

White Paper

Pressure Care in Sitting – An Analysis of Cushion Outcomes

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Novis Healthcare is a specialist in the design, manufacture and supply of pressure care devices, assistive technology solutions and clinical training. A strong focus on clinical outcomes including pressure injury prevention and patient handling ensures Novis provide healthcare products that exceed clinical and therapeutic expectations.

Novis utilises best practice, gold standard procedures and clinical evidence to ensure our research, innovation and design facilitate clinical excellence. Novis maintains a strong focus on delivering successful patient outcomes in acute care, long term care, rehabilitation and in the community.

INTRODUCTION

Pressure Injury Prevention is a full day strategy, focussing on all surfaces encountered during the 24 hour period.

Compared to lying, whilst seated the individual is subjected to high interface pressures because of the small contact area between the buttocks and the seating surface. The overall surface area bearing the body load is significantly decreased in sitting than in lying and thus privy to higher Interface Pressures.

The benefits of pressure relief and/or redistribution to minimise risk have been well documented, and these benefits can be provided by support cushions ¹. Air Cell Cushions have been found to be more consistently effective in interface pressure reduction than gel cushions or foam cushions ². (Figure 1)

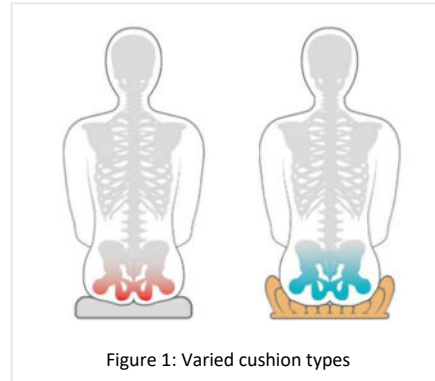


Figure 1: Varied cushion types

However, when implementing a pressure care support surface such as an Air Cell Cushion, (Figure 2) there are other factors than pressure reduction to take into account when attempting to achieve positive outcomes.

Selecting a cushion is a complex process of assessing comfort and the patient's ability to assist or correct posture, reducing the concentration of pressure, assessing function and safety ³.

The seat cushion can not only assist by redistributing pressure away from the vulnerable bony prominences under the pelvis. There may also be requirements to manage posture, to provide adequate balance and stability, to enhance functional capability and ensure comfort ⁴.

For those who are chair based, have high pressure care requirements, are unable actively communicate, have higher pressure injury risk, limited mobility, a seating therapist should be consulted for partnership in determining the most appropriate solution ⁵. Thus, Therapists need to consider all seating goals minimising the compromise in any one goal over another ⁶.

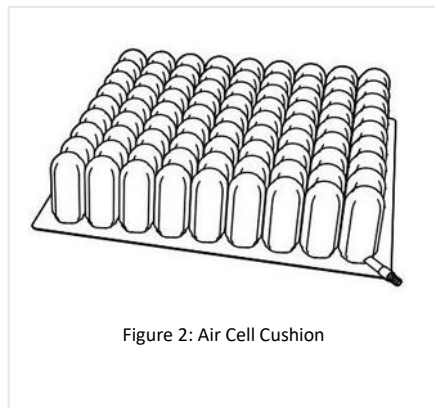


Figure 2: Air Cell Cushion

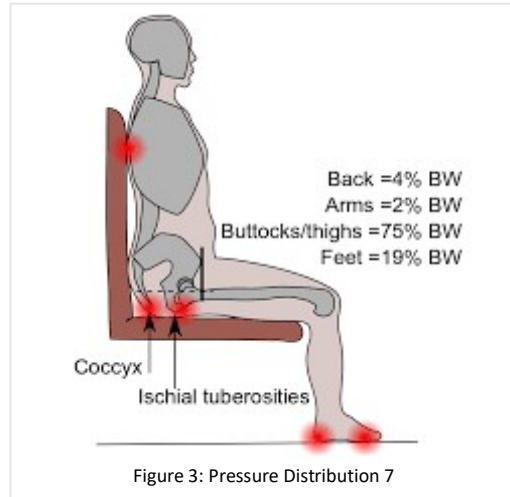
It is essential to establish a thorough understanding of the user's needs when selecting a suitable pressure cushion. This is identified through an in-depth assessment process by the Therapist. This needs to be combined with a comprehensive knowledge of cushion characteristics when selecting a support surface ⁶ to meet seating goals.

