Rehabilitation NURSING

Biomechanics and Injury Risk Assessment of Falls onto Protective Floor Mats

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KEY WORDS
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This study investigated the biomechanics of simulated sideways falls from various bed heights onto two types of protective floor mats. This article presents biomechanical injury criteria for evaluating the probability of sustaining injuries to the head, thorax, and pelvis. A side-impact dummy was raised to drop heights of 45.7 cm, 61.0 cm, and 76.2 cm and released. Two types of protective floor mats were evaluated and compared with impacts experienced on an unpadded, rigid floor. Results of the study demonstrated a high risk (>50%) for serious head injury for falls onto an unpadded, rigid floor at 61.0-cm and 76.2-cm drop heights. Falls onto floor mats demonstrated significant reductions in injury risk to the head and pelvis for all drop heights. Thoracic injury risk was significantly reduced for all but the highest drop height.

According to the National Center for Injury Prevention and Control (NCIPC), falls accounted for 16% of fatalities associated with unintentional injury in the United States between 1999 and 2007 (NCIPC, 2011). This was third only to motor vehicle accidents (39%) and poisoning (18%). Falls are ranked number one for unintentional injury and death in the elderly population (65 and older), accounting for 124,216 fatalities between 1999 and 2007. Another 14.6 million elderly people sustained nonfatal, fall-related injuries between 2001 and 2008 (NCIPC). Previous research has shown that as many as 24% of falls in the elderly population occur as a result of falling out of bed (Gurwitz, Sanchez-Cross, Eckler, & Matulis, 1994; Innes & Turman, 1983). As many as 20% of falls have been reported to occur in institutions such as hospitals or extended care facilities (Bulat, Powell-Cope, Nelson & Rubenstein, 2004). Fall rates in hospitalized patients have been reported to occur at a rate of 5.2 falls for every 1,000 patient days (Shorr et al., 2008). It has also been estimated that 1.54 falls per 1,000 patient days result in injury. As a result of the high frequency of fall-related injuries in the elderly population, the Joint Commission has identified fall prevention as a national patient safety goal (NPSG.09.02.01). The Joint Commission calls for the implementation of fall-reduction programs that involve the evaluation of a patient's risk for falls and implementation of a fall-prevention strategy that both reduces the risk for a fall and the risk of injury should a fall occur. Inherent to this program would be the ability of an organization to assess the injury-reducing capability of potential countermeasures such as padded floor mats.

Biomechanical injury risk assessment is a critical aspect of understanding the mechanisms of injuries related to falls as well as the evaluation of potential countermeasures. Bowers, Lloyd, Lee, Powell-Cope, and Baptiste (2008) provided insight into the biomechanics associated with falls from bed heights onto various floor surfaces. A Hybrid III, 50th percentile male crash test dummy with internal instrumentation was dropped onto its side from various heights. Although this may provide some preliminary insight into comparative loading between floor surfaces and drop heights, the Hybrid III crash dummy was originally developed for frontal loading and may not be entirely appropriate for lateral impact studies. An alternative, the side impact dummy (SID), was developed by the National Highway Traffic Safety Administration for the purposes of assessing injury risk to side impacts (Eppinger, Marcus, & Morgan, 1984). The combination of the Hybrid III head-neck and SID torso and lower extremities provides an improved biofidelity for evaluating biomechanics and injury assessment under sideways falls. Additional injury criteria specific to the SID may also be utilized for injury risk assessment to the thorax and pelvis. Injury criteria are biomechanical or engineering parameters that can be measured during an impact and then related to the likelihood of sustaining various physical injuries.

Of particular interest to the evaluation of fall-related injury risk in the elderly are the effects of age and gender on impact tolerance of human bone. Evans (1973) reported on the seminal work of Messerer (1880) who investigated the strength of fresh cortical bone specimens from long bones of men and women. Ultimate bending strength was found to increase with age, peaking at 20–30 years of age and then steadily declining thereafter. The ratio of maximum strength for the male at 75 years of age was approximately 81% of that at 24 years of age. For females, this ratio was 85%. Yamada (1970) reported similar results for static bending of fresh cortical bone with a maximum strength occurring between 20 and 40 years of age. The ultimate strength reported for 70–79 years of age was approximately 80% of that possessed by 20–29 year olds. Based on Evans' (1973) analysis, Haffner (1985) estimated a reduction in pelvis fracture tolerance of approximately 0.5 g per year.

