COMPRESSION FRACTURES

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Laurie Bell, PT - Physical Therapy
Gregg Weidner, MD - Anesthesia
Joe Tu, MD - PM&R
H. Francis Farhadi, MD, PhD - Neurosurgery
Case Presentation - Compression Fractures

- 76 year old female falls and has sudden and severe back pain in the thoraco-lumbar region.
- There is no weakness or numbness or tingling.
- The pain level is 7.
- She stays in bed for 3 days and the pain remains severe. She is placed on vicodin and it helps some, but she is still incapacitated.
- Her PE shows no weakness or abnormal findings other than tenderness at the lower thoracic spine.
- X-ray shows a compression fracture at L2 MRI with and without contrast shows only the fracture and no uptake around the fracture.
COMPRESSION FRACTURES

- Very Common: 1.5 million/year
- 25% of all post-menopausal women
- 1 VCF increases risk for another by 5X
- 30% of VCF in severe osteoporotics occur at bedrest
- 60-75% at thoraco-lumbar region
- 60% improve by 3 weeks with usual care
- Less likely to improve -> 78, obese, collapse >30%, severe osteoporosis
- Significant increases in morbidity and mortality with VCF
COMPRESSION FRACTURES
Pathologic vs Osteoporotic

History
- History of previous neoplasm or infection; history of smoking, weight loss

Exam
- Both tender over fracture-pathological more likely to have neurologic findings

MRI - best differentiating tool
- Do with and without contrast, neoplastic or infectious has uptake in tissue around fracture
2 Million 2 Many

Suzanne Stanek, CNP

Comprehensive Spine Center
Every year
There are 2 million fractures
That are no accident

YET ONLY 2 IN 10 FRACTURES
GET FOLLOW-UP TEST OR TREATMENT
FOR OSTEOPOROSIS.
2 Million Fractures Annually

Vertebral Fractures: 2/3 are asymptomatic 600,000+

Wrist Fractures: 400,000+

Hip Fractures: 300,000+

Other Fractures: 900,000+

Source: National Osteoporosis Foundation, 2005
Vertebral Fractures
Make the First Fracture the Last Fracture

RISK:

- 1 in 5 osteoporotic women with a vertebral fracture will fracture again within a year
- **Height:** Risk of having had a vertebral fracture is higher with height loss of **1.5 inches**
- **Back pain---Ask about it!**
Diagnosis of Osteoporosis

1. **Dexa Scan**: gold standard for testing

2. **Fragility Fracture** *(low impact)*
   
is more predictive of future fracture than bone density*
Differential Diagnosis

- Primary osteoporosis
  - Postmenopausal or age-related

- Secondary osteoporosis
  - Vitamin D deficiency, disease, medication

- Other bone diseases
  - Multiple myeloma, osteomelacia, Paget’s Disease
Just Elderly Women??

Not just your grandmother’s disease...
Mr. K, 64 year old white male, presents to the Spine Center with c/o 2 month history of mid-back pain, severity 2-8/10.

- Some radiation around to front of chest
- No sx cauda equina syndrome
- No history of trauma, cancer or DM
- Reports losing 3” height, from 5’9” to 5’6”
Mr. K’s Medical History

- **Asthma** with history of exacerbations and pneumonia
- **Barrett’s Esophagus** with history of esophagitis
- Essential HTN
- Diverticulosis
- Essential tremor
Mr. K’s X-ray Thoracic Spine

- DDD
- Osteopenia (at least 30% bone loss)
- Multiple compression fractures
- Kyphosis
Osteoporosis
Prevention & Treatment

Pharmacotherapy
(Antiresorptives and Anabolics)

Address Secondary Factors
(Drugs and Diseases)

Lifestyle Changes
(Nutrition, Exercise and Fall Prevention)

Risk Factors for Osteoporosis

- **Non-modifiable Risk factors:**
  - Female gender
  - Race
  - Thin body frame
  - Amenorrhea
  - Advanced age >65
  - Menopause < 45 yrs
  - Fragility fracture after age 45
  - FH of fragility fracture in 1st degree relative