By considering these individual elements of a cushion, determination of the appropriate cushion type, and comparison of similar cushions becomes a significantly more objective process. When utilising knowledge to select a cushion, gains in outcomes for the user are improved, facilitating a better quality of life.

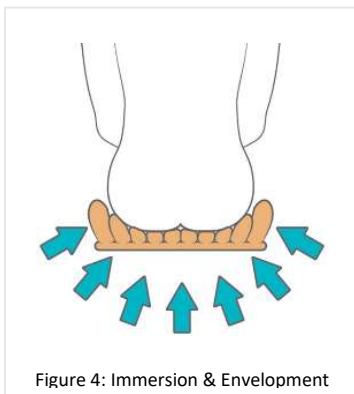
PRESSURE CARE

In sitting, up to 75% of the body weight (Figure 3) is supported by only 8% of the body surface (19), putting increased pressure on the bony prominences of the buttocks and thighs.

Sitting forces the weight of an individual against the supporting seat surface which compresses the soft tissues around the buttock area between the chair and the bony ischial tuberosities. This pressure causes an obstruction of blood flow that when combined with limited movement, poor sensation, malnutrition, and increased age can eventually lead to Pressure Injury (8).

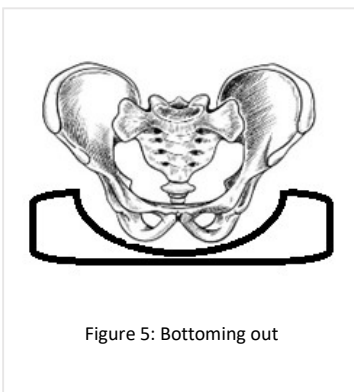


The Pan Pacific Clinical Guideline determines that a support cushion should be utilised for patients at risk of pressure injury when seated in a chair or wheelchair and that the time a patient spends in seated positions without pressure relief should be minimised (9).



The rationale behind the use of a Reactive Support Surface is Pressure Redistribution. That is “the ability of a support surface on which the patient is placed to reduce the pressure load on bony prominences in contact with the surface by enabling either immersion or envelopment into the surface” (9).

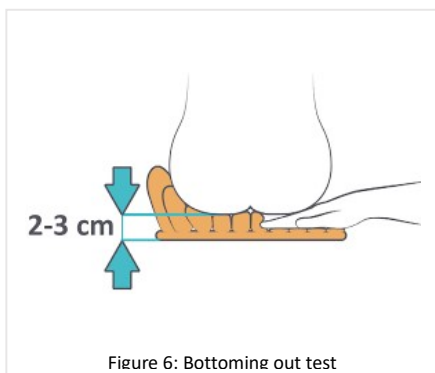
Immersion describes the reaction of sinking down into the surface, whereas envelopment describes the surface ability to conform to the contours of the body. (Figure 4) This leads to an effective increase of surface area and consequent reduction of peak pressures, especially that under bony prominences. Immersion and envelopment of the entire buttocks structure minimises the exposure of internal tissue to pressure (10).



Compared with other pressure-reducing systems, an ACC has the best pressure-distributing properties (11). It has been found that the ACC is the most effective solution on a stable surface (12). This is the consequence of ACC is superior immersion and optimal shear reduction (13).