The objective of this study was to perform a biomechanical assessment of falls from various heights onto both a rigid floor surface as well as two types of padded floor mats using the modified SID. Injury criteria and biomechanical data were referenced to gain insight into injury risk to various body regions and assess potential benefit offered by protective floor mats.

Methods

Equipment Setup

A sideways fall was simulated by raising the SID to predetermined heights and dropping it using a quick-release pin (**Figure 1**). The control condition for this evaluation was an unpadded, flat concrete floor. Two padded mats were chosen for evaluation (Personal Safety Corporation, Cedar Rapids, IA). The SBEV-1 mat was 2.54-cm thick, constructed from 40 kg/m^3 ethylene-vinyl acetate foam and placed in a 0.05-cm thick polyvinyl cholride (PVC) sheath. The SBSM-1 mat was 5.08-cm thick, constructed from 25 kg/m^3 polyurethane foam and placed in a 0.05-cm thick PVC sheath. Three drop heights were evaluated for each floor-mat impact condition: 45.7 cm, 61.0 cm, and 76.2 cm (18 in., 24 in., and 30 in.). Drop heights were based on an expected range of hospital bed heights from which a patient might fall (Tzeng & Yin, 2007). Three impacts were performed for each impact condition. A minimum of 5 minutes between repeat mat impacts was allowed for foam recovery.

Instrumentation and Data Processing

The SID was equipped with accelerometers in the head, chest (upper and lower ribs), lower spine, and pelvis to capture impact loads to these body regions. Injury criteria were calculated for the head and thorax for comparison to biomechanical injury risk charts. For the head, the head injury criterion (HIC) is the most widely used measurement of head injury risk and is currently incorporated into Federal Motor Vehicle Safety Standards for head protection in automotive impacts. The HIC is based on acceleration measured at the center of gravity of the head and takes the following form:

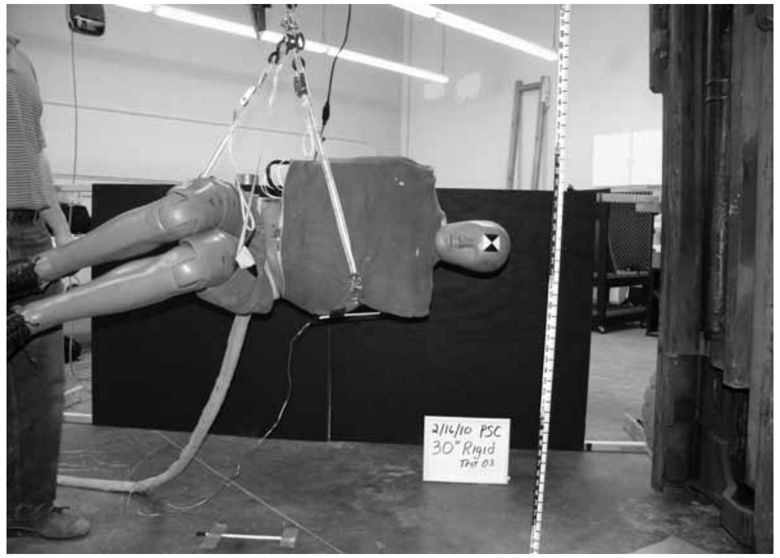
$$HIC = \left[\frac{1}{t_2 - t_1}\int_{t_1}^{t_2} a(t)dt\right]^{2.5}(t_2 - t_1)$$

(where t_1 and t_2 are any two points in time during the impact in which HIC is maximized; Versace, 1971). A time limit for t_2–t_1 of 15 ms was used as recommended by Prasad and Mertz (1985). Injury risk curves developed by the National Highway Traffic Safety Administration were referenced to determine the probability of sustaining varying severities of head injury (National Highway Traffic Safety Administration, 1997).