- **Modifiable Risk factors:**
  - Low body weight <130lb
  - ETOH use > 2 drinks/d
  - Smoking hx
  - Low Calcium intake
  - Eating disorder/ abnl menstrual cycles
  - Sedentary lifestyle/ immobilization
  - Medications associated with bone loss

STANEK
Non-modifiable Risk factors: Mr. K - NONE

- Female gender: NO
- Race: NO
- Thin body frame: NO
- Advanced age: NO
- Postmenopausal: NO
- Estrogen deficiency at early age, < 45 yrs: NO
- History of Fragility fx after age 50: NO
- Family hx of fragility fx in 1st deg relative: NO
Mr. K’s Modifiable Risk Factors

- Low body weight <130lb
  - NO
- ETOH use > 2 drinks/d
  - NO
- Smoking hx
  - NO
- Low Calcium intake
  - YES, cheese
- Eating disorder/abnormal menstrual cycles
  - NO
- Sedentary lifestyle/immobilization
  - SOME, walks at work
- Medications associated with bone loss
  - YES

Steroid tapers for asthma; PPI for esophagitis
# Secondary Causes of Osteoporosis

## Genetic Disorders
<table>
<thead>
<tr>
<th>Disorder</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cystic fibrosis</td>
</tr>
<tr>
<td>Ehlers-Danlos</td>
</tr>
<tr>
<td>Glycogen storage diseases</td>
</tr>
<tr>
<td>Gaucher’s disease</td>
</tr>
<tr>
<td>Riley-Day syndrome</td>
</tr>
<tr>
<td>Hemochromatosis</td>
</tr>
<tr>
<td>Homocystinuria</td>
</tr>
<tr>
<td>Hypophosphastasia</td>
</tr>
<tr>
<td>Idiopathic hypercalciuria</td>
</tr>
<tr>
<td>Marfan’s syndrome</td>
</tr>
<tr>
<td>Menke’s steely hair syndrome</td>
</tr>
<tr>
<td>Osteogenesis imperfecta</td>
</tr>
<tr>
<td>Porphyria</td>
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</table>

## Hematologic Disorders
<table>
<thead>
<tr>
<th>Disorder</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hemophilia</td>
</tr>
<tr>
<td>Leukemias and lymphomas</td>
</tr>
<tr>
<td>Multiple myeloma</td>
</tr>
<tr>
<td>Sickle cell disease</td>
</tr>
<tr>
<td>Systemic mastocytosis</td>
</tr>
<tr>
<td>Thalassemia</td>
</tr>
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</table>

## Rheumatic and Auto-Immune Diseases
<table>
<thead>
<tr>
<th>Disorder</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ankylosing spondylitis</td>
</tr>
<tr>
<td>Lupus</td>
</tr>
<tr>
<td>Rheumatoid arthritis</td>
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## Hypogonadal States
<table>
<thead>
<tr>
<th>Disorder</th>
</tr>
</thead>
<tbody>
<tr>
<td>Androgen insensitivity</td>
</tr>
<tr>
<td>Anorexia nervosa</td>
</tr>
<tr>
<td>Premature ovarian failure</td>
</tr>
<tr>
<td>Hyperprolactinemia</td>
</tr>
<tr>
<td>Panhypopituitarism</td>
</tr>
<tr>
<td>Athletic amenorrhea</td>
</tr>
<tr>
<td>Turner’s and Klinefelter’s syndrome</td>
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</table>

## Endocrine Disorders
<table>
<thead>
<tr>
<th>Disorder</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acromegaly</td>
</tr>
<tr>
<td>Adrenal insufficiency</td>
</tr>
<tr>
<td>Cushing’s syndrome</td>
</tr>
<tr>
<td>Diabetes mellitus (Type 1)</td>
</tr>
<tr>
<td>Hyperparathyroidism</td>
</tr>
<tr>
<td>Osteomalacia</td>
</tr>
<tr>
<td>Paget’s disease</td>
</tr>
<tr>
<td>Thyrotoxicosis</td>
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</table>

