Upper Extremity Fractures and Secondary Fall Prevention: Opportunities to Improve Management and Outcomes Across Disciplines

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• APTA and the Academy of Geriatric Physical Therapy
• Boston University, TREAT, NEPDC
Objectives

- Present current evidence related to UE Fx through the lens of secondary prevention
  - Selected studies from TDI MCRC Research Fracture Care Project
    - Study 1: Epidemiology of Second Fracture
    - Study 2: Prescription Drug Use Before and After Fx
    - Study 3: Evaluation and Treatment of Balance & Gait after UE Fx
    - Study 4: Opioid Use after Fx
  - Recommendations based on American Physical Therapy Association
    - Fall Risk Management Guideline
    - Systematic Review of Measures

Sample & Data Sources

- Fee-for-service Medicare beneficiaries age 66–99 years old who sustained a hip, shoulder, or wrist fragility fracture
- Enrolled in Medicare
- Without managed care enrollment for one year before and one year after the index fracture or until death
- Identified fracture types using claims
Study 1: Fracture Epidemiology

Second fractures among older adults in the year following hip, shoulder, or wrist fracture


Cohort Description

Number Eligible for Fracture
N=23,873,739

People with Eligible Fracture
N=342,557

enrollment Exclusions

- Not full yr Part A & B prior
- Not full yr Part A & B after unless died
N=60,575

Hip Hospital Community
N=169,082 N=0

Shoulder Hospital Community
N=6,552 N=31,743

Wrist Hospital Community
N=6,730 N=67,875

Clinical Exclusions

- Non-osteoporotic
- Major trauma
- Complication of prior fracture
N=8,653

Hip N=161,072 Community
N=161,072 N=0

Shoulder N=37,716 Community
N=6,030 N=31,686

Wrist N=24,542 Community
N=6,723 N=67,819
Results

- Hip fracture patients: older, had higher comorbidity.
  - Older more likely to die by 1 yr after index Fx
    - Hip: 27%
    - Shoulder: 13%
    - Wrist: 7%
- Women more likely than men to sustain any Fx
  - Gender imbalance > for UE than hip Fx
    - Wrist: 14 % male
    - Shoulder: 19 % male
    - Hip: 26 % male

Second Fracture Results

Fig. 2 Distribution of second fracture type among beneficiaries who sustained a second fracture within 1 year of index hip, shoulder, or wrist fracture.
Second Fracture Results & Conclusions

- Overall 11,885 people (4.3%) had second within one year
- Age and comorbidity have strong effects on risk of second fracture
- Little difference in risk by index fracture type or gender (hip: 7.3k; shoulder: 5.8k; wrist: 5.5k per 100k)

Results reveal that fracture prevention is as important after humerus and wrist fracture as for hip and for men as much as women.

Study 2: Prescription Drug Use

Research

JAMA Internal Medicine | Original Investigation
Patterns of Prescription Drug Use Before and After Fragility Fracture

Jeffrey C. Murson, MD, MSCE; Julie P. W. Bynum, MD, MPH; John-Erik Bell, MD, MS; Robert Cantu, MD, MS; Christine McDonough, PT, PhD; Qianfei Wang, MS; Tor D. Tosteson, ScD; Anna N. A. Tosteson, ScD

JAMA Internal Medicine  October 2016  Volume 176, Number 10
### Table 1. Drugs Associated With Increased Risk of Fracture by Proposed Mechanism

