Let's Get It Clear No.53
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What makes a good cushion?

5. Pressure Care

This is the fifth article in the series which aims to start getting people thinking more about what 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. In the third and fourth articles we addressed the benefits of a neutral pelvis and stability for posture management, and contouring to optimise positioning. This article addresses the core issue of pressure management and distribution.

For the clinician, as well as for the client, tissue integrity around the buttocks may well come first when selecting the attributes of a cushion. This article covers strategies for getting forces away from the sharper bony parts of the pelvis, i.e. the ischial tuberosities (ITs) – what we might call 'pressure management'. Pressure is considered to be a 'bad' thing since it is accompanied by shear, and the two combined lead to cell damage and reduced blood flow. (Part 6 in the series covers other influences than pressure alone, on tissue integrity, such as shear forces and microclimate.) On the other hand, some pressure is a 'good' thing since without it we would not stay in our seats. It's just where the pressure is that's critical.

The ITs present quite rough and pointy bits of bone covered with relatively small amounts of flesh, and man was not really designed to sit on these – by sitting on these we are putting those thin tissues under high risk of damage from the pressures exerted on those tissues from the ITs. So what can we do about this?

Pressure is force over area (P=F/A). The force comes from the pull of gravity on our body mass, and the equal and opposite reaction from the surface we are sitting on. So – the wider the area that we can spread that force, the less the maximum pressure over that area. Even better is if we can find less vulnerable areas of the body to redirect those forces towards. We will be covering aspects of cushion design that can assist with this redirection, but first let us look at what we can do under the ITs through the choice of suitable materials.

Immersion and envelopment

If we want to increase the area of the cushion that is in contact with the skin, we need to immerse the buttocks further into the cushion. However, immersion on its own will not be enough (see Fig. 1)[1] – to get the cushion to interact with a larger area of the skin, the cushion materials need to allow the cushion to come into full contact with the skin, to envelop it. Only then will you have the larger surface area over which to dissipate the forces, and thereby reduce the pressure.

Figure 1. Immersion does not necessarily equate with envelopment

Pressure redistribution

Where and how can we unload pressures away from the ITs? Within the cushion, this can be under the trochanters, under the thighs, and/or under the gluteal muscles. Away from the cushion, the person's body mass can also be spread into the back support, arm supports, foot supports, and even head supports (a pressure mapping system is the ideal tool to check the optimal height of the foot supports to redistribute pressures evenly along the thighs).

Let's start with the greater trochanters, which are the bony protuberances at the top of our thigh bones, the femurs, roughly opposite where the hip joint is situated (Fig. 2). As the pelvis's ITs sinks into the cushion (if the cushion is thick enough), eventually the sides of the cushions will come into contact with the trochanters, thereby bringing extra areas into play for spreading the forces. Different densities of materials under the trochanters (firmer) as compared with the ITs (softer) may facilitate this process. For most of us, the amount of immersion needed will be 30-40 mm.

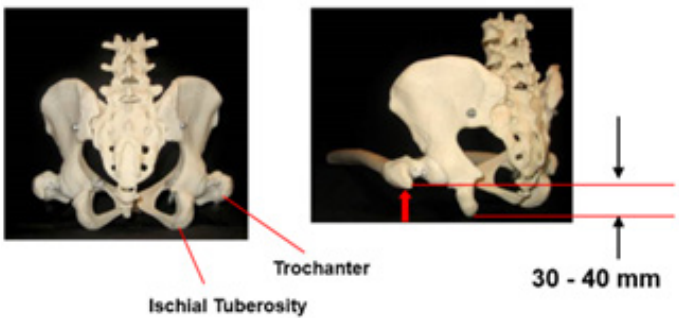


Figure 2. The anatomical relationship between the Ischial Tuberosities and the Trochanters

Note that too much redistribution of the forces towards the hip joint can damage the hip joint and lead to hip dysplasia, so don't leave the buttocks hanging off the trochanters over a large hole. You can have too much of a good thing!

To enable manufacturers to test the degree to which their cushions disperse the forces away from the ITs towards envelopment of the buttocks and offloading onto the trochanters, a wooden indenter device with implanted pressure sensors has been designed[2] (Fig. 3).