The Thoracic Trauma Index (TTI) is another injury criterion used with the SID device. The TTI can be related to the thoracic injury risk for a given age and weight (TTI = 1.4 * age + TTId * Mass / Mass$_{\text{std}}$). To represent the aging population most at risk for sideways falls (i.e., small females), the figures 52.2 kg (weight) and 75 years (age) were used in the study's calculations. The mass of the SID was used for standard mass (Mass$_{\text{std}}$) value. The injury risk curve developed by Morgan, Marcus, and Eppinger (1986) was used to assess the probability of sustaining a serious thoracic injury. Due to the lack of experimental data, injury risk curves for minor and moderate thoracic injuries currently do not exist. Injury severity was defined according the Abbreviated Injury Scale (AIS 2005; Gennarelli & Wodzin, 2005).

Data were collected via a TDAS Pro data acquisition unit (Diversified Technical Systems, Inc., Seal Beach, CA) at a sampling rate of 10 kHz and were filtered per the Society of Automotive Engineers (SAE) J211/1 standard. A one-way repeated measures ANOVA was performed to analyze the effect of flooring surface followed by pair-wise comparisons between surfaces using *Bonferroni* adjustments for multiple comparisons. A significance level of .05 was selected for all statistical tests.

Figure 1. Experimental Setup



Results

Twenty-eight drop tests were performed during this study (**Table 1**). Tabulated statistical results are presented in **Table 2**. An increasing trend between drop height and injury risk was observed for the head, thorax, and pelvis for all impacts.

Head Injury Risk

HIC results from the rigid impact tests indicate a range of head injury risks from minor to life-threatening, depending on drop height. The 45.7-cm drops resulted in a high probability (>50%) for minor head injury, such as mild concussion (no loss of consciousness). The higher end of this range indicates a 57% risk for moderate head injury. A *moderate* head injury, as defined by the AIS 2005, could include any of the following injuries: concussion with brief loss of consciousness (less than 1 hour), linear nondisplaced skull fracture, small epidural hemorrhage, subarachnoid hemorrhage, or tiny cerebral contusion. The 61.0-cm and 76.2-cm rigid drop results indicate a high risk for serious head injury (**Figure 2**). Serious head injuries include concussion (loss of consciousness between 1 and 6 hours), basilar skull fracture, tiny (<0.6 cm) subdural hematoma, subcortical hemorrhage, or small cerebral contusion. The 76.2-cm rigid drop results are indicative of a high risk for severe-to-untreatable head injury. Both mats demonstrated a statistically significant reduction in head injury risk over the rigid drop conditions.

Thoracic Injury Risk

The 45.7-cm drop onto a rigid surface resulted in a 45% risk of a serious thoracic injury for the older adult population, while both 61.0-cm and 76.2-cm drops represented a 58%–59% risk of a serious thoracic injury (**Figure 3**). For SBEV-1 and SBSM-1 drops, TTI values demonstrated a statistically significant reduction at the 45.7-cm and 61.0-cm drop heights. No statistical difference was found, however, between drop conditions at the 76.2-cm drop height.

Pelvic Injury Risk

Pelvic accelerations recorded for the rigid impacts were below tolerable limits currently used for protection of occupants in side-impact crashes (130 g). This limit was based on broad loading to both the greater trochanter and iliac wing. Zhu, Cavanaugh, and King (1993) found that concentrated loading to the greater trochanter can result in pelvic fractures at lateral accelerations of 50–70 g. An injury risk curve was developed from these data for the purposes of assessing pelvic fracture risk for the current study. Zhu, Cavanaugh, and King worked with 17 male and female cadavers with an average age of 60 ± 8 years to develop the pelvic fracture risk curve. The average age of female specimens (n = 7) was 59 ± 8 years. Extrapolating out to 79 years, based on Haffner's estimated reduction in tolerance, yielded a 50% risk of pelvic fracture at approximately 55 g. Based upon these limits, rigid impacts from the 61.0-cm and 76.2-cm rigid drop heights would represent a risk of greater than 50% for a pelvic fracture (**Figure 4**). Pelvis accelerations for the SBEV-1 and SBSM-1 tests were below a 15% risk of pelvic fracture, both statistically significant reductions compared to the rigid floor impacts.

