SATECH

A new generation of cushioning technology

Highlights of Simon Fraser University Study of SmartCells Cushioned Flooring
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SATECH Summary:

Among the 4 cushioning systems, compared to a rigid floor, SmartCells ranked highest in

- Force attenuation to the femoral neck per 1" of thickness -- 25%
- Balance preservation
- Practicality

SIMON FRASER UNIVERSITY

DESIGN OF LOW STIFFNESS FLOORS FOR PREVENTING HIP FRACTURES IN HIGH RISK ENVIRONMENTS:
COMPARISON OF FORCE ATTENUATION AND INFLUENCE ON BALANCE

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Selected excerpts from the study, SATECH comments added:

Introduction:
The prevention of hip fractures in the elderly is a public health priority. 90% of fractures are due to falls, and low stiffness flooring may be an effective means for preventing fractures in high-risk environments. However, this would only be true if such floors can attenuate impact force sufficiently, *without impairing balance so much that falls would be more likely.* Previous studies have shown that padded carpeting can attenuate peak impact forces by 15%, without causing a measurable impairment in balance (Gardner et al., 1998, Maki and Fernie 1990, Dickinson et al. 2002).

In the current study, we extended this line of enquiry to examine the effect of a wider range of floor stiffness on (a) peak impact force during a simulated sideways fall on the hip, and (b) measures in healthy elderly women of postural stability during daily activities.

Method:
We used a hip impact simulator, consisting of an impact pendulum and surrogate pelvis (Laing et al., 2006), to measure the attenuation in peak force applied to the femoral neck provided by each floor, for impact velocities of 2, 3, and 4 m/s (simulating falls of low, medium, and high severity, respectively). We also acquired measures of balance from fifteen healthy elderly women (mean age = 75.0 (8.1) yrs) on each floor. These included Get Up and Go (GUG) test time (Podsiadlo and Richardson, 1990), postural sway during quiet stance (quantified by range and velocity of the centre-of-pressure in the anterior/posterior direction), and success in recovering balance in five repeated backwards floor translations. We also used a questionnaire to acquire participant ratings of balance confidence and practicality for each floor.

Results:
When compared to the rigid floor, SmartCells:

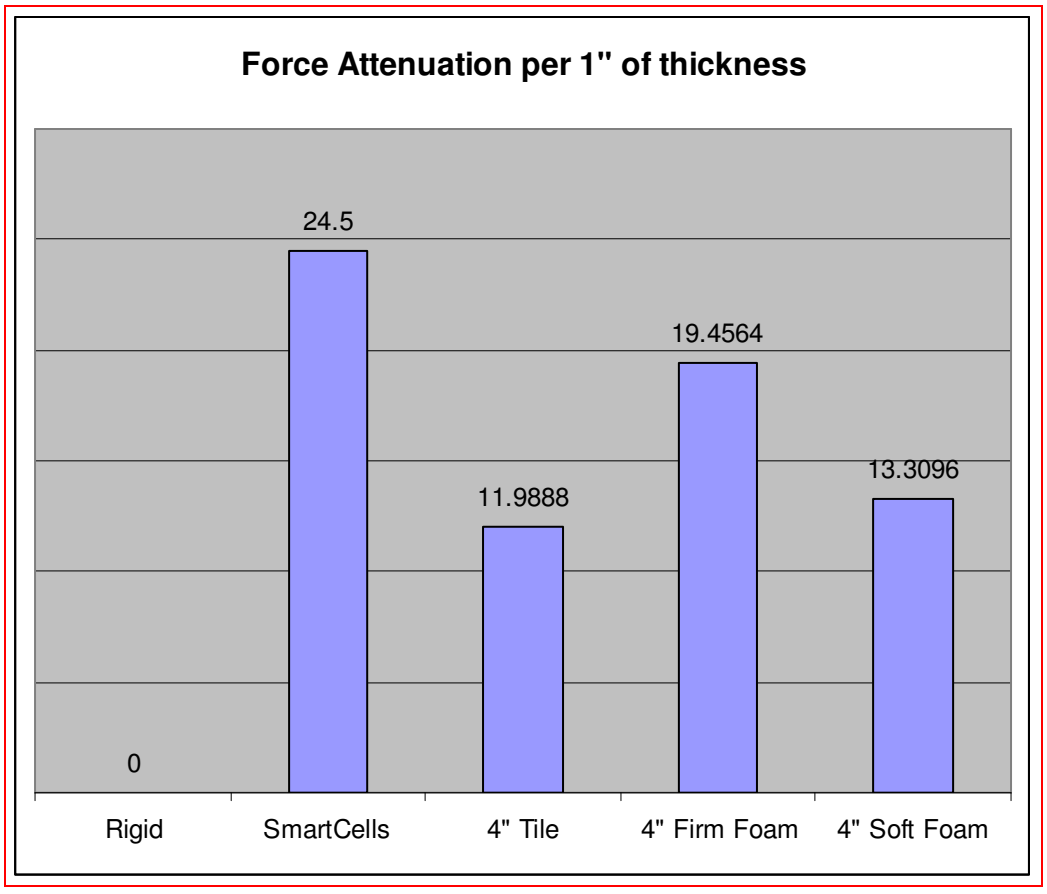
1. caused no impairments in ability to recover balance and GUG time, and were
2. ranked as high for balance confidence and practicality.
3. The force attenuation provided [by SmartCells] was significantly larger than the 4–15% observed for carpet (Gardner et al., 1998, Maki and Fernie, 1990), and the 12-24% observed for wearable hip protectors tested on our hip impact simulator (Laing et al., 2006).
4. In addition to attenuating force more effectively than hip protectors, low stiffness floors, [like SmartCells]are not dependent on user compliance, and likely reduce the risk of fall related upper extremity fractures and head injuries, in addition to hip fracture.
5. [SmartCells] reduce the force applied to the hip during simulated sideways falls, and are unlikely to increase fall risk compared to typical rigid floors. Furthermore, these floors were rated as practical by a sample of elderly women.