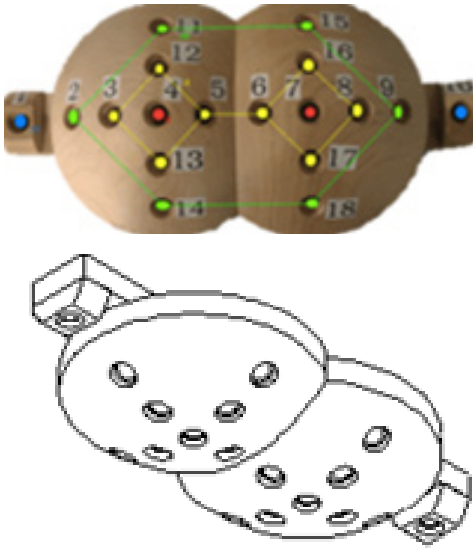
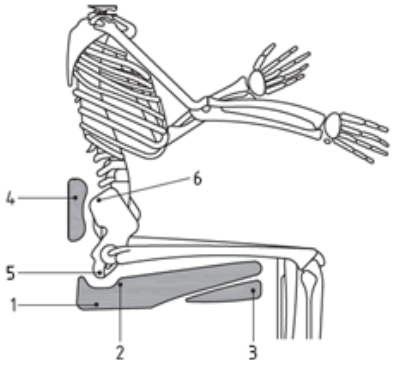


Figure 3. Indenter with implanted pressure sensors – red positions replicate the position for the ITs and the blue positions for the trochanters.

Thigh offloading

In part 3 of this series we looked at aspects of cushion design to aid in the positioning of the pelvis. In that article we introduced a means towards both encouraging a neutral pelvis while at the same time offloading the forces along the thighs:



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 4 Pressure redistribution under the thighs[3]

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 4: 3). This wedge is best if placed inside the cushion cover. Lowering the foot supports may achieve the same effect, but for most chairs this will result in the foot supports being too low for safe wheeling around.

Where else?

Many of us have more tissue than we feel we need around our buttocks. As we discussed in Part 4 of this series, if we can spread the support of the body more widely over this area, we are taking the forces into tissues well away from inadequately covered bony prominences. Using a pressure mapping system which shows gradients as well as pressures can also show clearly the potentially damaging forces around areas which are normally out of sight to the naked eye (Fig. 5).

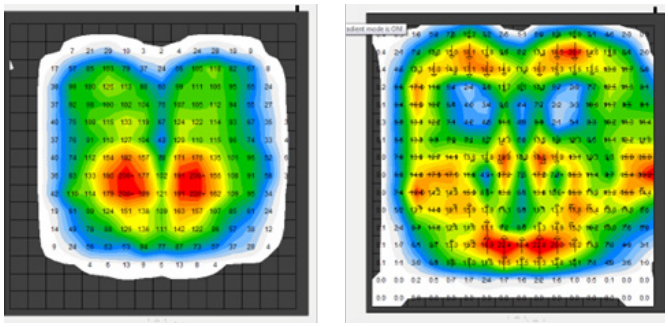
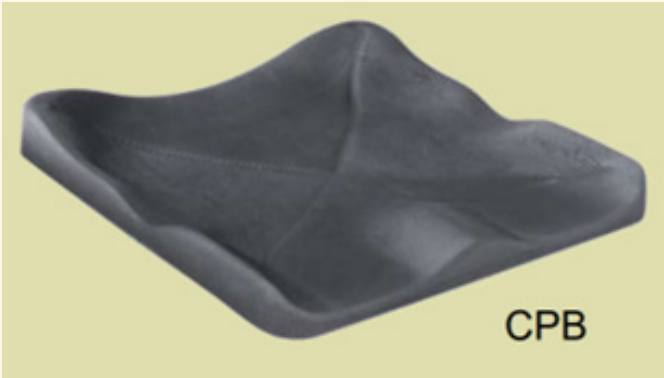


Figure 5. Pressure map showing left: pressures, with highest pressures under the ITs, and right: the gradients from the same map, showing greatest gradients are occurring around the sacral/coccyx area

Where the maximum pressures occur are not where the largest rates of change occur, and the greater the rate of pressure change, the greater likelihood of damaging shear strain – a topic we will come back to again on Part 6. To what extent does your cushion provide contouring around this area (one area of contouring that, incidentally, will not have an adverse effect on transfers)?

All ways round, there's a lot we can do to take the pressures off the bony prominences of the ITs, sacrum, and coccyx.



Adding peripheral support to a cushion

Adding, for example, a VariliteTM Contoured Positioning Wave Base (CPB) under a cushion, such as a RohoTM cushion, can provide additional offloading support

Cushion Pressure Management

Check/Score as per a cushion's ability to meet the user's needs

1. Immersion
2. Envelopment
3. Trochanteral off-loading
4. Thigh off-loading
5. Gluteal (posterior) support

1. *ISO 16840-13:2021 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/ISO 16840-15:2023 Selection, placement and fixation of flexible postural support devices in seating – Specification (NOTE: Advice on the use and application of these standards is available from BES Healthcare Ltd.)*

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