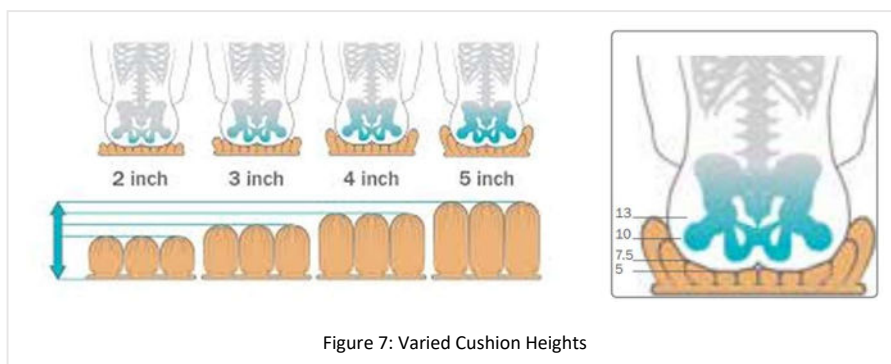
Not only do ACC offer greater immersion and reduced soft tissue stresses, it also provides better protection against bone shape adaptation, muscle atrophy, and spasms. Hence, theoretically should provide longer safe sitting times with respect to foam cushions (14). STAR recommends that it is essential that effect immersion is controlled to a 2-3cm depth from the bottom of the cushion. This avoids the risk of the Cushion ‘bottoming out’ (Figure 5)

‘Bottoming-out’ is the descriptor used to explain the result when a person is no longer being supported by the surface and is potentially inappropriately reaching the bottom of the surface. According to the 2019 Clinical Practice Guideline ‘bottoming out’ is the state of support surface deformation beyond critical immersion whereby effective pressure redistribution is lost (15).



For cushions available in various thicknesses, it is generally the case that thicker options have more potential for good pressure management and minimisation of “bottoming out” 4. A thorough assessment of sitting height is completed using a “bottoming out” test (Figure 6)

The STAR Cushion range offers a variety of cushion thicknesses with heights from 5cm, to a highly immersive ultra high 13cm. (Figure 7). This allows for an increase depth of immersion, greater pressure redistribution whilst minimising the risk of ‘bottoming out’.



The provision of a cushion should not be based upon the outcome of a Pressure Injury risk assessment tool alone, as these tools are not designed to identify risk for those who sit for long periods 16.

Consideration of Pressure Injury risk, history of Pressure Injury, time spent in seating, co-morbidities, communication ability and seated mobility all need to be considered in the assessment process.

Simulation study results suggest wheelchair users who are obese and have diabetes may benefit from using an ACC to minimize the increased mechanical strains and stresses in the weight-bearing soft tissues in the buttocks that result from these conditions 17.

An ACC cushion is generally better protecting patients with a history of severe Pressure Injuries manifested by large, possibly deep tissue scarring in their buttocks 18.

POSITIONING

Having the right postural position in a wheelchair is an essential component of implementation of a support surface. Not only does it have a significant effect on location of pressure, but will impact comfort, function and sitting tolerance.

In seating a user can be correctly positioned by choosing the required seat, support surface and back cushion to ensure the trunk and pelvis are positioned optimally for the individual’s requirements. This minimises risk of adverse effects to long term postural deformity and maximises the functional position of the user.

A correctly adjusted wheelchair with e.g. the right seat depth, width and height, arm rest position, head support and adjusted leg support length is of great importance for the user. This facilitates maintaining of the determined position, preventing sliding, shearing and minimising the need for additional repositioning 19.

A cushion should facilitate positioning in a posture that minimises pressure, friction and shear forces, maintains the usual range of activity 5 and minimises adverse effects of seating.

