Chronic Pain and Falls

People with chronic pain are prone to frequent falls. What is the incidence, who is at risk, and why do they occur?

By Richard C Dobson, MD [1]

Volume 15, Issue #7

Falls are a frequent occurrence among patients with chronic pain, especially low back pain. I first observed this phenomenon in the mid-90s, early in my practice that eventually consisted of several hundred people with chronic pain.

The population consisted predominantly of lower back pain patients, who entered my practice with an average duration of pain of 2 years, on average. Many of these patients stayed with me throughout my career, and at the time I retired, the average duration of the patients in my practice was 15 years.

More than half of patients reported sudden falls without any warning or obvious environmental precipitating factor.1-3 Most frequently the patient described the event as, “It was as if the leg just wasn’t there,” or less frequently, “It was like I was thrown backwards.” The falls seemed to occur without normal “protective reflexes.”

This led me to explore the biomechanics of movement and how the diseased spine and hips may impair movement in this vulnerable population. The following is a review of my experience over 20 years of pain practice.
The Scope of the Problem

No one really knows the true incidence of falls among pain patients, primarily because many falls go unreported. However, Stubbs et al conducted a meta-analysis of more than 1,330 articles on falls in older adults. They found that “community-dwelling older adults with pain were more likely to have fallen in the past 12 months and to fall again in the future. Foot and chronic pain were particularly strong risk factors for falls, and clinicians should routinely inquire about these [symptoms] when completing falls risk assessments.”

Leveille has published extensively on the epidemiology of falls, especially as it relates to the elderly and women living in the community. She documented that community dwelling women with pain fall more frequently than women without pain. In one study, she demonstrated that the use of at least 1 pain medication, without specifying dose or brand, provided some protection against falls in patients with chronic pain. However, another study showed that there was no correlation between use of medication and falls. The implication, I believe, is clear: medications are not a major contributor to the increased risk of falling in people with chronic pain.

My own experience mirrors these findings albeit in a much younger population, with average age in the 40 to 50 year old range consisting predominately of injured workers. Patients also report that they are never asked about falls and/or that they were too embarrassed to discuss the issue, often feeling embarrassed by their “clumsiness.” However, there was rarely a day in my office without at least one patient reporting a new fall during the past month.

The observed falls are not benign in nature, with frequent injuries including fractures at various sites, avulsed teeth, superficial and deep tissue (muscle, kidney) contusions, and lacerations and abrasions. Rubenstein et al reported that patients 65 years of age and older account for 75% of all death caused by fall. About 40% in this age group fall at least once a year, and 1 in 40 of them ends up in the hospital. Only half of hospitalized fall patients are alive one year later.

In my practice, a review of records documenting superficial injuries revealed a random distribution of injuries from head to foot: 15 head injuries, 15 trunk injuries, and 14.5 injuries per limb. This included one woman who avulsed the tip of a finger pad when she fell breaking a glass she was holding; 2 men in their 30’s with no evidence of osteoporosis who suffered proximal fractures of the tibia and fibula after a fall; and several patients who fell in areas of high traffic—one with fatal injuries. Table 1 illustrates 4 examples of typical fall patients in my practice.
Table 1. Case Examples

To illustrate the typical fall patient in my clinic, I present 4 case examples:

1. A 54-year-old woman walking with her left leg in the air during swing phase when sudden pain in the back was associated with elevation of the right leg (stance leg). She suffered fractures of the phalanx of the second toe, the fifth metatarsal, and the lateral right ankle.

2. A 40-year-old man falling backwards found himself suddenly airborne landing directly on his buttocks with burst fracture of T11.

3. A 42-year-old woman beginning to sit on the commode who turned to get her bearings and was thrown forward landing with her hands on the ground causing injury in the interscapular area. (Insurance issues precluded early diagnosis.) Subsequent CT myelogram showed failure of fusion at C7 that was performed 2 months prior to the fall.

4. A 54-year-old woman fell while walking in her driveway, using a straight cane for balance. Her first point of contact with the ground was the underside of her chin causing a large, deep stellate laceration.