Table 1. Test Results

Test No	Padding	Drop Height (cm)	Impact Velocity (m/s)	Head Accel Res (g)	HIC 15	Upper Rib Accel (g)	Lower Rib Accel (g)	Lower Spine Accel (g)	TTId	TTI 75 yrs 115 lb	Pelvis Accel (g)
1	None	76.2	3.9	452.7	2265	39.1	42.4	29.9	36	130	80.9
2	None	76.2	3.9	454.4	2117	52.1	54.0	47.2	51	140	83.2
3	None	76.2	3.9	425.4	1977	46.0	47.2	34.4	41	133	82.9
4	None	76.2	3.9	378.6	1639	46.8	46.2	37.8	42	134	81.6
5	SBEV-1	76.2	3.9	78.5	206	27.2	27.3	31.8	30	126	42.8
6	SBEV-1	76.2	3.9	86.4	241	27.2	30.1	25.4	28	124	39.8
7	SBEV-1	76.2	3.9	91.8	261	28.2	31.1	26.8	29	125	40.6
8	SBEV-1	61.0	3.5	66.0	160	22.9	25.3	22.1	24	122	32.7
9	SBEV-1	61.0	3.5	71.5	175	23.8	26.1	23.4	25	122	33.8
10	SBEV-1	61.0	3.5	55.8	113	24.5	24.9	27.4	26	123	36.9
11	SBEV-1	45.7	3.0	46.6	77	20.0	20.5	24.2	23	121	32.6
12	SBEV-1	45.7	3.0	45.7	75	19.1	19.8	23.1	22	120	32.0
13	SBEV-1	45.7	3.0	51.1	92	20.4	20.1	24.8	23	121	30.3
14	SBSM-1	76.2	3.9	54.4	119	33.4	31.9	32.0	33	128	38.2
15	SBSM-1	76.2	3.9	70.2	152	35.3	34.9	35.8	36	130	41.2
16	SBSM-1	76.2	3.9	72.8	140	38.2	36.6	35.5	37	131	45.3
17	SBSM-1	61.0	3.5	49.2	78	30.5	28.4	28.6	30	126	35.6
18	SBSM-1	61.0	3.5	49.8	80	30.6	29.1	29.3	30	126	36.5
19	SBSM-1	61.0	3.5	56.7	86	31.3	29.7	30.0	31	126	37.7
20	SBSM-1	45.7	3.0	28.6	37	23.9	22.7	22.9	24	121	28.3
21	SBSM-1	45.7	3.0	29.7	38	24.4	23.3	23.3	24	122	29.1
22	SBSM-1	45.7	3.0	25.8	31	23.5	22.7	23.0	23	121	28.6
23	None	45.7	3.0	256.7	639	31.8	30.6	30.8	31	127	54.2
24	None	45.7	3.0	220.7	473	32.0	29.4	25.1	29	125	53.5
25	None	45.7	3.0	255.1	640	31.8	29.9	28.2	30	126	56.2
26	None	61.0	3.5	343.5	1231	41.3	41.9	41.2	42	134	74.5
27	None	61.0	3.5	342.5	1228	41.9	41.8	40.6	41	134	74.6
28	None	61.0	3.5	336.2	1166	41.9	41.5	38.3	40	133	68.1

Discussion

Bowers and colleagues (2008) also evaluated the energy absorption capability of floor mats for simulated patient falls. Head-first and feet-first falls were simulated using a Hybrid III crash test dummy. Similar to the current study, head, thorax, and pelvic accelerations increased significantly with increasing fall height. These data support placing the patient at the lowest possible bed height to reduce patient injury risk in the event of a fall. Bowers and colleagues also found a significant reduction in head accelerations and HIC values between the rigid floor and the floor mat conditions. Protective effects for the thorax during feet-first falls and for the pelvis during head-first falls were also seen. These studies both support the finding that 2.5-cm EVA foam floor mats significantly reduce the risk for injury to the head, thorax, and pelvis. Differences between thorax and pelvis performance between studies may be associated with the impact orientation of the dummy, as previously noted by Bowers and colleagues. Additional differences in thoracic and pelvic performance may also be attributable to using different crash test dummies.