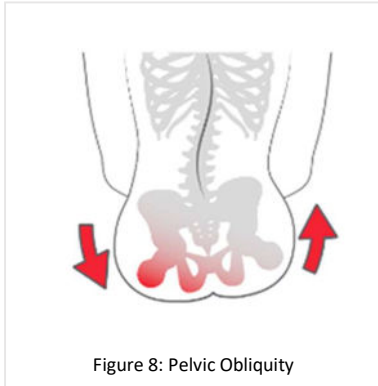


Figure 8: Pelvic Obliquity

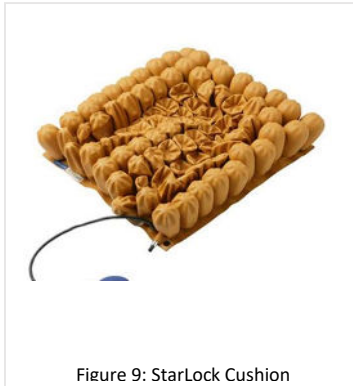


Figure 9: StarLock Cushion



Figure 10: Single Valve ACC

When seated in non-reclining chairs ensure the patient's lower limbs are supported in optimal alignment (often 90° at hip, knee and foot) within the patient's range of movement. To minimise pressure under ischial tuberosities, we need to avoid positioning hips at greater than 90° when seated ⁹. This means that the interaction of the cushion and chair combined need to be assessed when proscripting a full seating system.

Individual variations in postural presentation also affect tissue loading around bony prominences.

Pelvic tilt and pelvic obliquity are common postural presentations that have consequences for pressure management. A posterior pelvic tilt may place the coccyx in contact with the seat surface and the ischial tuberosities move forward on the cushion. With extreme posterior pelvic tilt the sacrum may also come into contact with the cushion and should be assessed for pressure risk ⁴.

In the case of anterior pelvic tilt the ischial tuberosities are located more rearward towards the back support. Pelvic obliquities will typically result in asymmetric pressures, with tissue on the lower side being more heavily loaded. (Figure 8)

These varied postural presentations may require correction or accommodation through cushion design determined through the seating assessment process ⁴.

The StarLock Cushion (Figure 9) provides control over the positioning of the user. Infinite positioning is offered through individual cell lock off which allows for customised positioning. The ideal position and posture can be determined, accommodated and then maintained each time the user returns to seating.

STABILITY

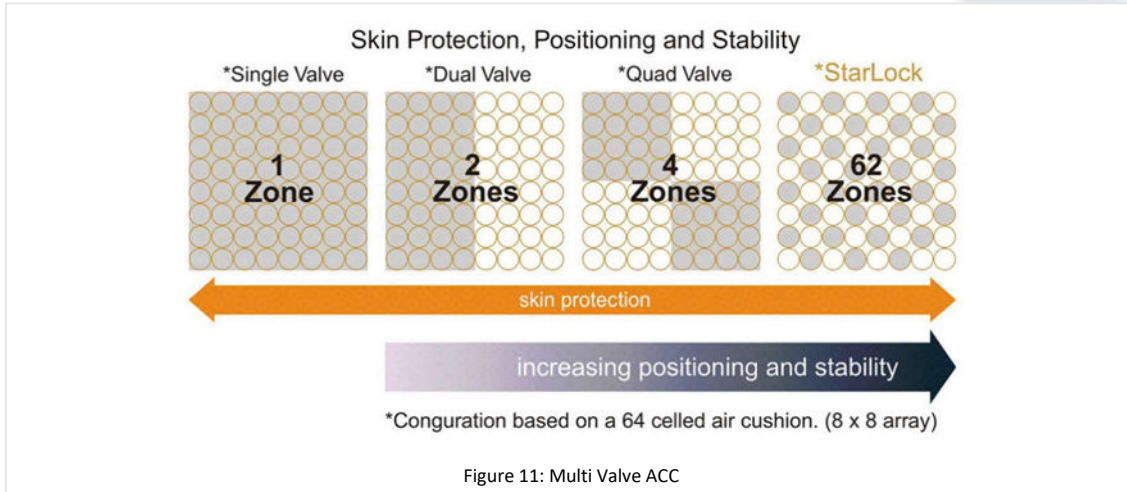
Postural stability is a prerequisite for the performance of seated movements and activities ⁸.

Stability is needed to maintain an appropriate individualised sitting posture. Loss of position increases the negative load on the body; the skin, muscles, nerves, blood vessels and other structures, and reduces the quality of life ¹⁹.

Contrary to traditional beliefs, it is possible to achieve seated stability on ACC ⁶.