Data:

	Rigid Floor	Approx **1" SmartCells**	Approx 4" Tile	Approx 4" Firm Foam	Approx 4" Soft Foam
Force attenuation %	0	25.4	47.2	76.6	52.4
GUG [balance test] time (seconds)	11.7	11.4	12.2	14	14
[balance] Recovery success	.79	.89	.79	.45	.67
Sway range (mm)	15.1	18.7	20.3	33.3	23.4
Sway velocity (mm/second)	8.0	9.1	9.3	20.3	12.8
Balance confidence	9.5	9.6	9.3	5.4	5.5
Practicality	9.1	8.5	8.2	2.6	1.9

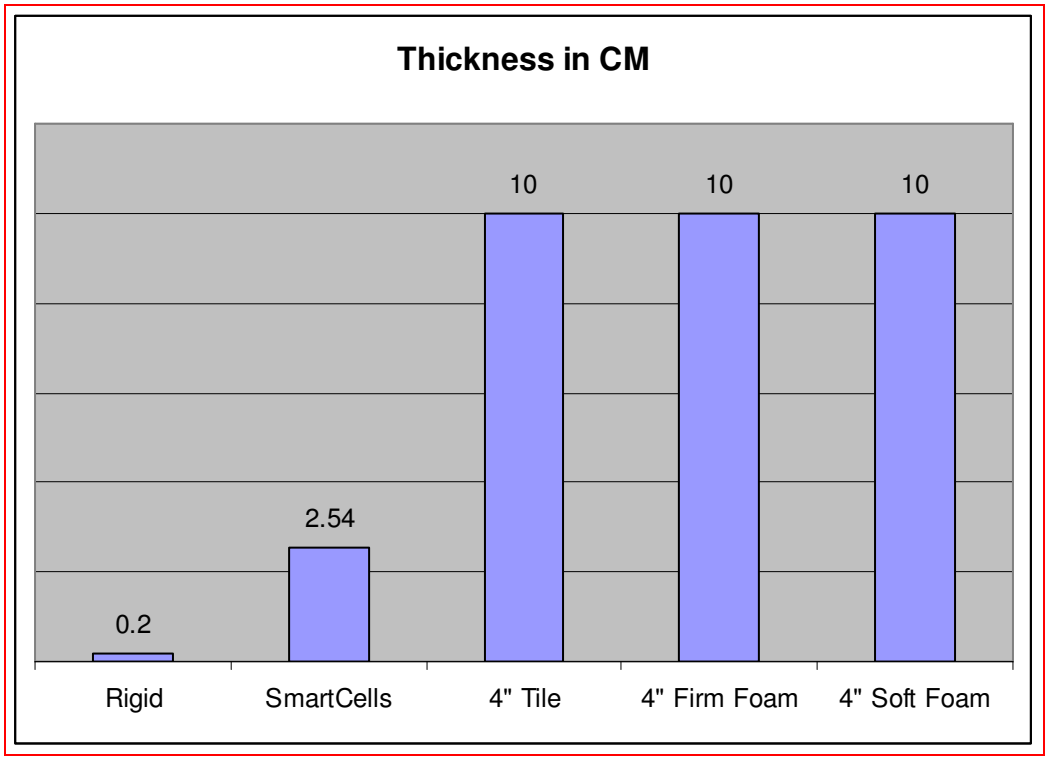
1. Force Attenuation Comments

Based on the reported results, SmartCells out performed all of the other cushioned surfaces in ALL categories except one: force attenuation. We suggest a closer look at these results because of the thickness difference between SmartCells and the other samples. One expects force reduction to