<table>
<thead>
<tr>
<th>Proposed Mechanism of Increased Fracture Risk</th>
<th>Cohort Use Prior to Fracture, %</th>
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</thead>
<tbody>
<tr>
<td>Increased Risk of Falls</td>
<td></td>
</tr>
<tr>
<td>Benzodiazepines</td>
<td>2.8</td>
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<tr>
<td>Barbiturates</td>
<td>1.2</td>
</tr>
<tr>
<td>Sedative-hypnotics (nonbenzodiazepine)⁴</td>
<td>10.8</td>
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<tr>
<td>Opiates</td>
<td>35.5</td>
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<tr>
<td>Selective serotonin reuptake inhibitors⁵</td>
<td>26.4</td>
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<tr>
<td>Tricyclic antidepressants</td>
<td>4.8</td>
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<tr>
<td>Anti-Parkinson disease drugs</td>
<td>5.6</td>
</tr>
<tr>
<td>centrally acting antihypertensives</td>
<td>3.9</td>
</tr>
<tr>
<td>Nitrates</td>
<td>8.6</td>
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<tr>
<td>Non-trace anti-anginal agents</td>
<td>1.4</td>
</tr>
<tr>
<td>Thiazide diuretics</td>
<td>23.4</td>
</tr>
<tr>
<td>Thiazide-like diuretics</td>
<td>2.8</td>
</tr>
<tr>
<td>Decreased Bone Density</td>
<td></td>
</tr>
<tr>
<td>Inhaled glucocorticoids</td>
<td>7.0</td>
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<tr>
<td>Oral glucocorticoids⁶</td>
<td>9.8</td>
</tr>
<tr>
<td>Proton pump inhibitors⁷</td>
<td>25.6</td>
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<tr>
<td>H2 receptor antagonists</td>
<td>5.6</td>
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<tr>
<td>Thiazolidinedionones⁸</td>
<td>5.7</td>
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<tr>
<td>Anticonvulsants</td>
<td>9.3</td>
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<tr>
<td>Unclear Primary Mechanism</td>
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<tr>
<td>Atypical antipsychotics⁹</td>
<td>5.2</td>
</tr>
<tr>
<td>Early-generation antipsychotics</td>
<td>1.8</td>
</tr>
<tr>
<td>Loop diuretics</td>
<td>21.0</td>
</tr>
</tbody>
</table>

*Subset of drugs with a risk of fracture most literature.

### Rationale: Prescription Drug Use Is Modifiable Risk Factor

- **Fragility Fracture**
  - Bisphosphonates
    - Increased Bone Density
    - Decreased Second Fracture
  - Proton Pump Inhibitors
    - Decreased Bone Density
    - Increased Second Fracture
  - Opiates, SSRIs, sedatives
    - Increase Fall Risk
    - Increased Second Fracture
Study 2: Prescription Drug Use

• Background:
  • Prescription drugs are modifiable risk factor for second fracture
  • Bisphosphonate use after fracture low
  • Small study showing high rate of use of drugs associated with fall risk
• Aim: To characterize prescription drug use and associated fracture risk before and after fragility fracture

Study 2 Results & Conclusions

• There was very little reduction in exposure to prescription drugs associated with fracture risk after fragility fracture
• some patients discontinued drugs associated with fracture
• an equal number started new risk-related drugs
• ~ 25% used bone-building drugs

Post-fracture care is an opportunity to ↓ medication-related risk of second fracture risk
Study 3

Original Research

Falling Down on the Job: Evaluation and Treatment of Fall Risk Among Older Adults With Upper Extremity Fragility Fractures

C.M. McDonough, PT, PhD, Department of Orthopaedic Surgery, S.L. Rubin Clinical Research Center, Geisel School of Medicine at Dartmouth, Dartmouth-Hitchcock Medical Center, One Medical Center Drive, Lebanon, NH 03756 (USA), and Boston University School of Public Health, Boston, Massachusetts. Address all correspondence to Dr McDonough at chris.m.mcdonough@dartmouth.edu.

C.H. Colla, PhD. The Dartmouth Inst.

Study 3 Methods

Subjects: Fee-for-service beneficiaries age 66 to 99 treated as outpatients for proximal humerus or distal radius/ulna ("wrist") fragility fractures

Outcomes
- % evaluated or treated for fall risk up to 6 months after proximal humerus or wrist fracture from 2007-2009
- Predictors of receiving evaluation or treatment (logistic regression)
Percent Receiving Assessment or Treatment for Extremity Fracture Study Results

Percent of Medicare Beneficiaries who Received Evaluation or Treatment up to 6 Months after Index Proximal Humerus or Wrist Fracture (n=309,947).

Study 3 Results

• 10.7% received evaluation or treatment for fall risk or gait issues
• Using the broader definition the percentage increased to 18.5%
• Higher likelihood of services after fracture were: evaluation or treatment for falls or gait prior to fracture, more comorbidities, prior nursing home stay, older age, humerus fracture (versus wrist), female sex and white race
Study 3 Conclusions/Next Steps

This low rate of assessment and treatment after an upper extremity fracture is the most important finding of this study, marking a large missed opportunity to reduce future falls and associated functional loss.

