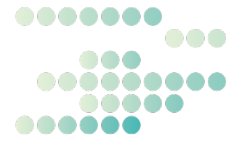
Overall, pressure mapping helps patients *visualise* pressure in a way that is otherwise not possible, making it an effective tool for education, prevention, and long-term self-management.

The following image shows the results of pressure mapping. The image shows points where the pressure is high (yellow and red dots) and areas where the pressure is low or more tolerable for the skin and underlying tissue (green and blue).

This technique can give crucial information about anatomical areas in more risk of pressure damage, and using this data the healthcare professional can be more assertive in terms of selection the proper support surface and to correct the posture of the SCI person in the wheelchair.

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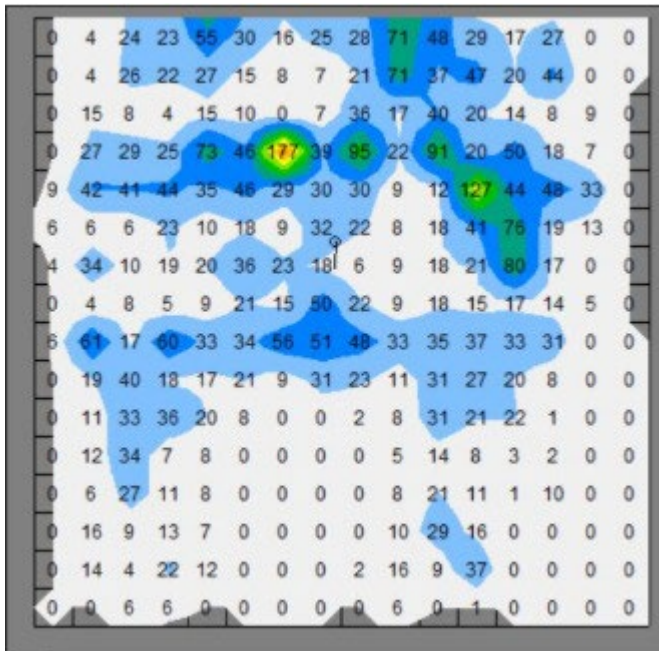


Figure 2: Pressure mapping.

Utilising pressure mapping technology, systems are incorporated beneath the support surface to inform individuals with a spinal cord injury (SCI) when to perform necessary pressure-relief exercises.¹⁴

Other seat surfaces

Armchair

The principles guiding the provision of a wheelchair should be considered for a static seating system such as an armchair or easy chair as outlined above.

Toilet/commode

Time spent using a commode or toilet seat should be assessed for pressure redistribution in those deemed at risk. Where time is spent for personal care else bowel care regimes this should be assessed to ensure the least time is spent using such equipment.

Overlays and soft padded systems utilising tilt in space and other postural support may be available to accommodate at risk clients.

Car seat

The seating surface within a motor vehicle should be considered if used frequently or for extended periods of time. Some vehicles can be adapted to transport a wheelchair else allow a person to “drive” from their wheelchair. If this is not possible adapted cushions are available to help provide pressure relief considering transfer and functional needs.

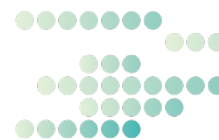
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Patients should be encouraged to increase frequency of small repositioning where possible and avoid static positions with frequent breaks when on long journeys.

*Also be aware how climate effects materials such as cold (foam/gel type cushions tend to be firmer, higher temperatures can alter/degrade fluidised gel so is less effective plus risk of overheating can cause burns in extreme high temperatures).



Mattress

A full body support surface should appropriately accommodate the individual's size and distribution of mass to ensure its performance characteristics function as intended. A full body support surface should provide adequate width to facilitate repositioning and/or bed mobility, and to promote safety.

The full body support surface can be:

- Pressure redistribution foam;
- Powered air (reactive) (excluding low air loss);
- Non-powered air;
- Alternating pressure air (active);
- Low air loss (with enhanced microclimate management features);
- Air-fluidised (reactive).