Single valve ACC (Figure 10) have the entire sitting surface made with interconnected air cells so that the whole cushion is self-contouring to the shape of the user. This allows the user some variation in placement on the cushion and in pelvic posture while maintaining good pressure management ⁴.

For those who are able to shift their weight in a controlled method the cushion facilitates movement and essentially responds to the new position without compromising the immersive qualities of the cushion.



However, for those with unstable sitting, have limited movement or reduced control of movement the reactive ability of the single valve ACC can unbalance some users and lead to reduced stability.

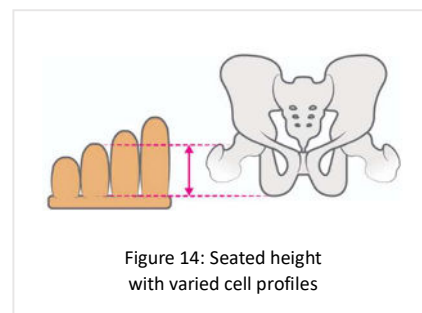
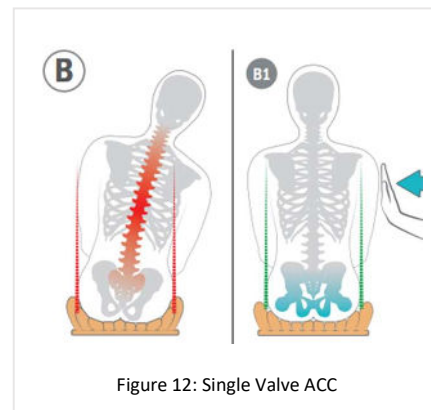
Providing an alternative versions of the ACC, having the air cells fixed to the posture of the user we can improve the stability and balance whilst maintaining correct positioning. This is done using a multi valve ACC (Figure 11)

The StarLock cushion offers the greatest stability of all ACC. Enabling each cell to be positioned and maintained to support the determined position and minimising the motion of air through interconnection cells.

This not only provides stability of posture but may assist in stable transfers on and off the cushion. Some users find ACC difficult for self-transfer, because unlike a firm cushion, the user's hands sink to the level of the cushion base during transfer. The StarLock cushion mitigates this concern by providing a more stable surface without active air motion.

The StarLock ACC allows for infinite positioning and when the second valve is locked off each cell is then stable facilitating effective balance and function. Accommodation can be made for fixed postural deformities, and flexible deformity can be corrected, minimising long term effects of poor support. (Figure 12)

A lower profile ACC (Figure 13) can increase stability for more active users but consequently does not provide the same level of Pressure Care. This would only be recommended for those who are more active, have a lower Pressure Injury risk or when assessed to gain benefit from a lower cushion height.



It is important to recognise that the full seating height does not change by profile of cushion. As the immersion into the cushion means the user ends up at the same height once fitted. Higher cushions offer deeper immersion but the sitting height remains the same as with a lower profile cushion. (Figure 14)

VARIATION

Changing position is important to vary the load on the skin, muscles, nerves, blood vessels and other structures and helps to increase circulation, so health can be optimised ¹⁹. Repositioning patients to varied postures assists in reducing duration and magnitude of pressure over vulnerable areas, including bony prominences ⁹.

One of the most effective methods for preventing skin damage is regular varied repositioning ³⁷. Regardless of the support surface used, regularly reposition the user at appropriate intervals should be guided by skin assessment ⁵.

Healthy, mobile individuals can sit for lengthy periods without developing pressure related injury. frequent

