The Nuts, Bolts, and Rx of Osteoporotic Fractures

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Conflict of Interest

- Consultant for Synthes Orthopaedics
- Previous member of AOA Own the Bone Committee.

I’ll recommend your stock to the public, but first I need some conflicts of interest to make it worthwhile.
Overview

- Demographics of osteoporotic fractures.
- Locking plates.
- Intramedullary nails.
- Ceramics
- Osteobiologics
Demographics of osteoporotic fractures

- 54 million Americans have osteoporosis and low bone mass.
- Approximately one in two women and up to one in four men age 50 and older will sustain a fracture due to osteoporosis.
  - National Osteoporosis Foundation
Other Disease Crises

Cancer

HIV

Centers for Disease Control Data
Cost!

- Two million fractures annually at a cost of $19 billion.
- By 2025, we expect three million fractures annually at a cost of $25.3 billion (4.3% of Medicare cost in 2013).
Proximal Femoral Fractures

- Annually, more than 250,000 hip fractures are attributable to osteoporosis.
- A 50-year-old white woman is estimated to have a 17.5% lifetime risk of fracture of the proximal femur.
  - National Osteoporosis Foundation
Proximal Femoral Fractures

• The incidence increases each decade for all populations.
• The highest incidence is found among men and women ages 80 or older.
  – National Osteoporosis Foundation
Vertebral fractures

- 35 to 50% of all women over fifty had at least one vertebral fracture.
- 700,000 vertebral fractures occur annually in the USA.
  - National Osteoporosis Foundation
Distal Radial Fractures

• Annually, 250,000 distal radial fractures are attributable to osteoporosis.
• The lifetime risk of sustaining a distal radial fracture is about 16% for white women.
• By age 70, about 20% of women have had at least one distal radial fracture.
  – National Osteoporosis Foundation
What’s the problem?
Osteoporotic Disasters
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Advances to Treat these Fractures

- Locking technology
- Cephalomedullary nails
- Ceramics
- Osteobiologics
Plate Evolution

- **DCP**
  - Dynamic Compression Plate

- **LC-DCP**
  - Limited Contact Dynamic Compression Plate

- **LCP**
  - Locking Compression Plate
How is a Locking Plate Different?

- Conventional plates & screws depend on friction between the screw thread & bone for stability.

- Locking plates & screws create fixed angles that do not rely on screw purchase in bone.
Conventional vs. Locking Plates
When do Locking Plates Work Best?

When conventional screw purchase may be poor:

– Osteopenic bone
– Metaphyseal areas
– Periprosthetic fractures
– Failed fixation/nonunion
– Screw strippage
Plate Design: Combination Hole

- “Figure of eight” hole design
- Locking screws
- Conventional cortex & cancellous screws
Locking Screw Design

- Threaded underside of head
  - To thread (lock) into plate hole

- Larger core diameter:
  - Increases strength
  - Dissipates load over larger area of bone

- Smaller thread pitch:
  - Threads not used to generate thread purchase in bone
Conventional Plate Fixation

Loss of Reduction
Conventional Plate Fixation
Locking Plates & Screws

No Bone Alignment to the Plate
Locking Plates & Screws

No Fracture Malalignment
Variable Angle Plates

• New in locking plate technology
  – Allows screws to be angled around central axis of plate hole to match anatomy
  – First seen in distal radius plates
Variable Angle Plates

Variable Angle locking screw  Standard locking screw
Biomechanical Studies

- Humeri plated with nonlocking plates failed at a higher rate than those with locking plates (67% nonlocking vs. 28% locking, \( p = 0.008 \))
- Locking plates were shown to provide improved mechanical performance over nonlocking plates in torsional cyclic loading in a osteoporotic cadaveric fracture model.

Improved Techniques
Advances in Nail Design

- Cephalomedullary Nails.
- Blade versus Screw
- Interlocking Screw
Advances in Nail Design

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Bone Loss During Fixation
Calcium Phosphate
Calcium Phosphate Studies

- While the maximum pullout strength of the screws in the artificial bone only was 30±7N, it could increase up to approximately 1000N under optimal conditions.
- Since cement augmentation significantly increased pullout force in all cases, we conclude that the loss of cortical fixation can be compensated by cement augmentation.

- Patients treated with SRS had better functional outcome, restoration of movement and grip strength (p<0.001). Loss of reduction was significantly higher in the control group (p<0.001).
Meta-analysis

- Polymethylmethacrylate and calcium-phosphate cements increased the primary stability of the implant-bone construct in all experimental and clinical studies, although there was considerable variation in the design of the studies.
- In randomised, controlled studies, augmentation of intracapsular fractures of the neck of the femur with calcium-phosphate cement was associated with poor long-term results.
- There was a lack of data on the long-term outcome for trochanteric fractures. Because there were only a few, randomised, controlled studies, there is currently poor evidence for the use of bone cement in the treatment of fractures of the hip.

Cortical struts and DBM
After fixation, Nurses should:

• Monitor for increased pain or swelling (consistent with early loss of fixation).
• Observe for any perceived loss of motion or deformity.
• Encourage well balanced nutrition that is rich in calcium and Vitamin D.
Weight Bearing

- Weight-bearing after fixation is specified on an individual basis.
- Weight bearing is extremely important for fracture healing, but must not be performed at the expense of stability.
Weight Bearing

• After fixation of the hip fracture, the injured limb supported was 51 per cent that of the uninjured limb at one week, and it gradually increased to 87 per cent at twelve weeks.

• Elderly patients who are allowed to bear weight as tolerated after operative treatment of a hip fracture appear to voluntarily limit loading of the injured limb.

Summary

- Osteoporotic fractures are extremely common and a massive financial drain on the US economy.
- Locking plate technology has dramatically improved the care of these fractures.
- Advances in interlocking has dramatically improved the stability of intramedullary fixation.
- Ceramics increase the compressive strength of osteoporotic bone.