Osteoporotic Fractures: What I Have Learned that Works

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Osteoporosis
Skeletal disorder

Bone strength (reduction in bone mass)

Increased risk of fracture.
Fractures related to osteoporosis

- 40% of women
- 14% of men

over the age of 50 years
Bone Architecture

The osseus tissue

Reduced skeletal strength

Increased susceptibility to fractures
Bone Architecture

Osteoporosis; Thinner cross-linking connections within trabecular bone

Bone Architecture

Changes; The Diameter of the inner and outer cortices

- Endosteal diaphyseal resorption
- Medullary expansion
Bone Architecture

The mineral density decreases in cancellous and cortical bone,

Cortical bone vs cancellous bone

both decrease in thickness with osteoporosis,

 reductions are usually less drastic than those in cancellous bone
Affect; Bending and torsional characteristics of the entire bone

Dissipation of bone mass

Predispose; to low-energy fractures,
The healing of a fracture in osteoporosis

Evidence; Animal model

Healing femur of an osteoporotic rat model

(ovariectomy and low calcium diet)

The healing of a fracture in osteoporosis

40% reduction of callus in the cross-sectional area

23% reduction in bone mineral density

The healing of a fracture in osteoporosis

Similar results

Healing; took longer in older rats,

stiffness and strength remained (below the values of controls)

The healing of a fracture in osteoporosis

Clinically;

Delay in fracture healing is reflected in a dramatic increase in the rate.

failure of implant fixation

Cells in osteoporosis

Osteoporotic individuals

Mesenchymal cells

Fewer mesenchymal stem cells

Lower proliferative response

Cells in osteoporosis

Age-related decrease in the number of osteoblasts.

Treatment
Operative treatment

Is a challenge for the surgeon, with unpredictable outcomes.
Maintenance of fracture reduction, decreased functional loading, is difficult.
Surgical fracture treatment

Elderly, Maintenance of fracture reduction

Early mobility is desired.
Current aspects of management

Advances;

- Implant design
- Surgical technique.
Rigidity of Implant Assembly
Bone Architecture

Poor fracture fixation

adverse orthopaedic health outcomes
The weakest link

Material modulus

When the implant material modulus is;  
Much stiffer and stronger > bone,  
(porotic bone)

The bone is the weakest link.
Architecture

Increase in porosity,

Affects the holding capacity of screws

Fixed-angle devices

SUCCESS

screws rigidly fixed to the plate

Relative stability techniques

- intramedullary nails,
- buttress fixation,
- fixed-angle devices,
- bone augmentation
- joint replacement.
Intramedullary nail
Intramedullary nail

Fracture fixation in porotic bone

Central location, distribute loads

more uniformly than eccentric plates do

Interlocking bolts

- often fail to gain purchase
- soft porotic cancellous bone

Interlocking bolts

The high stresses at the implant–bone interface

Large Implant Surface
Improved Intramedullary Nail Interlocking in Osteoporotic Bone

Keita Ito, *Ruth Hungerbühler, Dieter Wahl, and †Rene Grass

AO/ASIF Research Institute, Davos, Switzerland; *Stratec Medical, Oberdorf, Switzerland; and †Department of Trauma Surgery, Carl Gustav Carus University Clinic, Tech. University of Dresden, Dresden, Germany
conventional locking bolts vs. bladelike device.

tested under axial load:

- stiffness
- strength

were compared
Improved Intramedullary Nail Interlocking in Porotic Bone

conventional locking bolts  Spiral blade

Stiffer

Keita Ito,
Biomechanical stability

Bladelike device;

Lowers intraosseous stress levels

distributing the load over a greater volume of bone
Angled blade plate

Fixed-angle devices;

- Implant provides a large contact area at the bone-implant interface,

Relative stability techniques

Buttress-plate fixation of metaphyseal fractures

- effective in porotic bone
- avoids high strain at a single screw

Resist angular deformation torsion,

The strain is reduced because the blade has a large surface area.

High pullout resistance
L.C.P.

Plates with locking-head screws

The holding power increased screws at multiple fixed angles.

Bone augmentation

Achieved by:

- bone autograft
- allograft
- bone cement
- bone substitutes.

Bone augmentation

Achieved by;
Improvements in screw fixation

Prof. Reynders

Bone Cement

278 %
Bone augmentation

- Dynamic hip screw improve fixation.

Local cement application through the implant.

Bone augmentation

Cannulated screw

side openings

inject polymethylmethacrylate (PMMA)

around the screws

enhance their purchase in fractures

Bone augmentation
Screw + PMMA
Screw + PMMA

improve pull-out forces in lumbar vertebral bodies by 278%

Joint replacement

option for osteoporotic patients

Articular fractures,
Metaphyseal fractures,

Summary
Decreased bone density

Regular bone

Porotic bone

Decreased holding capacity
early fixation failure
Surgical treatment
Fracture patterns

complex

altered mechanical properties of bone
Porotic bone

Failure of internal fixation

Bone failure

rather than implant breakage
Intramedullary nail

- locking bolts often fail in porotic bone.
Development of implants

- improve the bone-implant interface

preventing high stress

distributing the forces transmitted to bone in a load-sharing, rather than load-bearing way.
Proximal humeral nail

Bladelike device

Optimal purchase
In the proximal bone

Removal of bone is minimal

Their central location provides a uniform load of distribution
Bone Augmentation
Surgical treatment
Complex in the elderly

Medical comorbidities

Thank you for your attention