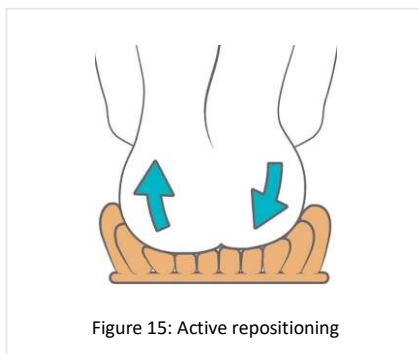


Figure 15: Active repositioning

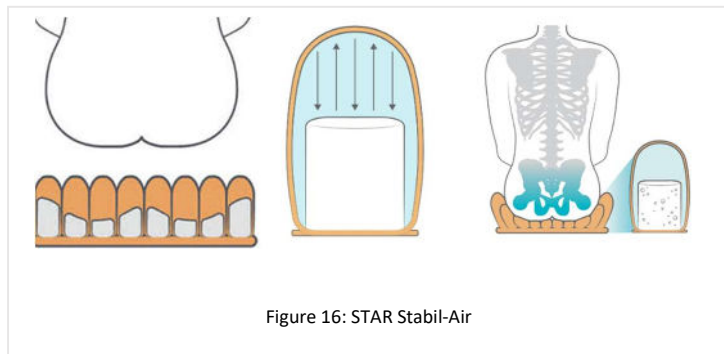


Figure 16: STAR Stabil-Air

postural movements when seated altered interface pressure and can restore blood flow, thus facilitating tissue health ⁸. People change their posture on average 7.8 times an hour in the frontal and sagittal planes when sitting. This results in an increase in subcutaneous oxygen saturation ²⁰.

Single Valve ACC facilitate variation in posture due to the motion of air from one cell to the next. This allows the cushion to move with the postural readjustment, minimising shear and maximising Pressure Care ¹³ as the user actively repositions. (Figure 15)

This facilitates the ability for natural human readjusting movement in adapting posture to varied locations of the sitting skin surface to minimise risk of long term pressure on any single location. Even slight pelvic movement is enough to effectively reduce the maximum pressure ^{21, 22}.

The STAR cushion range can allow for the advantages of an ACC in this scenario. It encourages normal postural shifting and via the motion of air, it follows the varied positioning and supports the person in the new posture.

If slower reaction of the adapting ACC is required the STAR Stabil-Air (Figure 16) is an appropriate alternative. The low resilience foam cores inside the cells, slow down air movement between the cells allowing for a more stabilised change in posture.

Not only are the foam cores protected by the cells minimising infection control risk, in the situation where ACC maintenance is done poorly the contoured cells prevent the user from 'bottoming out'. The STAR Stabil-Air is a solution when compliance with maintenance is determined to be a risk in the assessment process.

To support variation when seated in the absence of spontaneous controlled movement, the possibility of changing tilt and recline of the seating is vitally important. (Figure 17) Variation is required given a user often sits many hours in the chair, and a change of pressure distribution is needed to prevent skin damage ¹⁹.

“The greatest reduction in pressures were seen when combinations of tilt and recline were used together, with studies using 25-45° of tilt with 110-150° of recline.”²³

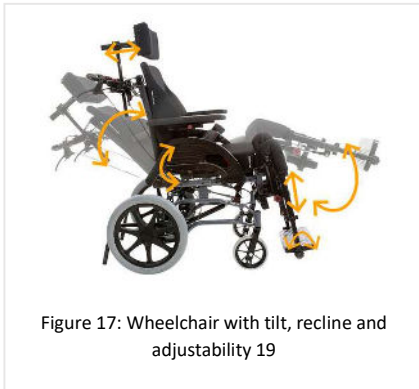


Figure 17: Wheelchair with tilt, recline and adjustability¹⁹

For surfaces with tilt function only, >30° defines a pressure relieving tilt²⁴. Beyond 45°, the user's body weight starts to load through the back surface. Whilst pressure under the Ischial tuberosities reduce, the pressure on the upper part of the pelvis, spine, shoulders and head all increase²³.

Complete pressure relief for 3 minutes each 30 minutes is more effective than 1 minute duration²⁵. Currently, individuals “at risk” are advised to change their posture by performing pressure relieving movements as often as every 15 to 30 minutes⁸.

Although the degree of pressure will be lower with an ACC, unless the patient repositions or is repositioned, the pressure may remain constant and may still be sufficient to occlude circulation to the tissue²⁶.

