

## What makes a good cushion?

### 3. Stability and a neutral pelvis

This is the third article in a series which aims to help people to think more about what it is that goes into a cushion that makes it ‘good’ for one person, but maybe not for another. In the first article we identified the three key elements around which a cushion can be assessed – functionality, posture management, and tissue integrity. This article reviews the first elements around the subject of posture and positioning, considering the role of ‘stability’, the health benefits of a neutral pelvis, and how this can be achieved.

For the clinician, as well as for the occupant, tissue integrity of the seated area may probably come first when selecting the attributes of a cushion. However, the construction and stability of the elements of the cushion’s design will have major effects on the occupant’s ability to carry out their normal activities while seated on their cushion. In addition, without appropriate support and stability at the pelvis, there are potential knock-on effects to the occupant’s health, e.g. from misalignment of the spine leading to pain and to associated impacts on the physiological processes within the torso.

#### Stability

We emphasise the importance of stability, but what do we mean? Stability is an interesting term when it is applied to the seated person, and around what that person can do. If we take a matchbox, and place it on its end, it could be considered to be stable. However, it could be knocked over to a more stable position on its side (Fig 1). When one has a so-called stable item that can be transferred to a more stable position, the former is known as being metastable.



Figure 1 Metastable and stable match boxes

For a seated person ‘metastability’ is potentially more functional than full stability, in that it allows the person to move their centre of gravity further towards the edge of their seating area – but, this only works for the individual if the person is able to fight against gravity to get back into the original metastable position. So, in seating, the degree to which the cushion both supports and aids the occupant as they reach sideways or forwards is critical – an area now catered for and measurable in the new ISO 16840-13 draft standard<sup>1</sup>.

In this article, and in Part 4 of the series, we explore elements which can be designed into a cushion in order to help keep the pelvis in a central or ‘neutral’ position, to counteract the effects of gravity trying to pull the individual away from this metastable position, and to allow maximal functionality.

#### Neutral pelvis

What do we mean by a neutral pelvis? A neutral pelvis is where the Posterior Superior Iliac Spine (PSIS) (Fig 2: K) and Anterior Superior Iliac Spines (ASIS) (Fig 2: L) are level with each other in the horizontal plane (approximated visually by the line of your belt): this equates to the hip joint (fig 2: M) and the iliac crest (Fig 2: J) being aligned vertically.

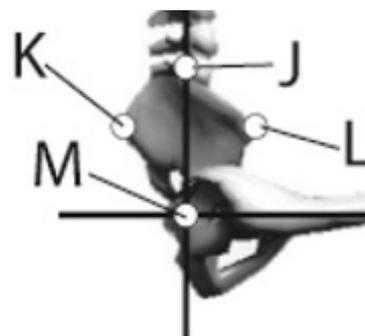
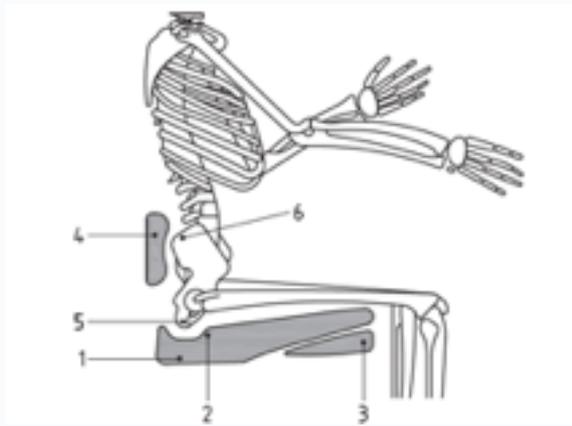


Fig 2. Alignment of the pelvis in a neutral position<sup>2</sup>



## Key

1. Flast seat base under ischials
2. Pre-ischial ridge
3. Ramping wedge under thighs
4. PSIS block
5. Ischial tuberosity
6. PSIS

**Figure 3 Protecting against posterior tilt<sup>3</sup>**

Consequently, the spine will be at its straightest at this point, and the torso and head at a maximum height. This stretched shape of the spine offers the most benefit to the torso, allowing optimum breathing, digestive, cardiovascular, and bladder function, and allows the head to be positioned best for communication and other functions. However, staying in this position can be tiring, and most people ‘relax’ back into a pelvic posterior tilt where the PSISs become lower than the ASISs. In setting up the seat it is not unusual to allow a couple of degrees of posterior tilt, for comfort. However, too much tilt leads to kyphotic curvature of the spine, compression of the internal organs of the torso, and misalignment of the head. On top of this, gravity will ‘grab hold’ of any distortion and make it worse.

