Considerations for using GlideWear™ Seating Interface Technology (SIT)

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I. Background Science

The challenge presented to clinicians and wheelchair users to prevent pressure ulcers is significant and ongoing. There are several factors and variables related to pressure ulcer generation, and these are well documented by the National Pressure Ulcer Advisory Panel (NPUAP)[1] and many other sources[2, 3]. Some factors can be controlled, some are lifestyle choices, and some are not controllable (sensation loss for example).

The primary extrinsic factors that a wheelchair support surface may be able to affect or influence include: pressure, friction, shear, and microclimate. GlideWear influences the friction and shear factors (without interfering with pressure or microclimate factors). Friction forces give rise to shear distortion and damage within skin and other soft tissue.

- Pressure is the factor most commonly understood and wheelchair support surfaces attempt to address the pressure factor by redistributing it away from vulnerable bony prominences and to distribute load over the contact areas of the human body[1]. Pressure causes tissue compression, especially where there are bony prominences near the surface of the skin, reducing/restricting tissue perfusion (ischemia). There are multitudes of support surface categories and designs/materials (air, foam, viscous liquid, etc., etc.,) available for consideration for any patient[1, 2, 3].

- Friction is the *force* resisting motion between two material surfaces in forceful contact. Friction force causes a shearing distortion within the skin and soft tissue. It is common to only associate friction with the action of one object rubbing/sliding against another such as sliding down on a seat support surface or being dragged across bed sheets. This results in abrasion damage to the skin surface layers. Friction forces exist both prior to and during sliding[1, 2, 3].

- The term "Shear" is closely connected to friction and that often causes confusion. Shear is less intuitive and more confusing since the term is used in many ways, such as abbreviations of "shear stress" and "shear force", and as a verb "shear"/ "shearing"[2]. Shear stress causes the tissues to deform (the *amount* of deformation is quantified as shear strain, and the ease with which the skin may be (*mobility)* distorted is the shear modulus) [3].

  When a tangential force is applied (in seating and on beds, this usually is caused by gravity), friction is the *force* which resists sliding of the skin/clothing on the support surface and causes shear stress to build within the tissue up to a maximum magnitude before sliding occurs – this limit is the "limiting friction load" (LFL)[3] at the "threshold of motion"[4]. The LFL can be calculated; it is the product of the perpendicular load – pressure- and the coefficient of friction (CoF) of the materials in contact[3, 4]. Motion will not occur if the LFL is not reached (static friction condition). Sliding/motion will begin if/when the tangential force overcomes the LFL - objects sliding on each other describes a dynamic condition (kinetic friction) e.g.; sliding down in a wheelchair or being dragged across bed sheets.

It is less obvious to think that damaging forces could be present when sliding is not occurring or has come to a stop. The same phenomenon (friction) that is resisting motion/sliding in the dynamic condition is present under static conditions in a chair or bed (with raised headrest). As noted earlier, friction forces reach a maximum just before sliding begins to occur[3, 4]. Those static friction forces usually then remain near maximum when the sliding ("settling" in the bed or chair) stops. Friction loading occurs always between skin and the unmoving support surface depending on the coefficient of friction of the contact surfaces. Doing something to lower the friction properties will free the body/skin to slide at a lower LFL, preventing the skin from being subjected to higher, damaging friction force levels.

- Microclimate, when used in relation to pressure ulcers refers to two factors; tissue or skin surface temperature and the moisture conditions at the body and support surface interface[2]. There are currently few support surfaces capable of microclimate control/influence at the contact surface/ interface area.
    - Temperature affects the metabolism on a cellular level. It is known that a 1°C increase will raise metabolic activity by 10% - this creates a greater demand for perfusion to meet the needs of the cells in a local "at risk" area (such as beneath the ischial tuberosities)[1, 2, 3]. Increased temperature also affects the stratus corneum –at 35°C the mechanical strength of the stratum corneum is 25% of that at 30°C[2]. Hypothermia is not likely on a wheelchair support surface, but it is known that preventing hypothermia in the surgical theater reduces the incidence of pressure ulcers[2].
    - Moisture, when excessive, reduces the strength/toughness of the skin. It also increases the coefficient of friction (CoF) of the materials in the area (skin, textiles, etc.)[1, 2, 3]. The "International Review of Pressure Ulcer Prevention; pressure, shear, friction and microclimate in context" reported that the strength of the stratum corneum at a relative humidity of 100% is 25 times weaker than at 50% relative humidity[2].

