



Commentary

## Hip Fractures can be Prevented with Use of Emerging Technology

Rebecca J Tarbert\*

Director of Clinical Programs, ActiveProtective Technologies, Inc, Fort Washington, Pennsylvania, United States

### Introduction

Hip fractures are a major health problem worldwide with expectations of increased impact in the coming years. Globally, hip fractures are estimated to affect approximately 18% of women and 6% of men adding up to 1.6 million in the year 2000. Though efforts to avoid fragility fracture including hip fracture, are a priority for many healthcare organizations, the expansion of the older adult population worldwide increases anticipated number of hip fractures to reach 4.5 million globally by the year 2050 [1]. The incidence of hip fracture increases with age and associated decrease in bone mass with increased rate of falling. Prevalence of hip fractures is highest in the Northern and Central European countries with raising rates in South American and Asia. The contributions in urban settings including harder surfaces, decreased participation in physical activity and limited sun exposure with resultant decreased levels of Vitamin D contribute to the 20-60% likelihood of hip fracture in this environment versus rural residence. Medical changes accompanied by the timing and environmental alterations of hospital admission, care facility admission and initial weeks returning home from an inpatient stay has been correlated to increased risk of hip fracture with decreased familiarity of surroundings, increased fragility and even transitional weakness [2]. Cost of hip fractures to care systems around the world continue to be the highest injury costs to healthcare. Estimations of annual cost to the UK associated to hip fracture were reported at £1.1billion in hospital costs alone, and in the US total cost per year being \$10-15 billion [3-4]. An older woman is more likely to die from suffering a fall with hip fracture as compared to risk of death from breast cancer, uterine cancer and ovarian cancer combined. Outcomes following hip fracture if survived include high likelihood of dependency for

mobility, increased risk for future fracture and reduced quality of life. The compounding consequences after experiencing the devastating fall with hip fracture with reduced mobility increases incidence of cardiovascular diseases, depression and disability. The physical, emotional, societal and financial costs of hip fracture continue to impact the individual, their family, the healthcare organization and society well beyond the incident alone. Health practitioners providing care in locations with a predominant older adult population can offer avoidance of hip fracture with recognition of risk factors and incorporation of regular screening with recommendations to implement protective measures in order to avoid hip fractures.

Older adults presenting upon emergency or well visit warrant screening for fall and hip fracture risk to include recommendations of risk reduction and avoidance of life altering outcomes before a fracture occurs. Utilizing typically captured criteria on health history and general health to identify possible risk of hip fracture can be generalized as osteoporosis, frailty, sarcopenia and falls risk [5]. Each of these areas are treatable with influence dependent upon the extent of syndrome progression. Intervention associated with addressing all risk factors of possible occurrence of hip fracture incorporate the consideration of physical activity, nutrition, and fall prevention and medication management. Interdisciplinary management of falls and hip fractures can include the screening of risk factors and offering measures for management of factors including referral to community resources. Risk factors for hip fracture specifically shared by the International Osteoporosis Foundation include: osteoporosis, sedentary lifestyle, smoking, high intake of alcohol (specifically >4 units/day doubling the risk of hip fracture), prolonged use of corticosteroids (doubling hip fracture risk), long term use of proton inhibiting drugs, low body weight/ weight loss, previous low trauma fall fracture, fall risk and use of anxiolytics, sedatives, neuroleptics and antidepressants [6].

Identification of osteoporosis is critical for early administration of treatment and fracture prevention strategies. The diagnosis of osteoporosis utilizing bone mineral density scan known as (DXA) dual-energy X-ray absorptiometry provides the strongest indication of implementation for osteoporosis medications, such as a bisphosphonate and Vitamin D supplementation [7]. This costly diagnostic is recommended for institution of clinical effectiveness against hip fracture, but this test is not always available to the patient who may be at risk [8]. Mobility limitations, financial limits of health insurance coverage, behavioral impact of the testing process and burden of testing for some older adults who have indications of osteoporosis may outweigh the benefit of receiving the BMD score. Health care practitioners need to consider risk already identified and potential benefit for individual cases with aspects of cost to facilitate transportation, testing and results analysis versus the physical and emotional cost the testing would cause the frail older adult to endure. The FRAX® Fracture Risk Assessment Tool is a validated web-based risk assessment that takes the risk factors for osteoporosis and places them into an easy to use questionnaire. This publicly available tool can be

\*Corresponding author: Rebecca J Tarbert, Director Of Clinical Programs, ActiveProtective Technologies, Inc, Fort Washington, Pennsylvania, United States, Tel: +1 267 242 6125; Email:rebecca@activeprotective.com

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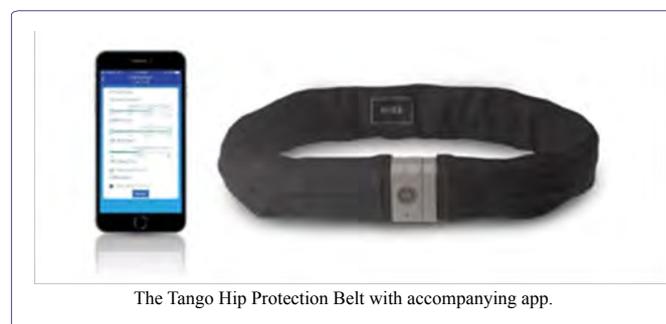
utilized with or without bone mineral density to estimate the 10-year risk of fracture. Identification of a person who is at risk of fracture can support the intervention by clinical teams before a fall and fracture occur. Evidence-based practice utilizing information from DXA scan T-score, risk screen such as the FRAX and the clinician’s judgment and patient preference should be utilized to initiate prevention of hip fracture as soon as possible.