Next step
Rerun the analysis from 2010-2013 to address more recent incentives and policies (AGS/BGS CPG, APTA CGS, PQRS, Medicare annual wellness visit, etc.)

Opportunities to Improve Management and Outcomes Across Disciplines

Fragility fractures should be sentinel events triggering
• Assessment of medication-based risk & reduction
• Evaluation & treatment of balance and mobility deficits
• Consider humerus, wrist, and hip fracture as equally predictive of second fracture

Take appropriate action as soon as possible after fracture
Methods: Identification of Clinical Practice Guidelines (CPGs)

- Systematically search (11 databases)
- Search terms: falls, geriatric, older adult
- Inclusion
  - Published between 2000 and 2013
  - English and
  - Adults over the age of 65 living in the community or in assisted-living settings
- Exclusion
  - Specific to a neurological condition (e.g., stroke, Parkinson disease, multiple sclerosis)
  - Fracture management
  - Clinical practice statements excluded
Methods

• 4028 CPGs identified
• 5 met inclusion criteria
• Critically appraised by >=3 reviewers: AGREE II
  — AGS/BGS (American & British Geriatrics Societies)
  — NICE (National Institute for Health & Care Excellence)
  — FSGG (French Society of Geriatrics & Gerontology)
  — AGILE (UK Society for PTs working with older adults)
  — Moreland J et al. 2003

Recommendations

• The recommendations were written for physical therapists
• Based on multi-disciplinary CPGs, therefore may be relevant for other disciplines
• Levels of Evidence
  — Level I: Strong (RCTs, SR)
  — Level II: Moderate (small RCTS, quasi-experimental)
  — Level III: Weak (observational studies)
Screening

[Physical therapists] should routinely ask older adult patients if they have fallen in the previous 12 months (Strong Recommendation based on Level III evidence). Screening should include:

- History and context of falls over previous 12 months
- At least one question about the patient’s perception of difficulty with balance or walking

Screening

For each patient who reports a fall or falls or reports difficulty with balance or walking, [the physical therapist] should screen by observing for gait or balance disturbance (Strong Recommendation based on Level III Evidence). Positive screening result is when either is found:

- Multiple falls
- One fall + balance or gait impairment
### Assessment Evidence: Health Conditions

**Cardiac conditions**

- **VV** Cardiac exam (NICE, AGS/BGS)
  - HR, rhythm, postural pulse, BP, hypotension (AGS/BGS)
- **√** Anti-arrhythmia medication (NICE)
- **√** Cardiac drugs and postural hypotension (Moreland)
- **VV** Osteoporosis (NICE, AGS/BGS)

  Risk assessment or diagnosis

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### Assessment Evidence: Health Conditions

- **√** Depression (Moreland)
  - Assess for risk
  - Geriatric Depression Scale

- **VVV** Medication review
  - Number of meds with dosage
  - Cardiac
  - Psychotropic (benzodiazepines, hypnotics, antidepressants, tranquilizers)
Assessment Evidence:
Body Functions and Structures

Strength of the extremities
- Lower extremity strength (AGS/BGS)

Balance
- No specific procedures or methods for balance assessment are provided within the CPGs
- Frequently used tests: BBS, TUG, POMA

Vision
- Visual acuity (AGS/BGS)

Urinary function/ incontinence

Cognitive assessment/ neurologic function
- Cognitive evaluation (AGS/BGS, NICE)
- Peripheral nerve function, proprioception, reflex testing, and cortical, extrapyramidal, cerebellar function (AGS/BGS)
Assessment Evidence: Activity and Participation

✔✔✔ Gait (thorough and detailed)
  • Gait deficits or abnormalities are a risk factor for falls
  • No specific procedures or methods were recommended
  • Individual professional should identify appropriate measures for the assessment of gait for each older adult (NICE)
  • Use of walking aids (Moreland)

Assessment Evidence: Activity and Participation

✔✔ Activities of daily living and mobility
  • ADL skill including use of adaptive equipment
  • Mobility aids (AGS/BGS)
  • Transfers (Moreland)

✔ Physical activity
  • Given that moderate activity levels may be protective to balance and falls, assess levels of physical activity (Moreland)
Assessment Evidence: Environmental and Personal Factors

