Pilot Study to Assess Mobility Safety on a Dual-Stiffness Floor

Frank D. Knoefel, BSc, MD, CCFP (CoE), MPA, Margaret Mousseau, BSc (PT), MCPA, Marjorie Berry, BSc (PT), RPT

ABSTRACT

Background

Falls and injury are significant issues for older adults, the aging society, and the health care system. SATECH Inc. has produced a SmartCells, dual-stiffness flooring product, which has been shown anecdotally to reduce morbidity related to falls in older adults. The purpose of this pilot project was to verify the safety of the product in a frail older adult population.

Methods

Ten independently mobile geriatric rehabilitation patients were selected for comparison: using the Berg Balance Scale and Timed Up and Go (TUG) tests on both experimental and conventional floors. They also answered a short questionnaire.

Results

Nine patients, 77.3 ± 7.1 years old, all using mobility aids, participated. There were no statistical differences between their TUG and Berg Balance scores. In answer to subjective questions, including perceptions of safety and comfort, clients preferred the experimental floor.

Conclusions

Although this dual-stiffness floor was designed to reduce work-related injuries, it could show promise in reducing morbidity associated with falls in older adults. This pilot study showed that its use in frail older adults did not impact mobility or balance in short-term usage. Further studies are required to verify its long-term impact in older adults' home environments.

Key words: falls, flooring, older adults, safety

Falls and injury are significant issues for older adults, the aging society, and the health care system.[1–4] To date, interventions to reduce falls and the morbidity associated with falls have focused on intrinsic factors (diet, medication, exercise) and extrinsic factors (hip protectors, home environment modifications) involving the older adult. However, compliance in redressing these factors remains an issue.

It has been shown that the type of flooring and underpadding used can have an impact on the outcome of falls in older adults.[5–8] Using a mechanical hip model, dual-stiffness design flooring has been predicted to reduce the risk of fracture.[9,10] SATECH Inc. has developed a dual-stiffness floor to reduce fatigue in employees who spend significant amounts of time standing during their work.[11] Anecdotal evidence has suggested that the mat format of their SmartCells floor reduces morbidity associated with falls in nursing homes (Bryce Betteridge, personal communication).

Given this, we decided to investigate a full dual-stiffness flooring option that would have high acceptance with clients and the potential to reduce morbidity due to falls. Before beginning a large prospective project to study the utility of a dual-stiffness floor, we felt that a pilot was required to study the impact of such a floor on a frail older person's mobility.

Methods

The study was approved by the SCO Health Service Research Ethics Board.

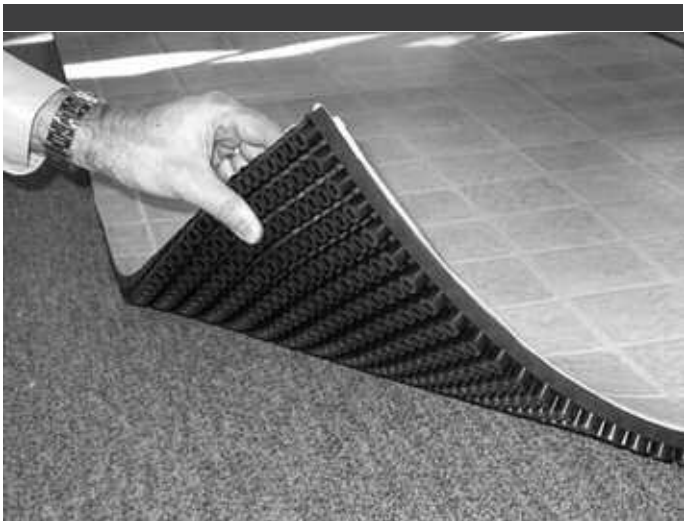
Because a frail, mobility-challenged older adult population was the target group, we decided that 10 inpatient geriatric rehabilitation patients would be identified to take part in the study. The other inclusion criteria were having a Functional Independence Measure score (FIM) of ≥5 for transfer from

Frank D. Knoefel, BSc, MD, CCFP (CoE), MPA, Margaret Mousseau, BSc (PT), MCPA, and *Marjorie Berry, BSc (PT), RPT,* are with SCO Health Service, Ottawa, Ontario. *Frank D. Knoefel, BSc, MD, CCFP (CoE), MPA,* is also with the Department of Family Medicine, University of Ottawa, the Department of Systems and Computer Engineering, Carleton University, and the Elisabeth Bruyère Research Institute in Ottawa, Ontario.
Address for correspondence: fknoefel@scohs.on.ca
Conflict of interest: None declared

chair and walking, and the ability to understand English or French in order to provide a valid consent.

The location of the study was an indoor garden (solarium), which had plenty of natural light and a conventional floor of poured concrete with ceramic tiles. The SmartCells floor used was 2.5 cm rubber (60 Durometer Core A) covered with a vinyl faux tile (Figure 1).

Figure 1. SmartCells Floor



The objective outcomes chosen to assess balance were the "standing unsupported" and "standing with eyes closed" items of the Berg Balance Scale.[12] To assess mobility, the Timed Up and Go (TUG) test was used.[13] Two physiotherapists who have extensive experience using these tests scored each patient independently. After a trial to ensure the subjects understood the requirements of the TUG, each was asked to perform these balance and mobility tests once on each floor. Coin toss assigned each subject to begin either with the experimental floor or the conventional floor. Student *t*-tests were used to compare the mean TUG scores for each group.