## Gastrointestinal Diseases
<table>
<thead>
<tr>
<th>Disorder</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gastrectomy</td>
</tr>
<tr>
<td>Inflammatory bowel disease</td>
</tr>
<tr>
<td>Malabsorption</td>
</tr>
<tr>
<td>Celiac disease</td>
</tr>
<tr>
<td>Primary biliary cirrhosis</td>
</tr>
</tbody>
</table>

## Miscellaneous
<table>
<thead>
<tr>
<th>Disorder</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alcoholism</td>
</tr>
<tr>
<td>Amyloidosis</td>
</tr>
<tr>
<td>Chronic metabolic acidosis</td>
</tr>
<tr>
<td>Congestive heart failure</td>
</tr>
<tr>
<td>Depression</td>
</tr>
<tr>
<td>Emphysema</td>
</tr>
<tr>
<td>End stage renal disease</td>
</tr>
<tr>
<td>Epilepsy</td>
</tr>
<tr>
<td>Gastric restrictive surgeries for obesity</td>
</tr>
<tr>
<td>Hypovitaminosis D</td>
</tr>
<tr>
<td>Idiopathic scoliosis</td>
</tr>
<tr>
<td>Immobilization</td>
</tr>
<tr>
<td>Multiple sclerosis</td>
</tr>
<tr>
<td>Muscular dystrophy</td>
</tr>
<tr>
<td>Post-transplant bone disease</td>
</tr>
<tr>
<td>Sarcoidosis</td>
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</tbody>
</table>

## Medications
<table>
<thead>
<tr>
<th>Medication</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anticoagulants (heparin)</td>
</tr>
<tr>
<td>Aluminum</td>
</tr>
<tr>
<td>Anticonvulsants</td>
</tr>
<tr>
<td>Cytotoxic drugs</td>
</tr>
<tr>
<td>Glucocorticoids and adrenocorticotropin</td>
</tr>
<tr>
<td>Gonadotropin-releasing hormone agonists</td>
</tr>
<tr>
<td>Immunosuppressants</td>
</tr>
<tr>
<td>Lithium</td>
</tr>
<tr>
<td>Methotrexate</td>
</tr>
<tr>
<td>Progesterone (parenteral, long-acting)</td>
</tr>
<tr>
<td>PPIs</td>
</tr>
<tr>
<td>Thyroxine</td>
</tr>
<tr>
<td>Tamoxifen</td>
</tr>
<tr>
<td>Total parenteral nutrition</td>
</tr>
</tbody>
</table>
AACE-Recommended Laboratory Tests

Complete Blood Count and Sed Rate

Serum Chemistry Studies

- Calcium
- Phosphorus
- Pre-albumin
- Alkaline phosphatase
- Liver enzymes
- Creatinine
- 25-hydroxyvitamin D
- Parathyroid hormone (PTH-I)
- TSH
- Urinary calcium excretion

Special Tests

- Serum protein electrophoresis
### Mr. K’s Laboratory Tests

<table>
<thead>
<tr>
<th>Test</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>CBC: Hgb</td>
<td>normal</td>
</tr>
<tr>
<td>Sed rate</td>
<td>normal</td>
</tr>
<tr>
<td>Calcium = 9.2</td>
<td>normal</td>
</tr>
<tr>
<td>Creatinine = 0.80</td>
<td>normal</td>
</tr>
<tr>
<td>Phosphate = 2.8</td>
<td>normal</td>
</tr>
<tr>
<td>Pre-albumin =</td>
<td>normal</td>
</tr>
<tr>
<td>PTH-I = 38.2</td>
<td>normal</td>
</tr>
<tr>
<td>Alkaline phosphatase = 63</td>
<td>normal</td>
</tr>
<tr>
<td>TSH = 2.902</td>
<td>normal</td>
</tr>
<tr>
<td>ALT/AST = 26/33</td>
<td>normal</td>
</tr>
<tr>
<td>25-hydroxyvitamin D = 13.1</td>
<td>LOW</td>
</tr>
<tr>
<td>Urinary calcium excretion</td>
<td>not done</td>
</tr>
</tbody>
</table>
Who May be D-Deficient?