Combining all of the factors described above, I propose the following model for explaining some of the falls that occur in the presence of chronic pain:

1. Normal gait is characterized by exquisite and highly orchestrated control of sequential limb movements such that net angular momentum about the center of mass is nearly 0.

2. Chronic pain is a condition that increases the sensitivity of reflex activity by mechanisms that have yet to be elucidated.

3. Reflex intensity can be increased in the presence of chronic pain. Abnormal reflexes such as the crossed adductor reflex can also be seen in patients with chronic pain and they may contribute to loss of dynamic balance.

4. Flexor withdrawal reflexes, and perhaps extensor thrust reflexes, can be triggered by both nociceptive receptors as well as mechanoreceptors. Thus a flexor withdrawal reflex can be triggered in the absence of pain via stimulation of mechanoreceptors. The presence of pain may also sensitize the mechanoreceptors so that a lower mechanical stimulus is required to trigger a withdrawal reflex.

5. Buckling can occur in the normal spine on rare occasions but seems more likely in the degenerated disc and especially in the vacuum disc. Peripheral joints are also capable of buckling. Buckling can result in sudden low amplitude but high velocity (high force) displacement when the joint is restrained by ligaments joint capsules and other soft tissues. These high velocity stretches are capable of triggering flexor withdrawal reflexes and/or extensor thrust reflexes.

6. Sudden flexor withdrawal reflex (and/or extensor thrust reflex) can impart energy to the various body segments involved, such that the added segmental angular momentum destroys the control of the net angular momentum about the person’s center of mass. An impulse of sufficient power is capable of initiating loss of balance or even a fall.
Risk of Falls

Several factors account for the risk of falls among chronic pain patients, including osteoporosis, age-related physiological changes, sensory losses, medication side effects, and loss of biomechanical movement.

Over the years, I have tried to synthesize seemingly disparate events and information to develop a proposed model of the intrinsic factors that increase the risk of falling in people with pain. Note that falls that have clearly been triggered by external obstacles or events have been excluded. The information has been gleaned from the following:

- The nature of injuries that are suffered and the patterns of their distribution.
- Reflex parameters as measured in the clinical examination.
- Electrodiagnostic studies focused on reflex events that can also be measured relatively easily, although more advanced electrodiagnostic techniques may be required.
- Patient reports of the events that occur immediately prior to, during, and immediately after loss of control of their antigravity motion.
- Review of the literature.
- Principles of physics, including dynamic and static momentum mechanics and biomechanics.

Clinical Observation

Over a one-week period in my clinic, 57% of patients seen had reported at least one fall since the onset of their pain. I have also observed brisk patellar reflexes among patients with chronic pain. Reflex testing is performed with a “Queensquare pattern reflex hammer” with the patient sitting with feet placed flat on the floor. This position places the leg in a consistent position from one exam to the next and from one patient to the next. The examiner’s thumb is placed on the infrapatellar tendon and the thumb is struck with the weighted head of the reflex hammer. The pendulum motion of the hammer provides a reproducible rapid stretch of the infrapatellar tendon.

Using this technique, it is possible to elicit reflexes in almost all patients. Patellar reflexes in many patients with chronic pain are also often accompanied by a crossed adductor reflex. In fact, 44 of 100 (44%) chronic pain patients seen in 1 month demonstrated the presence of a crossed abductor reflex using this technique. I did not have a true control population, but in most people without chronic pain, I have not been able to elicit the cross adductor reflex, which is generally considered to be a pathologic reflex.

An extensive review of reflex phenomenon as measured with electrodiagnostic techniques by Courthey et al has shown that flexor withdrawal reflexes can be triggered by both nociceptive and mechanoreceptors. Various measurable parameters, including delayed latency responses of electrical events, are discussed, citing multiple studies. Researchers have proposed that measurements of some of the delayed latency responses may actually be a marker for chronic pain. Babiy et al has also reported a case in which the patient suffered an isolated instance of “asterixis,” which led to a fall in a patient taking gabapentin.