The current study also compared a thicker, less dense mat material (SBSM-1) with the EVA foam mat. Because of the increased allowable deformation of the SBSM-1 mat, HIC values were significantly lower than those recorded for the SBEV-1 mat from the 76.2-cm drop height. However, there was no statistical difference found between SBSM-1 and SBEV-1 mats at the 76.2-cm drop height for thoracic injury risk. These data indicate that both mats had reached their energy absorbing capability for the thorax at 76.2 cm. It should be noted that the effective mass of the torso of the SID is greater than would be expected for an at-risk population, so these results could be considered conservative for bottoming out the mat (i.e., lighter individuals would deform the mat to a lesser degree).

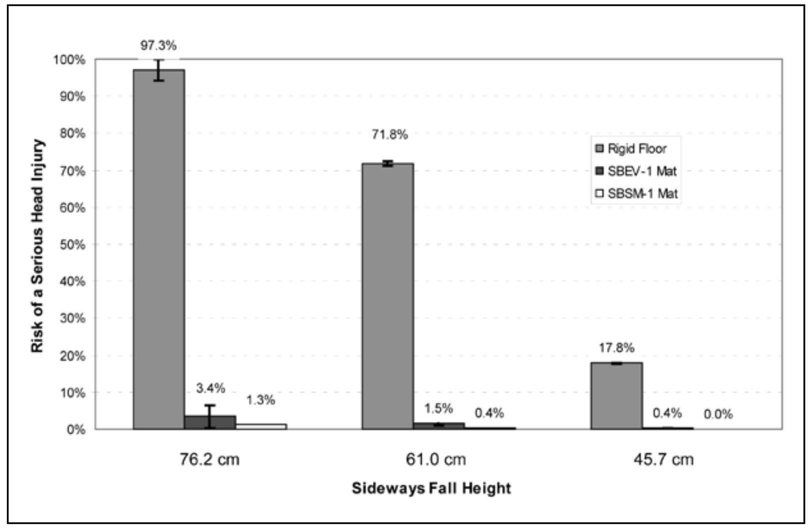
Table 2. Resultant *p* Values from Pair-Wise Comparisons

18" Drop	Rigid v SBEV-1 p-value	Rigid V SBSM-1 p-value	SBEV-1 v SBSM-1 p-value
Head Accel	0.009	0.010	0.060
HIC	0.032	0.032	0.078
Upper Rib	0.001	0.014	0.068
Lower Rib	0.007	0.026	0.325
Lower Spine	0.229	0.268	0.555
TTI	0.006	0.033	0.676
Pelvic Accel	0.012	0.004	0.176

24" Drop	Rigid v SBEV-1 p-value	Rigid V SBSM-1 p-value	SBEV-1 v SBSM-1 p-value
Head Accel	0.000	0.001	0.628
HIC	0.000	0.001	0.247
Upper Rib	0.002	0.000	0.009
Lower Rib	0.006	0.007	0.021
Lower Spine	0.055	0.030	0.161
TTI	0.016	0.020	0.012
Pelvic Accel	0.024	0.017	0.258

30" Drop	Rigid v SBEV-1 p-value	Rigid V SBSM-1 p-value	SBEV-1 v SBSM-1 p-value
Head Accel	0.004	0.004	0.040
HIC	0.008	0.006	0.036
Upper Rib	0.107	0.414	0.086
Lower Rib	0.083	0.138	0.118
Lower Spine	0.869	1.000	0.633
TTI	0.333	0.590	0.188
Pelvic Accel	0.005	0.005	1.000

Figure 2. Risk of Serious Head Injury



At face value, the SBEV-1 mat is more effective at reducing thoracic injury risk than the SBSM-1 mat. These results should be considered preliminary,