Screen:
- Adults > 50 years
- Limited sun exposure; sunscreen, protective clothing
- Darkly pigmented skin
- Live north of the Carolinas
- Inadequate intake of vitamin D; malabsorption
- Chronic liver & kidney disease
- Drugs: anticonvulsants, glucocorticoids; anti-rejection meds

Source: NHANES III
Who should get a DEXA?

**Women**
- age 65 and older
- younger postmenopausal with 1 or more risk factors

**Men**
- age 65 and older
- men > age 50 with risk factors

**Men and women**
- > age 50 who present with fragility fractures
- with primary hyperparathyroidism
- requiring long-term glucocorticoid therapy

Dexa of Spine: OA and False Negatives

Solution: read only areas not lit up
OR order Dexa of non-dominant forearm
Mr. K’s Dexas Scan

> 50% Fragility Fractures

- Osteoporosis
- Osteopenia/Low Bone Mass
- Normal Bone

Spine -2.3
Total hip -1.7
Femoral neck -2.2
Why does Mr. K have osteoporosis at this age and with few risk factors?

50% of men with osteoporosis have *secondary* causes.
Oh, By The Way……..

“I have 2 sons with celiac disease. If I have celiac disease, could that effect my bones?”
Mr. K’s Test Results for Celiac Disease

- Tissue Transglutaminase IgA = 10  **HIGH**
- Tissue Transglutaminase IgG = 3  **normal**
- Endomysial Antibodies IgA =  **negative**
Mr. K’s Diagnosis & Treatment of Osteoporosis

Diagnosed by fragility fracture of vertebra

Lifestyle Changes
(Exercise, calcium citrate 600 mg bid, vitamin D 50,000 IU weekly x 12 + 2000 IU daily)

Address Secondary Factors

Pharmacotherapy


STANEK
Mr. K’s Diagnosis & Treatment of Osteoporosis

Diagnosed by fragility fracture of vertebra

Pharmacotherapy

Address Secondary Factors
(Celiac disease; PPI, Steroids)

Lifestyle Changes
(Exercise, calcium citrate 600 mg bid, vitamin D 50,000 IU weekly x 12 + 2000 IU daily)
Mr. K’s Diagnosis & Treatment of Osteoporosis

Diagnosed by fragility fracture of vertebra

Pharmacotherapy
(IV-Reclast)

Address Secondary Factors
(Celiac disease; PPI, Steroids)

Lifestyle Changes
(Exercise, calcium citrate 600 mg bid, vitamin D 50,000 IU weekly x 12 + 2000 IU daily)
Mr. K’s Diagnosis & Treatment of Osteoporosis

Diagnosed by fragility fracture of vertebra

- **Pharmacotherapy**
  - (IV-Reclast)

- **Address Secondary Factors**
  - (Celiac disease; PPI, Steroids)

- **Lifestyle Changes**
  - (Exercise, calcium citrate 600 mg bid, vitamin D 50,000 IU weekly x 12 + 2000 IU daily)
Vertebral Compression Fracture

- Patient education
- Modalities
- Strength exercise for muscle and bone
- Weight bearing aerobic exercise
- Balance exercise
- Bracing
Vertebral Compression Fracture: patient education

- Explain mechanics of compression fracture
- Body mechanics and ergonomics
- Omit spinal flexion and bending
- Sit less (sitting is position of highest compressive forces in spine)
Vertebral Compression Fracture: therapeutic exercise/modalities

- Modalities: heat, ice, electric stimulation
- Strengthening exercise
- To decompress spine, improve spinal alignment and posture, stretch tight anterior musculature, strengthen weak posterior spinal musculature, increase bone strength.
- Start in supine which is position of least compressive forces in spine
Vertebral Compression Fracture: weight bearing therapeutic exercise/balance