be less for SmartCells because it is 1/4th the thickness of all the other cushioning surfaces tested. A better comparison on this point is to normalize all force reduction results to force per 1" of cushion thickness. Divide the other force attenuating results by 4 and then compare them to SmartCells. On this basis, SmartCells provides far greater force reduction per 1" of cushioning thickness.



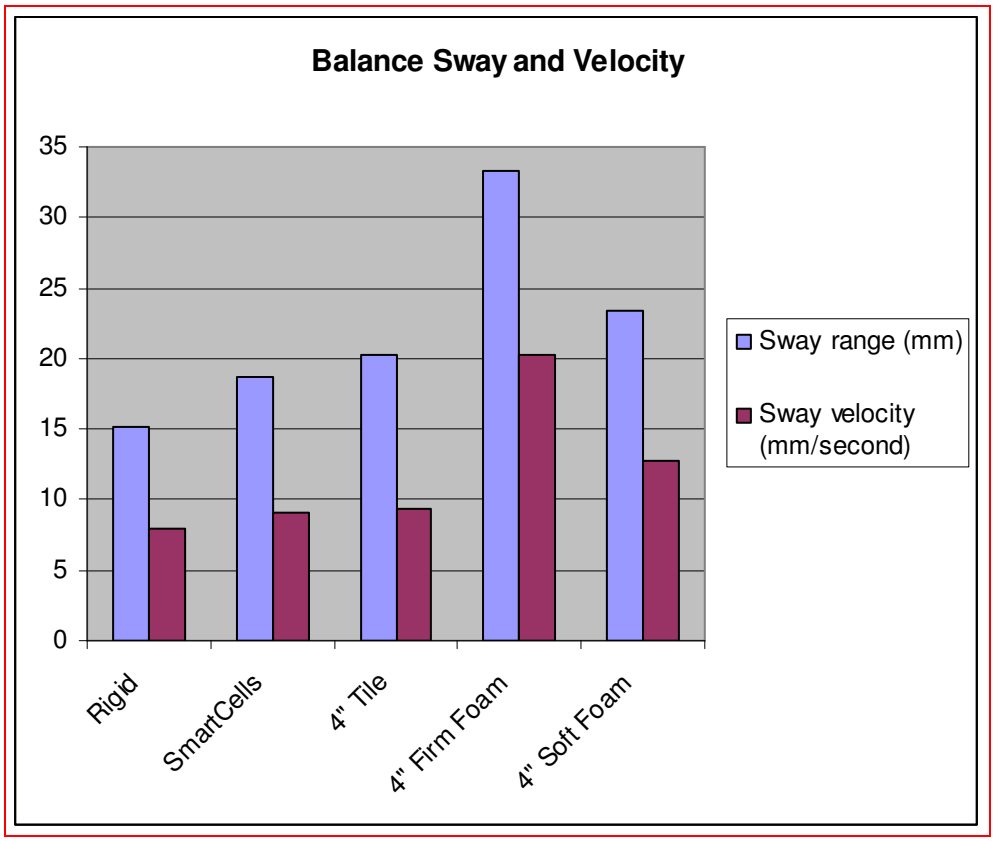
2. Thickness Comments

Other than the non-cushioning rigid floor, all other surfaces tested were over four times thicker than SmartCells, creating a much higher likelihood of tripping and transition issues, and impairing rolling loads and transfer / care processes. Thicker mats need to be moved when caring for a patient.