Figure 3. Risk of Serious Thoracic Injury

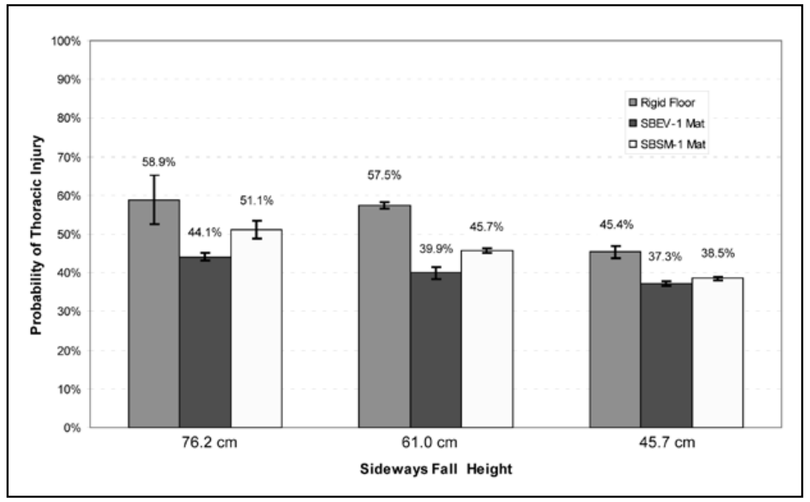
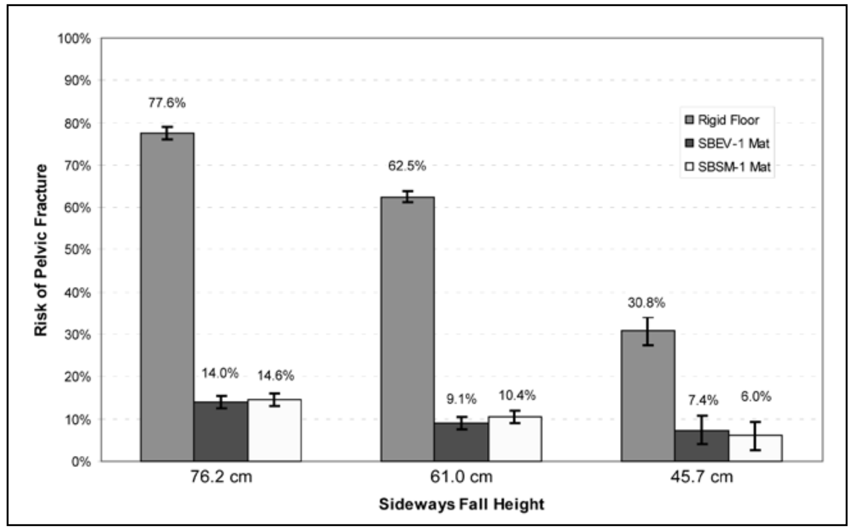


Figure 4. Risk of Pelvic Fracture Due to Concentrated Load to the Greater Trochanter



however. Previous research has indicated that the SID device has a tendency to demonstrate improved performance with padding of increased stiffness. This may explain the lower TTI results for the SBEV-1 mat at the 61.0-cm drop height. Previous research has also demonstrated that increased stiffness with lower chest accelerations in the SID is inversely related to chest compression, another injury risk indicator for thoracic trauma (Campbell, Wasko, & Henson, 1990). Additional testing using a dummy equipped to measure chest compression is recommended before the thoracic injury risk-assessment results reported in this article can be considered validated. Conclusions that may be drawn from these results, however, are that the mats appear to be reaching their maximum limit of energy absorption for the torso mass tested within this study at the 30-in. drop height.

Additional research and evaluation of mat designs are needed. Specifically, research is needed to quantify the dynamic change in contact area across the hip with various padding designs. Although padding can limit fracture risk by increasing the time over which the pelvis decelerates, it also has the effect of increasing the contact area over the hip and loading across the iliac wing. Greater force can be withstood if the load is spread across both the greater trochanter and iliac wing as opposed to having the load focused locally over the greater trochanter (Haffner, 1985; Zhu, Cavanaugh, & King, 1993), which was previously mentioned with respect to the pelvis fracture risk curve created by Zhu, Cavanaugh, and King. Current research methods, however, lack dynamic contact area information.

