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Original Study

Low-Impact Flooring: Does It Reduce Fall-Related Injuries?

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A B S T R A C T

Objectives: To compare fall rates and injuries from falls on low-impact flooring (LIF) compared with a standard vinyl flooring.
Design: Prospective, observational, nonrandomized controlled study.
Setting: Subacute Older Persons Health ward (N = 20 beds).
Participants: Older inpatients.
Intervention: Three different types of LIF.
Measurements: All falls in the ward were prospectively monitored using incident reporting, noting location and consequences of each fall. Fall rates (per 1000 bed days) and injuries, were compared between bedroom falls on LIF against those occurring on standard vinyl flooring (controls).
Results: Over 31 months, there were 278 bedroom falls (from 178 fallers). The bedroom fall rate (falls per 1000 bed days occupied) did not differ between the LIF and control groups (median 15 [IQR 8–18] versus 17 [IQR 9–23], respectively; $P = .47$). However, fall-related injuries were significantly less frequent when they occurred on LIFs (22% of falls versus 34% of falls on control flooring; $P = .02$). Fractures occurred in 0.7% of falls in the LIF cohort versus 2.3% in the control cohort. Rolling resistance when moving heavier equipment, such as beds or hoists, was an issue for staff on LIF.
Conclusions: LIF significantly reduced fall-related injuries compared with a standard vinyl flooring, whereas they did not alter the overall risk of falling.

Falling while in the hospital is common for older people.[1–5] Fall rates vary according to the type of ward from acute hospitals (3–10/1000 bed days), through geriatric medicine and stroke rehabilitation units (3–20 and 8–22 per 1000 bed days, respectively) to the highest rates for older people in specialist dementia units (7–48/1000 bed days).

The consequences of falls are significant. Many patients have a significant loss of confidence as a result of falls. A fall-related physical injury, usually soft tissue injury, occurs in approximately 30% to 40% of these falls. Between 1% and 5% of falls result in a more serious injury, such as hip, pelvis, or humeral fracture, which may threaten the person's life or independence.[1] It is generally not possible to predict which patients will have injurious falls.[6]

There are some effective fall-prevention strategies in hospitals,[7,8] but others have been unable to show significant reductions in falls or injuries.[1,9,10] Although it is important to continue a focus on reducing falls, an alternative and adjunctive approach is to try to minimize fall-related injuries. Hip protectors may reduce hip fractures (but not other injuries), but require targeting to those at greatest risk and are effective only if worn.[11] Low-impact flooring (LIF) can potentially benefit all patients, without the need for targeting high-risk individuals, and once laid, is "active" as an intervention all the time. LIF[12] may work by spreading the impact over a larger area and deceleration occurs over a greater distance, thus reducing the energy transferred to the patient. Devastating fall injuries, such as hip fractures, may be mitigated by the flooring having a larger finite thickness and hence deceleration occurs over this distance, rather than directly on the hip. The end result is potentially bruising rather than a hip fracture.

There have been some preliminary studies suggesting that different LIF solutions may reduce injuries, particularly fractures. These include residential care in Sweden[13] and the United States,[14] and hospitals in the United Kingdom.[15,16] However, none of these studies showed a clear benefit in fracture reduction. Recently, the Swedish residential study reported encouraging results from their larger cohort, showing a

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Low-impact flooring was provided and installed by Acma Industries Limited (Kradal), Jacobsens Creative Surfaces Limited (Tarkett Omnisport Excell), and Inzide Commercial Limited (SmartCells). These 3 companies had no other involvement in the study.

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significant 59% reduction in all injuries, but not fractures.[17] This study is ongoing. Cost-effectiveness studies from the United Kingdom and Sweden are in favor of LIF but not definitive.[18,19]

The effectiveness and practicality of LIF may differ in residential care compared with hospitals, as the patient populations are different and have different acuities, and in the hospital there may be greater movement of equipment, such as beds, hoists, and trolleys. Drahota et al[15] in their study of one LIF system in 8 UK hospitals documented staff concerns about pushing equipment. In a small exploratory study, our group found similar concerns.[20]

As preparation for rebuilding our Older Persons Health (OPH) wards on a different location, a small exploratory study was undertaken to determine whether any of the available LIF systems should be installed in the new wards.[20] Three quite different flooring systems were found from literature and industry searches and were installed in one ward to determine practicality issues. The 3-month timeline between installation and making a decision on flooring precluded adequate exploration of the LIF effectiveness. However, these floors remained in situ on the ward, with the ward continuing to function normally, until the rebuild was completed and associated decommissioning of the index ward. This allowed a longer period of observation. The aim of the current study was to assess the effectiveness of LIFs in preventing injury in a subacute hospital setting.

The hypotheses for this study were that LIF (1) would not increase fall rates and (2) would reduce fall-related injuries.

Methods

At the Princess Margaret Hospital (PMH), OPH had 4 general subacute wards for older people and 1 specialist stroke rehabilitation ward.[21] The wards take approximately 70% of admissions from the acute hospital and 30% direct admissions from the community. Ward 2B, in which the LIFs were placed, is a 20-bed general ward with a focus on medical and rehabilitation needs of frail older people.