√√√ Since home safety and hazards are risk factors, assess the home for hazards
  • Example: Tripping hazards: attention to loose rugs and mats

√√ Fear and health perception
  • Assess perceived functional ability and fear of falling

Assessment: Environmental and Personal Factors

✓ Social support
  • Identification of the older adult’s social support network (Moreland)

✓ Alcohol use
  • Assessment of consumption and inappropriate alcohol use (Moreland)

✓ Feet and footwear
  • Assess feet and footwear (AGS/BGS)
Intervention Evidence: Health Conditions

- Conduct medication review; modify/withdraw psychotropic meds if possible
- Treat cardioinhibitory carotid sinus hypersensitivity (NICE, AGS/BGS)
- Treat postural hypotension (AGS/BGS, Moreland)
- Treat vitamin D insufficiency (AGS/BGS)
- Treat impaired cognitive status (Moreland)
- Treat depression (Moreland)

Intervention Evidence: Body Functions and Structure

- Individualized balance training
- Individualized strength exercises (NICE, AGS/BGS)
- Monitored by appropriately trained health care professional (NICE, AGS/BGS)
- Coordination training (AGS/BGS)
- Flexibility and endurance should be offered; not as stand alone intervention (AGS/BGS)
Intervention Evidence: Body Functions and Structure

For persons who have fallen, but with no specific findings on assessment

✔ Tai chi or other balance control ex (e.g. on foam surfaces) (Moreland)

✔ For women over 80 yrs, individualized home physical therapy program for strengthening, balance, and flexibility (Moreland)

Intervention Evidence: Body Functions and Structure

Delivery

✔ Referral to physical therapy (Moreland)

✔ Tai chi or physical therapy (AGS/BGS)

✔ Group exercise or individual (AGS/BGS)
### Intervention Evidence: Body Functions and Structure

| ✓ | Expedite first cataract surgery when indicated (AGS/BGS) |
| xe | Advise against multifocal lenses for walking on level and stairs (AGS/BGS) |
| ✓ | Treat vision and hearing impairment (Moreland) |
| ___ | Insufficient evidence to recommend vision correction as stand-alone falls intervention (NICE, AGS/BGS) |

### Intervention Evidence: Activity & Participation

| ✓ ✓ | Individualized gait training combined with balance and strength training (AGS/BGS, Moreland was specific to older women) |
| xe | Advise against brisk walking for post-menopausal women with fracture history (Moreland) |
| ___ | Insufficient evidence for brisk walking (NICE) |
Intervention Evidence: Activity & Participation

- ADL training for those with difficulty performing ADL activities. (AGS/BGS, Moreland)

Intervention Evidence: Education

- Education and information giving
- Verbal and written re: prevention, effective measures, motivation to exercise, benefits of engagement in risk reduction activities (NICE)
- Tailored education within multi-factorial intervention (AGS/BGS)
- Insufficient evidence for targeted or untargeted educational programs as stand-alone interventions (AGS/BGS)
**Intervention Evidence: Alcohol and Physical Activity**

For those with inappropriate alcohol use
√ Educate and refer for treatment (Moreland)

For those with risky activity level
√ Educate and refer for treatment (Moreland)

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**Intervention Evidence: Environmental Factors**

Home hazard modification
√√√ Home hazard assessment combined with modifications. Home hazard assessment should not be conducted without follow-up and modifications
**Intervention Evidence: Personal Factors**

**Footwear**

- ✓ Treatment of foot and footwear problems identified in multi-factorial assessment (AGS/BGS)
- ✓ Advise low heels and high surface contact area (AGS/BGS)

**Hip protectors**

- ✓ Insufficient evidence to recommend hip protectors for fall prevention (NICE)

**Note** that hip protectors may be effective in preventing fractures associated with falls.
Assessment Recommendations

[Physical therapists] should provide individualized assessment within scope of practice that contributes to multi-factorial assessment of falls and fall risk. Additional risk factors may need to be addressed by the appropriate provider (Strong Recommendation based on Level II evidence). This assessment should include:

• Medication review
  – Polypharmacy & psychoactive drugs

• Medical History
  • Osteoporosis
  • Depression
  • Cardiac disease
    • Signs & symptoms of cardioinhibitory carotid sinus hypersensitivity
Assessment Recommendations