Additional work is needed to develop a standardized test methodology for evaluating protective floor mats. A standard evaluation methodology aimed at protecting against specific injuries, such as hip fractures or head injuries, would allow manufacturers to develop effective solutions and hospital and care facilities to make informed decisions about which mats will provide optimum protection for their patients.

Limitations

The injury assessment technology used in this study (i.e., SID, instrumentation, injury criteria) was developed through automotive safety research efforts to study side impact collisions. Although the current loading conditions (side body drop) are reasonable comparisons to these studies, one cannot ignore the lack of experimentally induced femoral neck fractures in the automotive side impact literature. Cesari, Ramet, and Bouguet (1983) reported on 22 postmortem human subjects exposed to 60 lateral pelvic impacts, 55 of which occurred with a rigid, flat surface. The majority of injuries were pubic rami fractures, followed by proximal femur fractures, dislocations of the sacroiliac joint, fractures of the iliac wing, and fractures of the acetabulum. Of the 22 cadavers tested, only three sustained femoral neck fractures. These occurred concomitantly with other pelvic fractures, such as ischiopubic rami fractures. Zhu, Cavanaugh, and King (1993) found a similar lack of femoral neck fractures. Fayon, Tarriere, Walfisch, Got, and Patel (1977) and Tarriere, Walfisch, Fayon, and Rosey (1979) reported on a series of 26 postmortem human subject drop tests, not unlike those performed with the SID in the current study. Subjects ranged in age from 25–71 years and weighed between 90 and 165 pounds. Subjects were suspended with cables and dropped onto the side against various impact surfaces. Drop heights ranged from 20–118 inches. Fractures of the pubic rami occurred in four subjects. Multiple injuries were observed in one subject that sustained fractures of both acetabulum and iliac wing in addition to pubic rami. There were no femoral neck fractures.

Nusholtz, Alem, and Melvin (1982) conducted lateral pendulum impacts to 12 postmortem human subjects. The impact was targeted for the greater trochanter. Six of the 12 sustained pelvic fractures, but no femoral neck fractures were observed. Cavanaugh, Walilko, Mahotra, and Zhu (1990) conducted side impacts with 12 postmortem human subjects with force transmission through the greater trochanter. Pubic rami fractures were observed, but again, no femoral neck fractures were found.

The lack of experimentally induced femoral neck fractures in whole-body cadaveric testing under side-impact loading is of particular interest when one considers the epidemiological and clinical experience reportedly associated with falls in the elderly population. It has been estimated that 90% of hip fractures are due to falls (Grisso et al., 1991). Clinical or epidemiological studies, however, lack the necessary information in most cases to conduct a sufficient laboratory reconstruction to investigate injury causation. They may only temporally relate injuries with events. As a result, some researchers have questioned whether hip fractures are the result or cause of a fall. Additional research is needed regarding why femoral neck fractures are not more prevalent in whole-body cadaveric side-impact experiments. One possible explanation could involve the screening process for selecting cadaveric specimens. For example, removal of severely osteoporotic specimens may reduce the prevalence of femoral neck fractures in such studies.

The use of the SID also has limitations. As was previously mentioned, the biofidelity of the torso has been questioned by some researchers (Irwin, Pricopio, Mertz, Balser, & Chkoreff, 1989; Viano, 1987). Recent advances in biomechanical surrogates have led to the development of improved side-impact test devices, such as the ES-2 and WorldSID crash test dummies (Byrnes et al., 2002; Cesari et al., 2001). These devices have improved biofidelity and increased measurement capability, including load cells for measuring forces acting through the pelvis. These data may be used as a foundation for additional experiments with other side-impact devices. One possible research effort might include computer simulation using multiple side-impact dummies. Computer simulation offers a cost-effective approach to conducting numerous experiments. The experimental SID tests from the current study may serve as the baseline validation for these efforts. This also may include investigation into alternate foam and material properties for optimal fall protection. Human finite element models are also being developed that would offer additional anatomical detail that could be advantageous for studying specific bony injuries, such as femoral neck fractures. Material properties of the various tissues may be tailored to the older population. Stress and strain on various anatomical landmarks may also be monitored and compared to experimental data on fracture tolerance.