As part of planning for a new hospital on a different site, 3 different LIF systems were installed during November 2013. The initial phase was to determine the practicality of 1 or several of these floors for the new hospital build. This practicality phase lasted only 3 months before final decisions needed to be made, dictated by the timing of the concrete pours for subflooring (March 2014). The main practical issues identified were the additional costs, and push-pull resistance when moving heavy equipment, such as beds or hoists.[20] Because of these factors and a lack of clear evidence of benefit, a decision was made not to install any of these LIFs in the new hospital. During construction of the new hospital, all the OPH wards, including ward 2B, continued to function normally. To enable temporary repairs to be carried out for damage sustained in the 2011 Christchurch earthquakes,[22] there was a 50-day period in 2014 when the whole ward shifted to an identical ward (but without LIFs) on the level immediately above. During this period, data collection continued with all patients on control floors. The LIF remained in situ after initial phase up until the time the ward transferred to the new hospital and the existing ward was decommissioned on June 13, 2016.

Throughout both the initial practicality phase and extension during construction, all falls and fall-related injuries were prospectively monitored, using the established normal quality incident event reporting (QIER) system. A fall was defined as "a sudden, unintentional change in position causing the individual to land at a lower level, on an object, the floor or other surface."[23] The department has run an active falls prevention program for more than 15 years and this continued throughout the trial.[24,25] To avoid investigator bias, the severity of injury assigned by the clinical and quality teams was used (see Table 1).

Three different LIFs were used based on international trials to date.[13–15] These were SmartCell (25 mm thick; Inzide Commercial, Auckland, New Zealand), Tarkett Excell Omnisport (8 mm thick; Jacobsens Creative Surfaces Ltd, Auckland, New Zealand), and Kradal (12 mm thick; Acma Industries Ltd, Upper Hutt, Wellington, New Zealand). Each LIF was installed in approximately 4 bed spaces (1 single-bed room and 1 × 3-bed room). Thus, 12 bed spaces were covered by one of the LIFs, and 8 bed spaces were surrounded by standard vinyl flooring (3–4 mm thick) laid on subflooring of concrete. The corridor, dining room, and wet areas (bathrooms and toilets) did not have LIF installed. To increase the power of the study, the bedroom falls from all 3 LIFs were pooled, and bedroom falls on the standard vinyl flooring acted as the concurrent control.

Table 1
Classification of Severity of Injury

No Injury: There was no injury noted.
Minor Injury: This includes minor bruising, a small skin tear, or the patient reports that he or she has a painful site or tenderness, but no injury is evident.
Moderate Injury: Resulting from a patient fall includes skin tears or lacerations that require suturing, a head injury that requires a radiograph but with no further injury noted, major bruising, and a fractured nose.
Serious Injury: Resulting from a patient fall most often refers to when a fracture has been sustained; often a fractured femur or fractured pelvis. Often these fractures require surgery. This category also would include moderate to serious head injuries.

Patients were allocated a bed space on the ward by nursing staff who were not involved in the running of this trial. Allocation was based on bed availability, as well as clinical need, such as proximity to nursing station.

Staff recorded where each fall occurred on the ward, using a map of ward layout attached to each QIER form (see the Appendix). Location of the patient's bedroom (and fall) was cross checked with our computerized patient management system. All falls were recorded and rates presented as falls per 1000 bed days. Each fall, in patients who fell multiple times, was recorded separately, as an injury is possible from each fall.

As the normality assumption does not hold, nonparametric (Wilcoxon Rank Sum test) comparisons between cohorts were made. Categorical variables were compared using χ^2 analyses.

Results

Over the 31 months, there were 323 falls (from 197 fallers) in the whole ward. Fallers were 19% of all admissions to the ward for this period. Of these ward falls, 278 (86%) occurred in the bedrooms (from 178 fallers), which are the focus of this study. There were no significant differences in the characteristics of fallers of the 2 cohorts (Table 2).

Table 2
Basic Characteristics of Both Cohorts of Bedroom Fallers

	LIF Cohort, n = 100	Control Cohort, n = 78	Differences Between Groups, *P*
Age, y			
Mean (SD)	83 (7.4)	83 (7.3)	.78
Median (IQR)	83.5 (79–88)	85 (79–88)	
Number (%) female	57 (57)	45 (58)	.93
Length of stay in days in ward			
Mean (SD)	24 (11.4)	24 (12.1)	.98
Median (IQR)	21.5 (16–29)	23 (15–29)	
Clinical Frailty Scale[26]			
Mean (SD)	7 (1.0)	7 (1.0)	.16
Median (IQR)	6 (6–7)	7 (6–7)	
Range	4–9	3–9	
Prescribed walking aid *at time of fall*			
No aid or stick	8	5	.79
Low wheeled frame	44	29	
Gutter (high) frame	14	11	
Immobile without help	17	14	