References:

1 National Pressure Ulcer Advisory Panel (NPUAP) - http://www.npuap.org/resources.htm http://npuap.org/NPUAP_S3I_TD.pdf

2 International Review. Pressure ulcer prevention: pressure, shear, friction and microclimate in context -a consensus document. London: Wounds International, 2010 http://www.eswell.eu/files/PressureUlcerPrevention.pdf

3 Seating Orthosis Design for Prevention of Decubitus Ulcers J. Martin Carlson, MS, CPO, Mark J. Payette, Lisa P Vervena, MS http://www.oandp.org/jpo/library/1995_02_051.asp

4 Friction Concepts HyperPhysics © Carl R. (Rod) Nave Department of Physics and Astronomy Georgia State University Atlanta, Georgia 30302-4106 http://hyperphysics.phy-astr.gsu.edu/hbase/hframe.html

II. GlideWear™ Seating Interface Technology (SIT) and How it Works

GlideWear is a Patent Pending wheelchair support surface interface technology designed to address friction/shear forces on the skin and soft tissue in the bony at-risk areas of a seated individual.

GlideWear controls the magnitude of the always present friction on weight bearing surfaces by strategically reducing the friction coefficient in the areas most susceptible to skin break down, areas such as the ischial tuberosities, the greater trochanters, and the coccyx. However, it allows "normal", unreduced friction to occur in the surrounding soft tissue areas of pelvis and posterior thighs. This strategic approach, applying a low friction coefficient only where required, protects high risk sites without sacrificing sitting stability and postural alignment. This enhancement increases the "margin of safety" for the sitter, and enhances seating comfort when sensation is present. The GlideWear interface may be placed directly over a standard wheelchair support surface cover.

Indications for use:

- Any wheelchair user at risk of developing skin integrity problems (users with impaired sensation)
    - People with paraplegic level motor and sensory involvement (various diagnoses) - encounter static and dynamic friction and shear stress related problems at the interface of the wheelchair seat support surface because of functional activities
    - People with quadriplegic level motor and sensory involvement (various diagnoses) – encounter predominantly static friction and shear stress related problems at the interface of the wheelchair seat support surface (assuming the person is well seated)
- Any wheelchair user reporting comfort problems on their bottoms from sitting (e.g.; ALS, MS, MD, CP, Geriatric, etc.)

Contra-indications for use:

- A wheelchair user who does not remain positioned in the chair (experiences the problems associated with excessive "sliding down" on the seat support surface)

III. Clinical Considerations and Sizing

Positioning and alignment is a variable which should be optimized as much as the situation will allow. The goal should be to have a seating system which cradles the seated person to reduce the "tendency to slide". This tendency is at its worst when the back is reclined, the hips are extended and the thighs are inclined downward. In these situations shear forces will be placed on the skin as the person settles down and into the support surface even when they are not continuing movement forwards and down in the seat.

GlideWear is not designed to assist transfers.

GlideWear, currently available in three sizes, can be used with most standard wheelchair seat support surfaces between 14"X14" and 20"X20", including rectangular dimensions (up to 2" difference between length and width). The fabric is very flexible and conforms well to a wide variety of dimension combinations.

- Small fits wheelchair seat support surfaces having dimensions 14" X 14" to 16" X 16"
- Medium fits 16"X16" to 18"X18"
- Large fits 18"X18" to 20"X20"

IV. Trial procedure:

1. Sitting positioning/alignment issues should already be solved (avoid "tendency to slide" position)
2. Test fit GlideWear SIT device on the wheelchair seat support surface
    - Pull GlideWear SIT over entire support surface device (leave the stock cover in place) making sure the low friction diagram is properly located in the sub-pelvic area
    - The bottom panel should surround the seat support surface base for retention
    - Press and rub on thigh area to confirm that it is not slippery - the only "slippery" area should be the "GlideWear" area in the sub-pelvic area.
    - The GlideWear fabric surface should be smooth but not too loose as retention problems may occur
    - The "stretchy" GlideWear material should allow the body to immerse into the support surface (GlideWear SIT should not fit so tight over the support surface that it causes the "trampoline" effect)
    - The next size up or down may be used to find the optimal fit on the support surface
3. Support Surface device placement in wheelchair
    - The support surface should be retained into the wheelchair in the usual way (commonly this is by use of an anti-skid material or with hook and loop strips on the bottom panel of the stock support surface cover).
    - Follow GlideWear instructions if hook/loop tape needs to be exposed (cut away circles of fabric from the bottom panel to expose hook/loop tape). Assure support surface retention in the wheelchair by testing.
4. Trial sitting (short term)
    - Settling always occurs as a person comes to a rest following a transfer or "push-up". Having a sense of some pelvic motion during the settling is not automatically bad – it will be the first time most people realize how much "pull" friction had on their seat area.
    - Individuals needing assistance with transferring and pelvic positioning will find the "pelvic leveling" process to be much easier for the attendant to do.
    - Evaluate / monitor to make sure the sitter does not slide excessively forward on the seat support surface. **GlideWear is contraindicated if the sitter slides downwards on the seat surface.** This will illuminate the fact that significant and hazardous levels of friction/shear forces are present in the current positioning situation, and should trigger discussion/improvements regarding positioning improvements to reduce the "tendency to slide" alignment.
    - Evaluate / monitor for overall stability. **GlideWear is contraindicated if negative stability occurs.** Other ways to improve stability may be considered for the same reasoning as the previous point.