2. Balance sway / velocity range Comments

While all floors affected postural sway during quiet stance, the effect was most dramatic for Firm Foam, which caused more than a doubling in sway range and velocity. SmartCells is statistically indistinguishable from a standard rigid floor.



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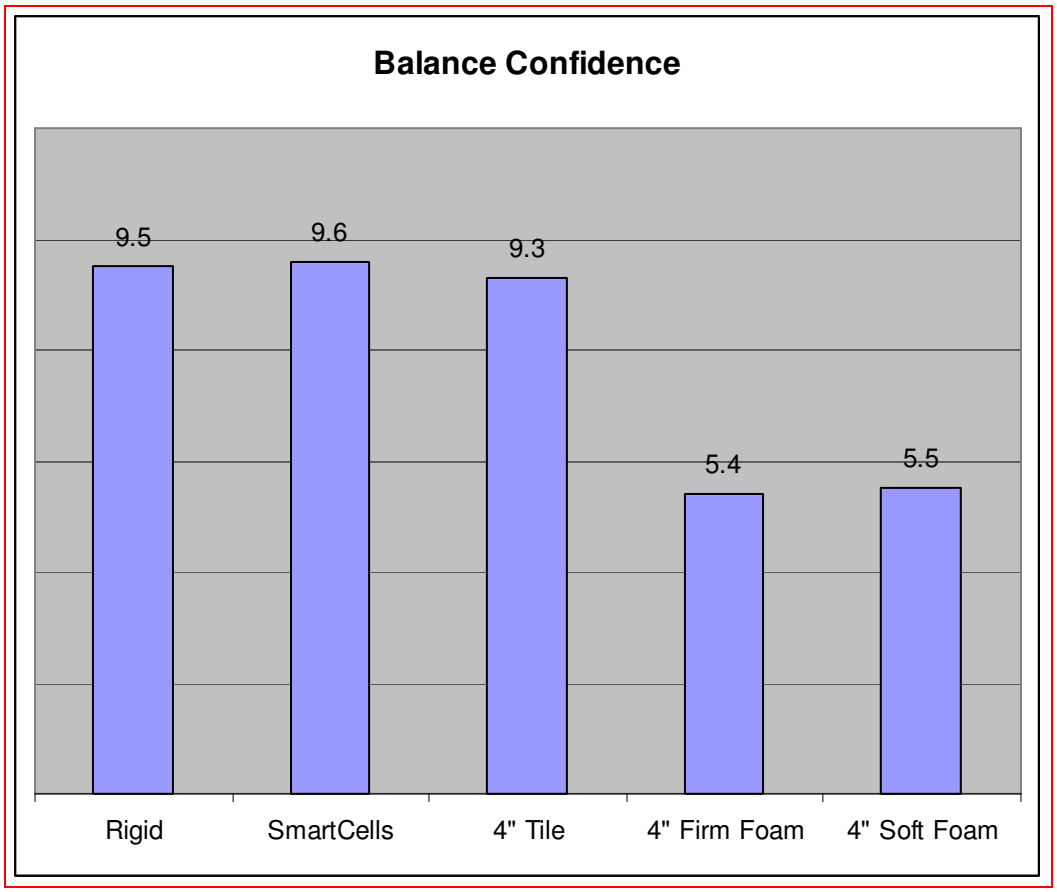
3. Balance Confidence Comments

SmartCells is slightly favored as a surface that engenders confidence while standing, and is statistically indistinguishable from a standard rigid floor.



4. Practicality

Practicality refers to the ease with which the test subjects believe the products can be utilized in their settings. In terms of practicality for a facility hoping to reduce fall injuries while at the same time providing care in a practical manner, some serious issues arise:

- Infection control -- Of what are these surfaces made? How cleanable are they? How are the joints sealed? The 4" Tile appears to be very rugged and would present some interesting challenges for infection control on both the surface and the seams.
- Trip Hazards -- Because of their height, the other surfaces are likely to create tripping and transition issues, and potentially impair rolling loads and interfere with transfer / care processes. Thicker mats need to be moved when caring for a patient.