Since there is no strong evidence about the superiority of one type of mattress compared to other, EPUAP/ NPIAP and PPIIA (2025)¹⁵ recommends:

It is good practice to consider the following factors when selecting or changing the mattress, overlay, or integrated bed support surface the individual's:

- overall risk of pressure ulcers/injuries,
- response of the skin and tissues,
- independence, mobility and activity needs,
- posture and sleeping position and their effects on pressure redistribution,
- need for microclimate management and shear reduction features, and
- preferences and care goals.

Automated turning devices

Automated devices can be incorporated within mattress systems or applied alongside.

The principle is to alternate a patient through a range of movements via a set program from side to side to supine. These systems are designed to allow caregivers to adjust turning intervals and angle to meet individual needs.

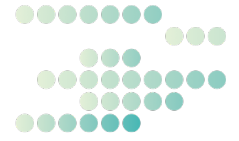
*Care should be taken when used in patients who have a degree of free movement else repositioning requires the patient is correctly positioned to ensure comfort and

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specific positioning for pressure relief especially in those with lower limb contractures.



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Manual handling

Transfer aids

Prevent undue friction/shear, allows trauma free transfer from bed to chair and allows optimum position in chair.

Hoist/sling

Fitted correctly in application, suitable and designed to remain under patient without removing where required.

Positioning in transfer results in pelvic alignment where possible for optimum pressure relief and function.

Medical devices

To reduce the risk of medical device related pressure ulcers/injuries, review purpose and select medical devices with consideration to:

- The device's ability to minimise tissue damage
- Correct sizing/shape of the device for the individual
- Ability to correctly apply the device according to manufacturer's instructions
- Ability to correctly secure the device

Regularly monitor the tension of medical device securements and where possible seek the individual's self-assessment of comfort.

Assess the skin under and around medical devices for signs of pressure related injury as part of routine skin assessment

Ensure devices are supported and secured to prevent additional damage from inadequate positioning which can cause trauma and pressure.

It is good practice to reduce and/or redistribute pressure at the skin-device interface by¹⁵:

- removing the medical device as soon as medically feasible,
- regularly repositioning the medical device, its securements and/or the individual,
- physically supporting the medical device in order to minimise pressure and shear, and/or
- alternating the type of device in use when possible.

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Masks/tracheostomy

Consider alternating oxygen delivery devices between a correctly fitting facial mask and nasal prongs to reduce the severity of pressure ulcers (PUs) for individuals receiving oxygen therapy, when it is appropriate and safe.¹⁵

It is recommended to employ a protective dressing or pad underneath the tracheostomy tube, specifically one that prevents excessive pressure and possesses the capacity for moisture absorption.

Fitted correctly, do not allow moisture build up beneath.

Catheters/tubing

Positioned and secured correctly.

Compression stockings

Correctly sized and fitted without wrinkles. Be aware of the seams position, to avoid pressure points.

Splints/casts/callipers

Regular skin checks where the device can be removed.

Additional padding over bony prominences and mechanism for increased review in those patients deemed at risk from pressure due to reduced sensation or where pain alerts to a potential issue.

Clothing

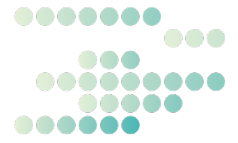
Clothing ideally should be made from flexible or stretchable materials and be breathable to minimise heat/moisture build up and avoid materials such as jeans or any trousers that contain seams and studs around the pelvic region. Rigid materials underneath the skin can cause damage when creased else prevent immersion so reduces pressure relieving properties within surfaces.

Shoes

Ensure shoes are not too tight or too loose. Consider getting shoes one to two sizes larger than normal due to potential foot swelling, especially if the person cannot move the feet much or use a brace.

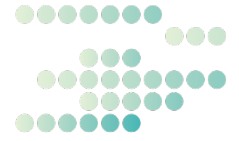
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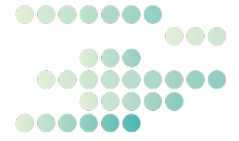
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