Static and Dynamic Mechanics

Physicians often have limited background in the physics of static mechanics (used in assessing static posture) and even less familiarity with the more complicated dynamic mechanics (necessary for assessing balance during active and purposeful movement). Some understanding of these branches of physics is necessary in order to comprehend the factors that precipitate and perhaps prevent falls. Normal stable static posture requires that the center of mass lie over the base of support. Stability
During dynamic activities such as walking, running, or performing athletic activities requires dynamic control of the momentum of the center of mass, a more complicated but still measurable parameter.

During ambulation and other purposeful movements, the extrinsic force of gravity and intrinsic forces from muscle contraction exert their effects on a person, with or without load. Coordinated and orchestrated sequential muscle contractions and relaxations accelerate and decelerate the center of mass in a predictable, controllable path. Momentum itself consists of linear momentum as well as angular momentum. Herr and Popovic\textsuperscript{12} have argued that, although body segments may develop significant angular momentum during ambulation, the net angular momentum about the center of mass is nearly 0, since angular momentum in one body segment will be counteracted by a change in the angular momentum in a contralateral segment.

The hip flexors are powerful muscles that accelerate the legs forward. They can also propel a gymnast in a smooth backward rotation during a backward flip.\textsuperscript{13} Coordinated contraction/relaxation of the hip flexors and other muscles will result in a smooth landing for the gymnast. However, any disruption of the coordination of the hip flexor contractions will result in an ungraceful landing if not a fall. It is proposed that similar dysfunction in the hip flexors during gait may also contribute to the frequency of falls in people with pain and other physical impairments.

**The Spine**

Biomechanics of the spine are rarely considered during assessments of gait and balance. They are, however, very crucial to smooth coordination of functional movement. The basic motion unit in the spine consists of two vertebral bodies that allow coordinated motion at three locations: the disc, consisting of the high-pressure fluid nucleus as well as the tough fibrous annulus, and the two facet joints. During functional movements the displacement of one segmental motion unit is highly coordinated with the motion at adjacent spinal motion units.\textsuperscript{14,15}

The disk is often somewhat erroneously compared to a “shock absorber.” Functionally, the disc has much more in common with the car tire than the shock absorber. The disc has high-pressure fluid (nucleus pulposus) surrounded by a flexible tough sidewall (the annulus fibrosis). The disc is attached to the vertebral body above and below. Similarly, the car tire has higher-pressure fluid (air), a flexible sidewall that is attached to the wheel above and firmly grips the ground below. The disc and the tire allow smoothly controlled movement in multiple directions. In the normal disc, spinal movement occurs with the instantaneous center of motion lying within the nucleus of the disc.\textsuperscript{16}

As the disc degenerates, the position of the instantaneous center of motion becomes more irregular, and in a badly degenerated disc, it can actually lie outside of the physical space of the motion unit. In other words, the motion can be very erratic. Conceptually, however, if there is sufficiently firm but flexible scar tissue, the degenerated disc may move in a relatively normal pattern under a wide range of loads.

Wilder\textsuperscript{17} measured the motion of healthy discs under load in his Masters Thesis in biomechanics. He found that sufficient axial load at the balance point of a normal disc can induce buckling of the disc. It is my belief that the degenerative disc, with its widely fluctuating instantaneous center of motion, has the capability of buckling in a similar manner, but under a much wider range of loads. This is analogous to a tire with a relatively low pressure, which can start wobbling and the sidewalls repeatedly buckling at a higher speed.

Modic and Ross\textsuperscript{18} have described the instability that can occur in a degenerated disc as follows: “Segmental instability can result from degenerative changes involving the intervertebral disc, vertebral bodies, and facet joints that impair the usual pattern of spinal movement, producing motion that is irregular, excessive, or restrictive. It can be translational or angular.” This instability can result in relatively small amplitude displacements, which can occur at relatively high velocity (ie, with high force).
The ultimate in disc degeneration is the vacuum disc, which has gotten little attention in discussions of the function of the spine other than to use it as a radiologic marker for disc degeneration. It is marked by the presence of a black streak across the disc on x-ray or CT scan and sometimes on MRI imaging. The image results from a process described by Modic and Ross, where “radiolucent collections [vacuum disc phenomenon] representing gas, principally nitrogen, occur at sites of negative pressure produced by abnormal spaces” within a degenerated disc.\(^{18}\) The distraction that produces the negative pressure occurs when the center of motion is displaced laterally and may even lie outside the nucleus of the disc.