- Walking, aerobics class, tai chi, dancing, elliptical machine (if too advanced, may start with aquatics)
- Balance exercise: to reduce falls
Vertebral Compression Fracture: Bracing

Jewett Type Brace

Knight Taylor Brace
Vertebral Compression Fracture: Bracing

Spinomed 4 A/P
The Patient with a Compression Fracture
Gregg Weidner, MD

- Medical management
  - NSAIDS
  - Calcitonin
  - Bracing
  - Muscle relaxants
  - Opiates
  - Bowel regimen
Percutaneous Vertebroplasty and Vertebral Augmentation (kyphoplasty) for the treatment of Vertebral Compression Fractures
Joseph Tu, MD

Introduction

- Osteoporosis
- Compression Fractures
- Conservative management
- Vertebroplasty
- Timing, Indications, Contraindications
- Risks/Side Effects
- Other Associated Symptoms
- Take Home Points
Risk factors for VCFs

- National Osteoporosis Foundation predicts 1 in 3 women over age 50 will suffer a VCF as a result of osteoporosis
- Lifetime risk of symptomatic vertebral fracture for women is 16%; for men, 5%
- Secondary osteoporosis resulting from use of therapeutic drugs:
  - Steroids
  - Anticonvulsants
  - Chemotherapy
  - Heparin
  - Corticosteroids
Traditional therapy for VCFs

- **Preventative:**
  - Hormone replacement therapy
  - Biphosphonates
  - Calcitonin

- **Symptomatic relief:**
  - Analgesics – temporary, side effects
  - Bed rest – risk of deep venous thrombosis
  - Immobilization/bracing
  - Surgery (rare)

- **Limited success of traditional therapies**
  - Many patients report intractable pain without narcotics
  - Inability to return to normal activities
Effect of PMMA on VCFs

- Main benefit of vertebroplasty: immediate pain relief
- While the precise mechanism of pain relief has not been proven it is believed to be achieved by:
  - Immobilization of the fracture
  - Relieving stress on the remaining bone by providing increased tensile strength and stiffness
  - Destruction of nerve endings by causing necrosis through:
    - Heat – exothermic reaction of monomer and polymer in the cement
    - Direct toxic effect
VCF Morphology

- Fracture Classifications
  - Superior endplate
  - Inferior endplate
  - Biconcave
  - Crushed
  - Vertebra Plana

- Posterior Wall Involvement
  - Burst
  - Intact but bulging posterior wall
Options

- Medical treatment
  - Pain control, Bracing, Bedrest

- Surgery often contraindicated
  - Too soft to hold instrumentation

- Inactivity may cause (1-4):
  - PE/Pneumonia/Bone & Muscle loss

- PMMA injection
  - Stabilizes fx
  - ↓ pain & ↑ ambulation5
Indications for Vertebroplasty

- Painful osteoporotic fractures less than one year old
- Pain refractory to traditional medical therapy
  - No long-term relief with analgesics (and/or side effects to dosage includes excessive drowsiness, confusion or constipation)
  - Pain negatively impacting mobility and ADLs
  - Worsens with weight bearing
  - Relieved with rest or when recumbent
- Painful fracture related to benign or malignant tumor (metastatic disease, hemangiomas)
- Patient with multiple compression fractures for whom further collapse would result in compromised pulmonary or GI function
Contraindications

- **Absolute-**
  - Coagulopathy, infection, refusal
  - Unstable Fx involving posterior element
  - Lack of definable level of vertebral collapse

- **Relative-**
  - Inability of the patient to lie prone
  - Lack of surgical backup (NS or Spine)
  - Lack of proper facilities and monitoring equipment (ASA)
  - Presence of neurological compromise
  - Compression greater than 50% of the original vertebral body height
Pain distribution in VCF
Fracture Age and Timing of Treatment

- Osteoporotic VCF progressively collapse over 6-18 months

Images showing progression from Nov 28, 2004 to Feb 23, 2005.
Fracture Age and Timing of Treatment

- **Acute Stage of fracture (Most Ideal)**
  - 3 months or less
  - Prevention of functional decline
  - Decrease adverse side effects of medical management

- **Sub-acute/chronic**
  - 1 year or less:
    - NEJM study noted no difference between conservative management vs vertebroplasty (will discuss this later)
Pre-Procedure Imaging

- X-rays
  - Compare w/ prior studies (is it really acute?)
  - Evaluate height loss (>50%)
  - Look for retropulsed fragment...degree of canal invasion?

