Pressure Redistribution

Selecting the appropriate Wheelchair Seat cushion is a task faced daily by clients who function from a seated position as well as by their supporting clinicians and ATPs/suppliers. Pressure Injuries are a global matter. In the US for example, the number of persons affected by Pressure Injuries in Hospitals is approximately 2.5 million per year. Pressure injuries cost $9.1–$11.6 billion per year in the US and the cost of individual patient care ranges from $20,900 to 151,700 per pressure injury. Medicare estimated in 2007 that each pressure injury added $43,180 in costs to a hospital stay. There are more than 17,000 lawsuits related to pressure injuries annually in the US. It is the second most common claim after wrongful death and greater than falls or emotional stress. Alongside the financial cost there are many personal challenges/costs for the client who is experiencing the pressure injury. Pressure injuries are often associated with severe pain for those who have sensation and approximately 60,000 patients/clients die as a direct result of a pressure injury each year.

There are many important features to be considered when selecting an optimal wheelchair seat cushion for a client who functions from a seated position. This article will focus on Pressure Redistribution.

In the world of seating support surfaces the term “Pressure redistribution” refers to the ability of a support surface to distribute load over the contact area of the human body (NPUAP 2007)

The goal of pressure redistribution in this context is to reduce potentially damaging peak pressures in areas of the body that are sensitive to load while functioning from a sitting posture (The ischial tuberosities, sacrum and coccyx for example).

Pressure redistribution is often achieved through immersion and envelopment. Immersion can be described as the ability of a seat support/cushion to provide “depth of penetration (sinking) into that support surface. Without adequate depth, cushioning cannot occur. However, immersion by itself is not adequate for optimal pressure redistribution.

This graphic represents the concept of Immersion

Immersion is a measure of potential cushioning effect. The depth of immersion is a predictor of total contact area over which the body’s mass can be distributed. In this
photo below, the contours predispose to immersion potential of approximately 3.5 cm

Contoured cushions have been shown to provide better force distribution on the skin of volunteers. Low to moderate variability in human skeletons allow this principle to be applied generally to cushions.

When thinking about pelvic dimensions, the distance between the ischial tuberosities (ITs) in a female pelvis measures a little wider (at approximately 5-6.5") than in a male pelvis (4-4.5") for example. The distance from the lowest point of the ischials to the undersurface of the trochanters (approximately 1.75-2.5") is often used to determine how much immersion the ischials and surrounding muscle and/or soft tissue need in order for the ischials to be protected. Pelvic structures don't vary as much from person to person as overall buttock mass can vary. Cushions with generic contours will often utilize this information in their design criteria.

In summary, Immersion can be described as the depth an individual ‘sinks’ into a support surface in this case – a seat cushion. Immersion has the potential to help peak pressures beneath the bony prominence to be spread over a greater area. The quality of immersion depends on

a) The force-deformation characteristics of the cushion,
b) The cushion thickness and
c) The design and flexibility of the cover

As a clinician how might we determine the immersion potential of a specific cushion?
We can do a visual inspection and palpation of how much the pelvis, thighs and trochanters are immersed into the seat support.
If we have Interface pressure mapping (IPM) available, we could take a look at surface contact area. Generally we are aiming at maximizing the surface contact.

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area. When redistribution of pressure/load is the goal we should make sure IPM reflects sites where less load can be tolerated (e.g. ITs) and make sure redirection to other areas is safe and not to other at-risk sites.
This image is showing the results of contact area on two different cushions with the same client. There is greater immersion shown here in terms of contact area on the image to the right.

**Envelopment:**
Envelopment can be described as the ability of a seat support in this instance to conform to the complex shape of the body that is placed upon it. Envelopment increases the effective load distribution by redistributing it to the hard to reach areas. High envelopment is the opposite of “hammocking”. Envelopment is affected by the surface tension in both the cover and underlying materials.
How do we know clinically about Envelopment on a specific cushion?
We can consider the intimacy of the shape formed in the cushion with the clients shape.
From a clinician’s standpoint, what tools have we to determine this? Sometimes this is a more difficult concept to feel or see with our hands and eyes. We can ask for client feedback when this is possible. Clients with sensation can often describe this as a feeling of total contact all over their buttock and posterior thigh area. Again, if we have interface pressure mapping available to us, we can take a look at color distribution and gradient as demonstrated below in this picture.

What does research tell us?
We know that internal deformation causes deep tissue damage. With this in mind, earlier/better management of deformation is key; not just for skin, but also muscle and fat. High immersion and envelopment is effective at reducing internal stresses.
and strains as it distributes pressure across the greatest surface area and accommodates to body shape to reduce cell deformation

Some parting thoughts:
Immersion & Envelopment reduce pressure gradients in the skin and underlying tissue in order to reduce the risk of pressure injury development.
Cover hammocking can significantly reduce immersion & envelopment… As can the pressure mapping mat…
Think carefully about the cushion cover s well as about the IPM mat… Could it be negatively impacting immersion and envelopment?

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Reading resources

Gefen A. Tissue Changes in Patients Following SCI and Implications for Wheelchair Cushions and Tissue Loading: A Literature Review. Ostomy Wound Management. Feb:34-45