Key Practice Points

1. Biomechanical injury risk assessment can help nursing professionals select fall-related safety devices such as protective floor mats.
2. The use of protective floor mats can significantly reduce the risk of injury to the head, chest, and pelvis under the tested fall conditions.
3. Minimizing the fall height by placing the bed at its lowest position also minimizes fall-related injury risk to the head, chest, and pelvis.
4. Additional research and testing is needed to establish standardized test methodologies and rating systems for protective floor mats.

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Disclosure

This content has been reviewed and found not to contain any conflicts of interest.

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Rehabilitation NURSING

Teaching Adults SAFE Medication Management

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KEY WORDS

medication instruction
medication management
medication safety

One in nine visits to the emergency department is the result of a drug-related adverse event and is possibly preventable (Zed et al., 2008). The rehabilitation nurse has the opportunity to teach adults a comprehensive medication management plan that will help reduce medication errors. Most patients have minimal medication experience or instruction; this article documents the effectiveness of using a S = systematic, A = accurate, F = functional, and E = effective instructional methodology to help patients learn about their medications. The methodology helps rehabilitation nurses teach the average patient about handling, absorbing, and implementing the information. This article presents detailed instruction about the salient points of the SAFE instructional program. Several figures, a checklist, and pictures demonstrate the techniques utilized. Prevention of medication errors is emphasized throughout.

The majority of older adults take an average of 5–10 prescription medications per day. Confusion and error increase exponentially if medications are taken 3–4 times per day and include special instructions (e.g., "take on an empty stomach, 30 minutes before meals, or at bedtime"). The difficulty managing medications can be overwhelming for the person who has had a recent illness, hospitalization, surgery, or exacerbation of a chronic condition (Kaufnam et al., 2002). Some patients are taking over-the-counter (OTC) products, herbs, and supplements along with prescription medications. Therefore, patients are frequently experiencing more side effects and interactions resulting in clinic and emergency department visits and hospitalizations (Budnitz et al., 2006).

For the purposes of this article, we are assuming that a typical patient requiring medication management instruction is able to understand and follow instructions and is anxious to recover and return to his or her normal activity level. Taking medications safely is one sure way of removing hazards and preventing unnecessary problems while the patient recuperates. If medications are not taken properly, side effects or interactions can result and cause the person to develop other serious complications.

Teaching Adults SAFE Medication Management

Using a well-designed instructional program for medication management is critical for rehabilitation nurses providing medication education to their patients. The goal of the S (systematic) A (accurate) F (functional) E (effective; SAFE) instructional program is to prevent and reduce patient medication errors.

Medication management instruction begins when the patient is admitted to the rehabilitation unit and continues throughout hospitalization. When medications are reviewed by the rehabilitation nurse with the patient, it is important to have an additional person present to receive the information. Oftentimes, patients are eager to go home when they are discharged and fail to listen carefully or remember medication instructions. It can be very beneficial for the patient to include someone else in the education about the medications and serve as support. This person can provide the patient with reminders about instructions and the importance of taking medications on time.

It is critical that instruction be provided at a pace that can be absorbed and understood by the patient and his or her designated support person. The nurse should allot time for instruction on medication management during hospitalization. It is best to divide the information into small segments to make it easier to learn and retain. The patient's and his or her support person's questions need to be answered during the instruction. Reinforcement of previous information should be provided when necessary.

When personalizing the SAFE medication management program, rehabilitation nurses should consider the patient's abilities, knowledge, and background; their resources and support systems; and the list of instructions for specific medications (Curry, Walker, Hogstel, & Burns, 2005).

The SAFE medication management program includes information about how to

- make and carry a medication list
- understand, learn, and talk about medications with the healthcare team
- safely store, take, and dispose of medications
- identify and discuss allergies, side effects, and interactions.

Make and Carry a Medication List

The medication list is a critical and valuable tool. It includes information about the patient and his or her emergency contact person(s); all prescription