Osteoporotic Fractures

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Objectives

1. Define osteoporotic fragility fracture and its incidence
2. Discuss science of osteoporosis and effect on bony architecture
3. Describe surgical principles in management of these fractures
4. Illustrate examples of surgical failures and how to avoid
5. Discuss bone health management after osteoporotic fractures
Osteoporotic Fragility Fracture

• Typically low energy mechanism (e.g., ground level fall)
• Most commonly at distal radius, proximal humerus, hip, vertebrae
• Lifetime risk of fragility fracture ~40-50% in females and 13-22% in males
• Likelihood increases with age
Osteoporotic Fragility Fracture

• Risk factors for fracture:
  • Age >75
  • Low BMD
  • Smoking
  • History of prior fracture
  • Poor nutrition
  • Poor executive function
Osteoporotic Fragility Fractures

• Continued increasing healthcare costs related to fragility fractures
• In 2005, ~$17 billion spent on osteoporotic fractures in US
  • Expected to increase ~50% by 2025
Osteoporosis

• Deterioration of microarchitecture of bone compromising strength
  • Increased risk of fractures
• Can be result of losing too much bone, making too little bone, or combination of both
• Most common bone disease
Osteoporosis Diagnosis

• Bone mineral density (BMD) measurement
  • Dual-energy x-ray absorptiometry (DXA) scan

• Osteoporosis defined by BMD that is 2.5 standard deviations or more below the average value for young healthy women (T-score)
  • Osteopenia = T-score -1.0 - -2.5

• Can also be diagnosed based on history of low energy fracture of vertebral body, hip, proximal humerus, or distal radius
Bone Changes Over Time

• Bone mass increases until age 25-30
• Osteoclast activity > osteoblast activity as age increases, particularly after menopause in women
• Results in thinned trabeculae and fragile cortices with increase in overall diameter of bone

Normal bone cross section  Osteoporotic bone cross section
Goals of Intervention on Fragility Fractures

• Stable construct that can allow early weight bearing

• Still following 4 AO principles:
  1. Fracture reduction to restore anatomical relationships
  2. Stable fixation providing absolute or relative stability
  3. Preservation of blood supply
  4. Early and safe mobilization

• Soft tissue friendly techniques given often poor soft tissue envelope
Surgical Issues With Osteoporotic Bone

• Thin, fragile cortices
• Poor screw purchase
• High risk of screw “cutout”
• Difficult to obtain rigid fixation
• Patients ability to heal worse
Screw Failure Osteoporotic Bone

• If friction between bone and plate is overcome, fixation depending on stiffness of screws
• With standard plating, axial stiffness is dependent on torque between screw and near cortex which can be weak in osteoporotic bone
• Leads to screw loosening and pullout
Locking Plates/Screws

- Locking screws are fixed-angle devices
- Do not rely on friction between screw head and plate for fixation
- Preferred in osteoporotic bone where plate-to-bone compression is limited

Locking Plates/Screws

- In normal bone, bicortical fixation is not necessary with locking screws.
- In osteoporotic bone, bicortical fixation of locking screws can enhance the torsional stability of the construct.

~3x More stable with bicortical fixation
Conventional plate/screw failure

• Screws pull out of bone sequentially

Locking plate/screw failure

• Plate/screw fails as unit
Bridging

• Bridge plating can be useful technique in osteoporotic bone
• Long plates for bone protection
• Still want anatomic reduction of articular surfaces
Peri-implant Considerations

• As patients life-expectancy has increased and longevity of arthroplasty has increased, increased frequency of peri-implant/periprosthetic fractures in geriatric population

• Main goals similar to any fracture:
  1. Uncomplicated fracture union
  2. Restoration of length/alignment/rotation
  3. Return patient to preinjury level of function
Peri-implant Considerations

• Preserve soft tissue attachments
• Likely need to employ indirect reduction techniques
• If performing ORIF, use long working lengths, avoid stress risers, and protect length of bone if possible
• Be prepared for revision arthroplasty if concern that implant is loose
Peri-implant Considerations

- Avoid stress risers by bypassing implants
- Utilize bridging constructs
- Indirect reduction techniques to limit soft tissue stripping
Peri-implant Considerations

• Revision arthroplasty if loose prosthesis
Fixation Failure in Osteoporotic Bone

- Screw cut-out
- Plate pull-off
- Varus collapse
- Malunion
- Nonunion
Factors for Fixation Failure

**Patient Factors**
- Poor bone quality
- Metabolic bone issues
- More medical comorbidities in geriatric population

**Surgical Factors**
- Implant choice
- Inappropriate implant position
- Poor reduction
- Poor soft tissue management
Hip Fracture Fixation Failure

- Non-displaced geriatric femoral neck fracture treated with CRPP
Hip Fracture Fixation Failure

- Hip pain with weight bearing ~3 weeks post-operatively
- XR shows screw cutout on lateral view
Hip Fracture Fixation Failure

• Converted to hemiarthroplasty, healed without issue
Inappropriate Implant Use/Positioning

- Geriatric female with prior THA, TKA, and supracondylar periprosthetic distal femur fracture treated with ORIF
- New ground level fall and RLE pain
Inappropriate Implant Use/Positioning

• New fracture distal to THA stem at proximal screw site
• No screw fixation to overlap fixation of plate and stem causing stress riser
Inappropriate Implant Use/Positioning