A short questionnaire was created to ask the patients about their impressions comparing their mobility and safety on the conventional floor and the dual-stiffness floor. It included five "yes-no" questions asked for each type of flooring, and five questions asking them to choose which flooring they preferred. The questionnaire is available upon request.

Results

The day of the pilot study, one patient withdrew from the testing because of fatigue. Thus, there were nine participants, five female, with an average age of 77.3 (± 7.1) years. Their reasons for requiring geriatric rehabilitation were three lower limb fractures, three lower limb joint replacements, one upper limb fracture, and two cases of "deconditioning" following prolonged illness. Mobility aids used by the group were four four-wheel walkers, four two-wheel walkers, and one cane.

There was no statistical difference between the TUG scores for the subjects on the two floors, and their Berg Balance scores were identical (Table 1). Subjectively, the physiotherapists noted a slight increase in sway for patients on the experimental floor compared with the conventional floor. In response to all subjective questions, including perceptions of safety and comfort, clients preferred the experimental floor (Tables 2 and 3).

Table 1. Objective Results

	Experimental	Conventional
Average TUG (s)	34.38*	33.85*
TUG SD	11.1	13.7
TUG range	23.20–60.48	18.06–63.23
Berg stand unsupported (points)†	4.0	4.0
Berg stand eyes closed (points)†	3.9	3.9

*p = .73.
†Berg 4 = stands 2 min unsupported; 3 = stands 2 min supervised.
†Berg 4 = stands safely 10 s; 3 = stands 10 s with supervision.

Table 2. Subject Impressions

	Experimental (n = 9)	Conventional (n = 8)
Difficulty getting up (# yes)	0	0
Safe walking (# yes)	9	7
Safe turning (# yes)	9	8
Safe standing (# yes)	9	8
Floor like home (# yes)	5	1

Table 3. Subject Comparisons

Characteristic	Experimental	Conventional	Both/ Neither
Comfort (preference)	7	0	2
Slipperiness (subjective perception)	0	2	7
Steadiness (subjective perception)	6	0	3
Ankle support (subjective perception)	0	0	9
Safety (subjective perception)	3	0	6

Discussion

This pilot study set out to verify that dual-stiffness floors do not place frail older adults at increased risk of falling. In this sample, it was found that there was no significant difference between frail older adults standing and walking on the dual-stiffness floor compared with the conventional floor. Although the therapists felt that there was slightly more sway on the engineered floor, they agreed that this had not negatively impacted patient safety during this pilot.

The nature of a pilot study does not allow conclusions to be drawn. Because the sample was small and the population was limited in diagnoses, caution should be exercised before accepting these results. Similarly, the simple motor activity in this study, TUG, insufficiently replicates normal activities of daily living, which typically include multiple physical and cognitive activities simultaneously. A prospective study, involving a much larger sample size, using dual-stiffness flooring over time and during different activities, will be required to confirm the results.

However, because there appeared to be no objective impact on mobility or balance and subjects overwhelmingly preferred the engineered floor, coupled with the potential benefits to frail older adults, this group feels that further prospective testing of this type of dual-stiffness flooring is warranted.

Acknowledgements

The authors would like to thank SATECH Inc. for providing the flooring used in this study at no cost. Furthermore, the help of Bryce Betteridge in installing the floor is gratefully recognized. Dr. Victor Emerson's help was instrumental in designing the data collection tool. Without the patients and staff of the geriatric rehabilitation program at SCO Health Service, this project would not have been possible.

References

1. Luukinen H, Koski K, Honkanan R, et al. Incidence of injury-causing falls among older adults by place of residence: a population-based study. J Am Geriatr Soc 1995;43:871–6.
2. Berg WP, Allesio HM, Mills EM, et al. Circumstances and consequences of falls in independent community-dwelling older adults. Age Ageing 1997;26:261–8.
3. Sterling DA, O'Connor AJ, Bonadies J. Geriatric falls: injury severity is high and disproportionate to mechanism. J Trauma 2001;50:116–9.
4. Lehtola S, Koistinen P, Luukinen H. Falls and injurious falls late in home-dwelling life. Arch Gerontol Geriatr 2006;42:217–24.
5. Healey F. Does flooring type affect risk of injury in older in-patients? Nurs Times 1994;90(27):40–1.
6. Minns J, Nabhani F, Bamford JS. Can flooring and underlay materials reduce hip fractures in older people? Nurs Older People 2004;16(5):16–20.
7. Simpson AH, Lamb S, Roberts PJ. Does the type of flooring affect the risk of hip fracture? Age Ageing 2004;33:242–6.
8. Yarme J. Flooring and safety. Nurs Homes LTC Manag 2001;50:82–3.
9. Casalena JA, Ovaert TC, Cavanagh PR, et al. The Penn State safety floor: part I—design parameters associated with walking deflections. J Biomech Eng 1998;120:518–26.
10. Casalena JA, Badre-Alam A, Ovaert TC, et al. The Penn State safety floor: part II—reduction of fall-related peak impact forces on the femur. J Biomech Eng 1998;120:527–32.
11. SATECH. Homepage. http://www.smartcellsmat.com/. Accessed April 3, 2008.
12. Berg K, Wood-Dauphinée S, Williams JI, et al. Measuring balance in the elderly: preliminary development of an instrument. Physiother Can 1989;41:304–11.
13. Podsiadlo D, Richardson S. The timed "up & go": a test of basic functional mobility for frail elderly persons. J Am Geriatr Soc 1991;39:142–8.