ACCOMODATION

External and internal anatomy change considerably in the months and years following the loss of mobility. Tissue structure and functional changes can typically include weight and fat mass gain, skeletal muscle atrophy, fat infiltration into muscles, bone loss, bone shape adaptation at the pelvis, vascular perfusion changes, and microstructural changes in skin and muscle that are associated with disuse and affect the biomechanical behaviour of these tissues²⁷.

Biomechanical Risk, or the intrinsic characteristic of an individual's soft tissues to deform in response to extrinsic applied forces, is greater in wheelchair users and in individuals at greater risk for Pressure Injury²⁴. (Figure 18)

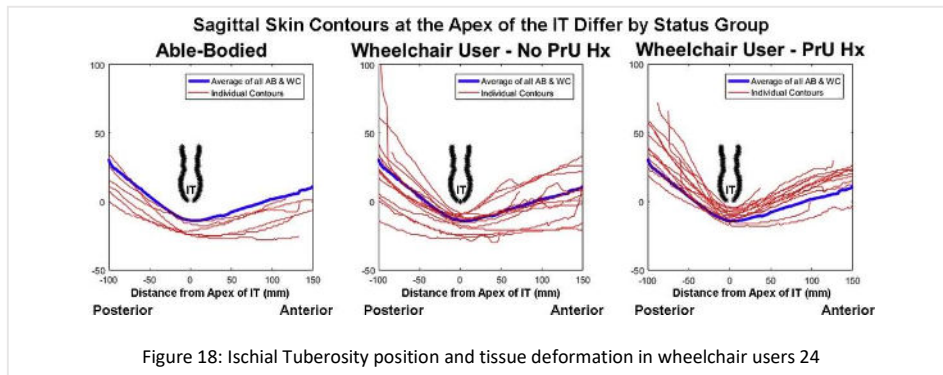


Figure 18: Ischial Tuberosity position and tissue deformation in wheelchair users²⁴

Support surfaces, particularly wheelchair cushions, should be designed to accommodate microchanges that occur for a seated person throughout the day (eg, changes in posture and position or muscle tone) as well as macrochanges in anatomy, tissue composition, and long term tissue physiological changes. Cushions must be tailored to, and adapted for, each individual patient on a regular basis²⁷.

An ACC allows for ongoing accommodation of these tissue microchanges. A single valve ACC such as STAR Cushion adapts in the moment as tissue changes occur and a dual valve ACC such as StarLock can be readjusted during regular maintenance to accommodate for ongoing change.

This infinite ability to change the cushion's surface shape avoids the user being confined to the position and shape initially assessed and therefore ACC accommodate of ongoing tissue change.

OFFLOADING

The 'size' and 'shape' of the bony features of a client's skeleton is individual. Tissue around smoother, flatter sections of bone is typically better able to spread loading, while tissue around rougher or pointer sections of bone are more vulnerable to localised high pressures.

In seating, this means that tissue around the coccyx and ischial tuberosities is most vulnerable to pressure injury, followed by the less protruding bony prominences such as the greater trochanters and the sacrum.

Conversely, tissue around the large, smooth femurs is typically able to sustain greater contact pressures. It is often desirable to configure a seating system to achieve low pressures under vulnerable tissue by increasing loading to areas of tissue that are more resilient 4.

ACC that rely on an air motion technology minimise interface pressures under bony prominences of the pelvis, particularly the ischial tuberosities 28, 29. Although these cushions reduce pressure it still may be high enough to create risk in some users 30, 31. For these users, utilising complete off load in high risk areas will effectively reduce the risk of Pressure Injury in those locations 30.

Off-loading cushions (OLC), still incorporate immersion and envelopment, with loads being transferred from high-risk areas, such as bony prominences, to lower risk soft tissues. The OLC provides greater reduction in tissue deformation in high risk areas than those without offloading ability 32. The OLC is designed to significantly decrease peak pressures immediately under these high risk bony regions of the pelvis 33.