• Revised with hardware removal and ORIF with new long plate bypassing implants
• Healed with good callus formation
• Ambulating pain free at 6 months

2 weeks post-op

6 months post-op
Poor Reduction/Hardware Positioning

• Non-displaced right IT fracture
Poor Reduction/Hardware Positioning

- Poor reduction, fixed in varus relative to contralateral hip
- Tip-apex distance >25mm
Poor Reduction/Hardware Positioning

- Increased pain ~2 months post-op
- Superior screw cut-out, varus collapse on XR
Poor Reduction/Hardware Positioning

- Converted to THA, diaphyseal fit stem
Post-Fragility Fracture Management

• High risk for secondary fracture
  • 50% of fragility fracture patients will have a second fracture
  • 50% of hip fracture patients will have had a prior fragility fracture

• Yet only 16-20% of post fragility fracture patients get placed on therapy for osteoporosis
Burden of Hip Fracture

- 2M osteoporotic fx annually
- 432,000 hospital admissions
- 2.5M medical office visits
- 10,000 nursing home visits
- 14% hip fractures
  - 72% fracture related medical expenses
  - 6 month post hip fx expense $34,509- $54,054
- 20-30% mortality within 1 year
- 50% will never ambulate without assistance
- 25% will end up in long term care

Lewiecki et al, Osteo Int 2018
Surgeon Buy-In Necessary

• Often mentality of “Fix it and Forget it”
• Treating Osteoporosis: “Not our expertise!”
• “We are not…”
  • Primary Care Provider
  • Rheumatologists
  • Endocrinologists
What is The Orthopedic Surgeon’s Role?

Position Statement

Osteoporosis/Bone Health in Adults as a National Public Health Priority

• Every orthopedic surgeon should work diligently to participate in prevention and treatment of osteoporosis and fragility fracture care
Must Break the Fragility Fracture Cycle

1. Low BMD, Osteoporosis
2. Fragility Fracture
3. Fracture Care
4. Recovery/Rehab
5. ????
Must Break the Fragility Fracture Cycle

Bone Health / Fracture Liaison Service

Bone Health Evaluation

Education, Treatment

Increased BMD, Decreased Fracture Risk!

Low BMD, Osteoporosis

Fragility Fracture

Recovery/Rehab

Fracture Care

????
Effects of Treatment After Initial Fragility Fracture

• Anti-osteoporosis therapy reduces risk of a second fragility fracture after a primary fracture
• ~40% risk reduction of secondary fracture in three years after initial fragility fracture
Fracture Liaison Service (FLS)

- FLS program helps patients reduce risk of suffering a second fragility fracture
- Patients enrolled after initial fragility fracture
- FLS provides a bone evaluation and plan for patients to improve bone health
- Improved adherence to osteoporosis treatment when patients enrolled in FLS

Boudout et al, Osteo Int 2011
Workup For Fragility Fracture Patient

• Thorough history (hormonal issues, medications)
• Nutrition status
• Lifestyle (exercise, tobacco, alcohol use)
• Family history

• Laboratory evaluation:
  • PTH
  • (25)-Vitamin D Level
  • Serum Calcium
  • Albumin
  • TSH
Treatment Options

• Nutrition
• Exercise
• Lifestyle changes
• Fall prevention
• Anti-osteoporosis medications
Nutrition

• Calcium requirements:
  • Young – 1000mg/day
  • Older – 1500mg/day
• Multiple forms of calcium. Can be taken in whatever form is tolerated:
• Healthy body weight
  • BMI < 18 is risk factor for fracture
  • Obese patients are at increased risk of falls
Nutrition

• Vitamin D3
  • Young – 400U/day
  • Older – 800U/day

• If deficient on laboratory workup, treat with 50,000U/week

• Sunlight helpful for Vitamin D
Exercise

• Weight bearing exercise for bone health
• Low impact exercises can help to prevent falls
Fall Prevention

• Polypharmacy places geriatric patients at risk of falls
  • Work with PCP and FLS for medication management

• Home safety evaluation to reduce risks:
  • Rugs
  • Poor lighting
  • Steps
  • Pets
Anti-Osteoporosis Medications

• Antiresopptive medications – inhibit bone breakdown
  • Bisphosphonates (oral and IV)
  • Selective estrogen reuptake modulators (SERMs)
  • Calcitonin

• Anabolic medications – stimulate bone formation
  • Parathyroid hormone analog (Teriparatide)
  • Parathyroid hormone related protein analog (Abolopaeratide)
  • Sclerostin Inhibitors (Romososumab)
Anti-Osteoporosis Medications Effects on Fracture Healing

• Little evidence of anti-resorptive drugs showing change in healing
  • Bisphosphonates may form larger and stronger callus with delayed remodeling, but no sign of delayed healing

• Parathyroid hormone analogs may accelerate healing in distal radius and pelvic fragility fractures

• Overall, no significant clinical data showing delay in fracture healing. Given patients are at high risk for subsequent fracture, providers should not delay initiation of anti-osteoporosis therapy

Ho Shin et al, J Bone Metab 2020
Summary

• Understand poor bone quality in osteoporotic fracture patients and adjust implant choice/fixation strategies accordingly
• Adhere to AO principles of fracture fixation
• Osteoporosis is significantly under-treated after fragility fracture
• Orthopaedic surgeons have active role in bone health care particularly after osteoporotic fracture