### Playing ball with the pelvis

So what can we do within the seating and cushion design to combat this ‘posterior tendency’? The pelvis behaves a bit like a basketball, in that it can rotate in three planes, and with posterior tilt it rotates in the anterior-posterior plane. Therefore the first thing we need to do is place the pelvis on a horizontal plane if we want the pelvis to be neutral. Many wheelchairs are provided with a ‘dump’ with the seat plate angled upwards (which is often employed to make the occupant feel more secure and stable, on the one hand, and to bring the knees higher and the feet off the ground, on the other). This ‘dumping’ does not provide a horizontal base, and tips the pelvis back into a posterior tilt.

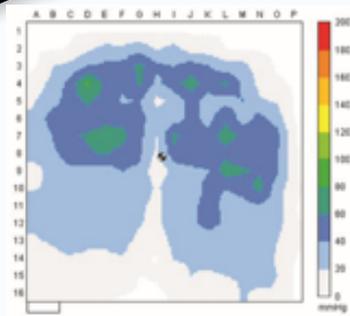
The solution is to have the seat plate horizontal, and therefore the pelvis neutral, but place a wedge under the cushion at the anterior part of the plate, thereby both elevating the knees, and also allowing pressure redistribution away from under the pelvis to below the thighs – to tissues more suited to carrying the pressures (Fig 3: 3). This wedge is best if placed inside the cushion cover.

Using a pressure mapping system is the ideal means to visualise where pressures are being most evenly redistributed away from the pelvis and under the thighs.

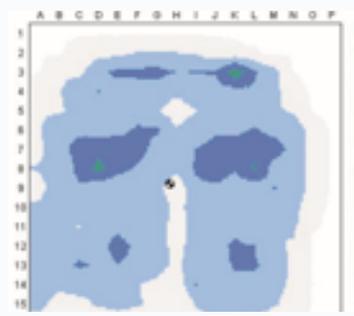
### Pre-ischial ridge

We now have the pelvic ‘ball’ on a flat surface. How do we keep it from rolling backwards or forwards? The answer is, first, to place a PSIS block behind the pelvis, to stop the pelvis from rolling backwards (Fig 3: 4). This can be achieved by the base of a solid back support, or with tension adjustable straps in a flexible back support. Next, to stop the pelvis from slipping forward, a small ridge anterior to the ischial tuberosities can be very effective (Fig 3: 2).

Try folding a tea towel three times and place across your dining room chair, half way back from the front edge, and see how much difference that makes in controlling your ability to slide your backside forward on the chair. that makes in controlling your ability to slide your backside forward on the chair.



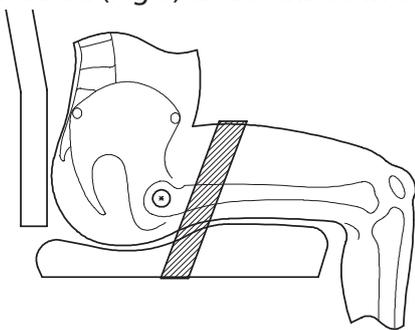
FSA pressure map without wedge



FSA pressure map with wedge

**Figure 4. The benefits of a wedge under the thighs for pressure redistribution**

A similar effect can be obtained by creating a buttocks recess in the cushion – the buttocks recess can also create greater immersion into the cushion, and therefore better pressure redistribution (Fig 3: 1). The critical element is that this depth should not be more than a maximum of 1 cm, otherwise you risk increasing pressures on the anterior side of the ischial tuberosities, and also you impair the user’s metastability i.e. their opportunities to change position in a self-controlled manner. At this point, if not enough control is being achieved, then a third point of control, a positioning belt should be applied. Remember: this should be mounted to the chair anterior to where the greater trochanter of the thigh bone is situated (Fig 5) as described in BS 86253.



**Figure 5 Positioning of a pelvic postural support anterior to the greater trochanter<sup>3</sup>**

**In conclusion**

There are many elements that should be taken into account when selecting what might be the most suitable cushion for an individual, and these go well beyond the immediate clinical needs of tissue integrity and the occupant’s

needs for functionality. This article provides a number of relevant solutions around stabilising and positioning the pelvis, under the posture and positioning heading. Other elements relating to posture and positioning are covered in Part 4 of this series.

1. ISO DIS 16840-13:2020 Wheelchair seating – Part 13: Determination of the lateral stability property of a seat cushion
2. From Figure 25 of ISO 16840-1:2006 Wheelchair seating — Part 1: Vocabulary, reference axis convention and measures for body segments, posture and postural support surfaces
3. BS 8625:2019 Selection, placement and fixation of flexible postural support devices in seating – Specification (NOTE: Advice on the use and application of this standard is available from BES Healthcare Ltd.)

**‘Let’s Get it Clear’ by Dr Barend ter Haar**

One in a series of occasional resumés of aspects in the world of posture and mobility where there are common misconceptions, and myths to be addressed, to help promote better practice. Further items can be found at [www.beshealthcare.net](http://www.beshealthcare.net). If you are interested in receiving further information on the topic, please contact [barend@beshealthcare.net](mailto:barend@beshealthcare.net).

Dr ter Haar has been involved in seating and mobility for over 30 years, including lecturing internationally, and developing international seating standards.