Conceptually, a vacuum disc has much more in common with a flat tire than it does with a normal high or degenerated low-pressure disc. (Note that most physicians have in fact seen the vacuum phenomenon occurring while using a syringe. Pulling back on the plunger when the needle is capped will result in production of a significant collection of gas either at the tip of the syringe or at the base of the plunger. This gas is produced by the lower pressure causing a simple phase shift of the nitrogen that is dissolved in the fluid shifting into the gaseous phase.)

Seo et al have presented evidence that the vacuum disc is a risk factor for falls and hip fractures in the elderly.\(^{19}\) The authors had the opportunity to interview some of the patients included in this study to determine what was happening at the instant they fell. The interviews were done in the course of clinical evaluation at the time of admission to a rehabilitation facility rather than in the course of a full study. Most of the patients were performing an activity that produced an axial torque or a twisting force on the spine, such as turning to look at someone, reaching for something, or simply getting out of a chair. While further study is needed, it is plausible that the axial torque on the vacuum disc combined with the mechanical incompetency of the vacuum disk may well lead to a sudden buckle of the vacuum disk.

Other degenerated peripheral joints undoubtedly can undergo buckling, but they clearly do not simply fall apart. They, like the degenerated disc, are restrained by ligaments, annulus, and/or joint capsules that may be damaged but still capable of withstanding the forces imparted to them. The buckling, be it spinal or peripheral, will produce sudden rapid stretch of the restraining ligaments. It is proposed that this rapid stretch is capable of triggering either a flexor withdrawal response and/or an extensor thrust response.

### Prevention Measures

Fall prevention measures have focused primarily on external causes of falls, motor impairment from specific disease, or classic vertigo.\(^{20,21}\) There are virtually no major discussions of generalized intrinsic factors that can lead to falls. With chronic pain patients there is a frequent response to blame falls on “medications” or “old age.” However, these arguments cannot explain any of the falls that occur in younger patients with no comorbidities who are not taking any medications. Indeed, Leveille\(^6\) has pointed out in one study that the presence of at least one pain medication a day seems to provide some protection against falls in community-dwelling elderly women. Other studies regarding pain and falls have shown no correlation between the risk of falls and medications being used.\(^1,5\)

### Conclusion

Athletes are capable of using much more highly integrated control of the center of momentum in order to perform athletic maneuvers. Any added impulse, either extraneous or intrinsic can disrupt that control of the center of momentum. The timing and intensity of an added flexor withdrawal reflex during gait may be variable but it can in theory impart sufficient alteration in momentum to cause loss of control of the dynamic and static stability of the center of mass. Indeed, at least conceptually, a sudden flexor withdrawal reflex in a leg need only lift the weight of the leg in order to make the person airborne. Such a mechanism would in fact explain not only the frequency of falls, but also some of the random distribution of the injuries.
Chronic Pain and Falls

Published on Practical Pain Management (http://www.practicalpainmanagement.com)

References:

2. Dobson RC; Unpublished data.
7. Dobson RC. Unpublished data.
Chronic Pain and Falls
Published on Practical Pain Management (http://www.practicalpainmanagement.com)

the Second World Congress on Neurorehabilitation, cosponsored by the American Academy of Neurology; Toronto, Ontario, Canada, April 13, 1999.

2. Dobson RC; Unpublished data.


7. Dobson RC. Unpublished data.

First published on: September 1, 2015
Continue Reading:
The Role of Body Posture In Musculoskeletal Pain Syndromes
[5]

Source URL: http://www.practicalpainmanagement.com/pain/other/co-morbidities/chronic-pain-falls

Links:
Chronic Pain and Falls
Published on Practical Pain Management (http://www.practicalpainmanagement.com)

[4] #fieldset