- Body functions and structure, activity and participation, environmental & personal factors
  - Strength
  - Balance
  - Gait
  - Activities of Daily Living
  - Footwear
  - Environmental Hazards
  - Cognition
  - Neurological Function
  - Cardiac function, including postural hypotension
  - Vision
  - Urinary incontinence

Intervention Recommendations

- Broadly, recommendations were similar for older adults at risk of falls
  - Individualized exercise program including:
    - Balance training
    - Strength training
    - Referral to physical therapy (Moreland)
  - There were differences...
Intervention Recommendations

[Physical therapists] *should* provide individualized interventions within the scope of practice (Strong Recommendation based on Level I evidence). Components of the intervention should include:

- Strength training that is individually prescribed, monitored, and adjusted (Strong recommendation based on Level I evidence)

Intervention Recommendations

- Balance training that is individually prescribed, monitored, and adjusted (Strong recommendation based on Level I evidence)
Intervention Recommendations

• Gait training (Strong recommendation based on Level I evidence)

Intervention Recommendations

• Correction of environmental hazards (Strong recommendation based on Level I evidence)
Intervention Recommendations

- Correction of footwear or structural impairments of the feet (Recommendation based on Level II evidence)

Which tests to Use to Determine Fall Risk

**Systematic Reviews**

**Determining Risk of Falls in Community Dwelling Older Adults: A Systematic Review and Meta-analysis Using Posttest Probability**

Michelle M. Lusardi, PT, DPT, PhD\(^1\); Stacy Fritz, PT, PhD\(^2\); Addie Middleton, PT, DPT, PhD\(^3\); Leslie Allison, PT, PhD\(^4\); Mariana Wingeod, PT, DPT, GCS\(^5\); Emma Phillips, PT, DPT, GCS\(^6\); Michelle Criss, PT, GCS\(^7\); Sangita Verma, PT, DPT, GCS\(^8\); Jackie Osborne, PT, DPT, GCS\(^9\); Kevin K. Chui, PT, DPT, PhD, GCS, OCS\(^10\)

*Journal of GERIATRIC Physical Therapy*  DOI: 10.1519/JPT.0000000000000099
### Summary of Clinically Useful Indicators of Fall Risk

<table>
<thead>
<tr>
<th>Category</th>
<th>Measure</th>
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<tbody>
<tr>
<td>Medical History Questions</td>
<td>Any previous falls</td>
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<tr>
<td></td>
<td>Psychoactive medication</td>
</tr>
<tr>
<td></td>
<td>Requiring any ADL assistance</td>
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<tr>
<td></td>
<td>Ambulatory assistive device use</td>
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<tr>
<td>Self-report Measures</td>
<td>Geriatric Depression Scale-15</td>
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<td>Falls Efficacy Scale International</td>
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<tr>
<td>Performance-based Measures</td>
<td>Timed Up &amp; Go Test</td>
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<tr>
<td></td>
<td>Single-limb stance eyes open</td>
</tr>
<tr>
<td></td>
<td>Five Times Sit-to-Stand Test</td>
</tr>
<tr>
<td></td>
<td>Self-selected walking speed</td>
</tr>
</tbody>
</table>

More details...


Mode

- Must include balance training
- Strength training only has small effect
- Multifactorial home or community-based interventions
- Walking programs alone have small effect

Intensity

- Intensity of training
  - Balance training
    - “demanding”
    - “challenging”
    - “appropriate and increasing levels of difficulty”
  - Highest possible level of difficulty without falling or near-falling
  - Mastery of each exercise before progressing
Frequency

- Minimum effective frequency twice per week
- Most consistently effective frequency three times per week
- Higher frequencies reduce fall risk, but adherence was poor

Time

- Total exercise volume?
  - At least 40* or 50** hours over the course of the intervention

*Power et al
**Sherrington et al
## Exercise components

- **What works**
  - Leaning beyond BOS
  - Shifting the COM
  - Minimizing UE support
  - Narrowing base of support
  - Dual-task movement
  - Altering sensory feedback
  - Functional activities
  - TJQMBB

- **What doesn’t work**
  - Lack of balance training component
  - Lack of functional relevance
  - Lack of exercise progression

## Questions?
Thank You!