The utilization of medications for bone mass is one strategy to avoid hip fracture, though is less likely to be utilized for older adults at very high risk of hip fracture due to being in their 8th - 9th decade. Identification of the risk factors that are leading to the individual’s risk of falling that can be modified including those that also have been found to increase risk of hip fracture can offer individuals and caregivers strategies to maintain healthy mobility even into last years of life. Fall risk factors that increase risk of hip fracture include, though are not limited to: incontinence, visual impairment, walking problems, cognitive impairment and orthostatic hypotension [9]. Interdisciplinary communication can offer effective medication management to lessen fall and hip fracture risk with recognition of those medications that increase fall risk for older adults such as psychoactive or cardiometabolic medications. Avoiding a hip fracture can be daunting with a compounding aspect of an individual’s fear of fracture and fear of falling. The fear of falling has been associated with self-limiting behaviors of older adults which perpetuates decreased participation in physical activity. The innate fear and lessening mobility performance contribute to a further increase in fall risk and quality of life reduction [10].

Offering options that can ease fear of falling, lessen fear of fall injury and encourage the participation in independent mobility for those at high risk of falling and risk of hip fracture can be provided. Recommendation of the identified person to a physical therapist for fall risk assessment and treatment can facilitate patient specific fall risk factor counseling addressing those items specifically placing the individual at risk. Physical therapy can offer postural system and musculoskeletal system testing to identify specific areas of impairment for remediation and/or compensation for modifiable and unmodifiable areas of risk. Many communities have fall awareness programming to increase fall risk awareness for self-referral to treatment options. One example of such offering is A Matter of Balance by the NCOA in the United States [11], which has been shown to improve the individual’s balance and self-perception of balance confidence. There will inevitably be individuals that will continue to be at high risk of hip fracture due to unmodifiable risk factors such as age, history of previous fractures, presence of osteoporosis and high fall risk with unmodifiable factors. Traditional management of hip fracture risk beyond the modifiable factors for falls include the utilization of “padding” equipment on the person and in their environment. The use of anatomically designed external hip protector pads that are sewn into garments such as shorts, have demonstrated the ability to reduce hip fractures significantly [12]. The effectiveness of such passive hip pad devices is limited due to their limited compliance with use. Factors impacting the utilization of wearable hip pad include ease of use with the older adult client, incontinence issues and comfort as the harder the pad, the more protection offered [13].

Advancement of technology in the arena of wearable sensors has enabled the emergence of less obtrusive methods. Recently a fall-sensing belt that can be comfortably worn 24 hours a day has

been available for those most at risk of falls and hip fracture. This wearable contains a 3D sensor which accurately detects when the wearer is entering into an irrecoverable, serious, hip-impacting fall. In the circumstance that the belt senses this fall motion toward the hip, it will deploy airbags before the hip strikes the ground to attenuate forces away from the proximal femur and avoid injury. The airbag in this smart belt (Tango Belt) that inflates immediately before the user’s hip strikes the ground has found to provide 200% more anatomical coverage than the typical passive hip pad and reduce a greater amount impact force as compared to the most effective passive hip pad in market. The belt will provide alerts to caregivers in order to bring attention to the wearer when assistance is critically needed. The 3D sensor is located on the lower back aspect of the slim fitted belt where it can capture posture and mobility information. Data gathered by the internal sensor is shared to individuals and/or care teams with a companion mobile app. Current data that is included in the app is wear adherence over past 30 days and daily, self-perception of balance confidence and average deviation from midline in terms of postural sway over a 24 hour period. Adherence to the use of the belt has been reportedly strong with 80-90% wear as recommended. Many of the individuals who wear the Tango belt do so for periods of 24 hours in order to be protected in times of most vulnerability to falls and fall injuries including overnight when going to use the bathroom. Users of the belt report increased confidence in their balance and participation in mobility. The Tango Belt has demonstrated positive deployment of airbags in scenarios with serious, hip-impacting fall motions detected in real world use with zero hip fractures while worn to date.



Just as helmets are utilized in day to day life by those who wish to avoid injury to the head, the use of technology to protect hips when most needed can become a lifesaving device for those most at risk of hip fracture. Hip fractures are a devastating event for the individual who experiences the fall and hip fracture, as well as for the family and caregivers of the individual. The utilization of fall-sensing technology has the capability to prevent this serious event for the growing adult population. Screening older adults for risk of hip fracture in emergent care and usual care situations can provide opportunity to prevent a future hip fracture. Investment in technology that can offer increased safety and improved mobility for the soon to be largest age group supports healthy aging in all communities. The burden of healthcare costs impacts world economy and proactive care in avoidance of hip fracture for those most at risk can be provided to lessen the burden of the highest cost fragility injury. Encouraging older adults who fall into a high-risk of hip fracture need a solution to offer them the ability to continue with independent participation in mobility in their community and setting. All health care personnel should recognize that hip fracture can be effectively prevented. Various measures can

be implemented with collaboration of older adults and their families leading to decreased burden from hip fracture.



The Tango Belt on a senior user.

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