Deformation of tissues now loaded by the OLC is not significantly different from the deformations seen with the standard ACC 32. The OLC does not demonstrate reductions in the surface area or increased overall average pressure, further reinforcing its potential for mitigating likelihood of developing Pressure Injury in a high risk population 33.

The force-removal approach of the OLC design effectively reduces Interface Pressure, a known extrinsic risk factor for Pressure Injury, in the high risk ischial tuberosity and sacral/coccygeal regions of the buttocks 33.

The StarLock cushion offers all the benefits of an ACC combined with the ability to create zones of full offload.



Figure 19: StarLock ACC with offloading

(Figure 19) This is particularly beneficial for high risk areas, areas of current or previous Pressure Injury or locations where cushion contact initiates pain.

Specific Cells of the StarLock ACC cushion can be manually deflated and locked down under these high risk areas creating areas of full offload, transferring pressure to less vulnerable tissue without compromising the overall value of an ACC.

CUSHION COVER

The cushion cover is an important design component of the cushion. It is required to not detract from the cushion technology, minimise shear and friction and support immersion and envelopment.

The addition of a cushion cover can impact on the outcomes of pressure relief if not designed to maximise the therapeutic benefits of the internal cushion.

The cover needs a soft, stretchy material on the sitting surface to allow the user to sink into the cushion. There is a need to avoid excessive tension in a stretched cover, which increases pressure under bony prominences. A cover which is stiff or inflexible does not allow for envelopment ⁴.

In the case of some cushions, a portion of the pressure management material is integrated into the cushion cover. A pressure management cushion should therefore always be fitted with the manufacturer's cover to ensure the full benefit of the designed pressure management ⁴. All cushions should be used with an appropriately sized, specified cover as determined by the manufacturer ⁹.

The strains and stresses in muscle, fat and skin tissues are lower for the ACC cushion with respect to the standard foam ¹⁰ but these positive results rely on an effective multiway stretch cover design.

The Cover utilised in the STAR Cushion range are designed to increase the positive benefits of cushion implementation. The cover facilitates gross and micromovements in all directions minimising potential for shear and friction.

The controlled stretch in the STAR Cushion cover allows for immersion and envelopment of the ACC to not be compromised. Interface Pressure measurements demonstrate the addition of a cover to a cushion in fact improves pressure care management ³⁴.

At 5, 10 and 13cm the STAR ACC demonstrates reduction in peak pressure, maintenance of minimum pressures and inconsequential change in the surface area enveloped when the cover is applied ³⁴.

In order to maximise the positive benefit of the cushion cover technology, it is required to avoid excess linen between the support surface and the patient's skin ⁹.

SUMMARY

A Reactive Support Surface, a support surface which in response to applied pressure, distributes interface pressure over a wider body area through immersing and enveloping the patient ⁹ utilised when seated is an essential component of a comprehensive Pressure Care Program.

The ACC is an effective Reactive Support surface that can be an easily implemented solution to reduce risk of Pressure Injury in vulnerable users. Not only does the ACC offer effective immersion and envelopment but they lower strains and stresses in muscle, fat and skin tissues ¹⁰.

Manual wheelchair users spend an average of 9.2 hours per day in their chair ³⁵. This duration of time spend on the vulnerable buttock tissues warrants extensive focus on the elements of an effective support surface.

For users at high risk of Pressure Injury and those even seated for more than eight hours a day in a wheelchair, the use of a ACC will lower the incidence of Pressure Injury occurrence ³⁶.

Implementing a cushion to reduce risk of pressure is a complex process of analysing comfort, the patient's ability to assist, correction of posture, reducing the concentration of pressure, assessing function and safety ³.

STAR offers a comprehensive range of support surfaces to alleviate the risk of seated positioning. By providing a range of solutions the Therapist can implement the appropriate surface in response to a thorough assessment. The ability to accommodate postural support, postural correction, full offloading, improve stability, whilst offering all the benefits of an ACC, is a unique advantage of the STAR range.

By analysing each element of the users' needs implementation of an appropriate cushion is able to improve the safety and quality of the sitting position.

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