- Bone Scan
  - R/O metastatic disease
  - Infection
Pre-Procedure Imaging

- MRI
  - T1, T2, STIR sequences (w/n 3 months)
  - Assess for marrow edema
  - Exclude critical stenosis
  - Assess cortical integrity (obviously CT scan better for bone details)

TU
Height Restoration - Kyphoplasty

  - “magnitude of height restoration very variable with conventional kyphoplasty, nearly 4-fold depending on fx severity & reporting method.
- More appropriate in T-spine
Height Restoration

**Kyphoplasty**
- Lieberman (Spine, 2001)
  - 35% mean ↑ in height (2.9 mm)
- Rhyne (J Ortho Trauma 2004)
  - Ant restoration - 4.6 mm
- Gaitanis (Eur Spine J 2005)
  - Restoration of 4.3 mm
- Feltes (Neurosurg Focus 2005)
  - No height restoration

**Vertebroplasty**
- Teng (AJNR 2003)
  - 27% mean ↑
- Hiwatashi (AJNR 2003)
  - ↑ of 2.7 mm
- McKiernan (Spine 2003)
  - Height restoration in 23 of 65 pts
- Mean restoration 3.0 mm
- Dublin (AJNR 2004)
  - 49% mean ↑
Different Approaches

Transpedicular

Parapedicular
Risks and Adverse Effects

- Infection, nerve injury, paralysis, PE, stroke, death
- Adjacent compression fractures:
  - Most Common:
    - Up to 52%
  - Factors found to contribute:
    - Lower bone mineral density
    - Greater restoration rate of vertebral height
    - Pre-existing fracture
    - Intradiscal cement leakage.
Risks and Adverse Effects
A Randomized Trial of Vertebroplasty for Osteoporotic Spinal Fractures, Kallmes et al.

Conclusion:
- Improvements in pain and pain-related disability associated with osteoporotic compression fractures in patients treated with vertebroplasty were similar to the improvements in a control group (conservative management).
NEJM article

- Issues to consider:
  - Outpatient setting
  - Pain score of 3 and above
    - Avg pain intensity 7
    - Avg pain duration 18 weeks
    - 3 days post-procedure both groups at 4/10 pain
  - Both groups had alternative interventional treatments
    - Medial branch blocks and RFA being most common
    - Fractures healed with facet pain being the generator?
Other symptoms associated with compression fracture

- Radiculitis/radiculopathy
- Spinal Cord Injury
- Kyphosis
- Lumbar facet pain
  - Commonly seen
  - May respond to medial branch blocks and radiofrequency ablation
Possible utilization of vertebro-augmentation

- Acute pain due to compression fracture
  - Less than 12 weeks
    - Fractures heal significantly within 6-8 weeks
- Severe Immobilizing pain
  - Inpatient setting
  - Elderly:
    - Prone to deconditioning syndrome
- Ruled out other pain etiologies:
  - Facet pain:
    - May trial MBBs first
  - Radicular or discogenic pain
    - ESIs, water therapy, spine decompression therapies
Take Home

- Compression fractures are common in osteoporotic patients
- VCF can be debilitating in the elderly population
- Vertebro-augmentation can be an option if patient fails conservative management
- Get MRI with STIR
- Sooner and more severe the pain the better potential response
- Associated symptoms like facet pain can also be addressed
- Need help? Refer to us!
Surgical Management of Osteoporotic Compression Fractures

H. Francis Farhadi, MD
70 yro F, osteoporosis, fall over buttocks, T12 burst a/w severe pain/myelopathy
Discussion and Questions