Fragility Fractures
Clinical Pathways

Ghassan Maalouf
Department of Orthopaedics
St. George Hospital, Balamand University
Beirut, Lebanon

Karsten Dreinhöfer
Department of Orthopaedics
Ulm University
Ulm, Germany
Content

• Fragility fractures are under-diagnosed and under-treated

• Development of a pathway
  – Management of fragility patients
  – Risk assessment
  – Diagnosis
  – Treatment
    • Basic treatment
    • Pharmacological
    • Exercise

• Established pathways
Alarming facts
Osteoporosis assessment of non-vertebral fracture patients

- 852/2386 women identified as having sustained fractures over the age of 50
- 43 (5%) of those women have been previously assessed by DEXA scan to determine absolute fracture risk and make informed management decisions
- 81 (9.5%) women with ≥1 fracture on treatment

Coatbridge Prior Fracture Program

Awareness and knowledge of osteoporosis in fracture patients

385 patients with fragility fractures

“Have you ever heard of osteoporosis?”

NO: 20 % / YES: 80 %

“Do you think that the fracture you have experienced could be due to a fragility of your bones?”

NO: 73 % / YES: 27 %
Osteoporotic vertebral compression fractures – only 20% receive treatment

n=934 women >60 years old

Gehlbach et al. Osteoporos Int 2000; 11:577-582
Multinational Survey of Osteoporotic Fracture Management

Survey of 3422 orthopaedic surgeons from 6 countries

- 90% do not routinely measure bone density following the first fracture
- 75% are lacking appropriate knowledge about osteoporosis

Dreinhöfer et al. Osteoporos Int 2005; 16:S44-S54
Consequence

Development of pathways for orthopaedic surgeons
Fracture

Accident pattern / Risk assessment

- inadequate trauma with / without risk factors or adequate with risk factors
- adequate trauma without risk factors

Process according to evidence based DVO-guidelines

History / Physical examination

- ? Primary Osteoporosis
- ? Secondary Osteoporosis or other bone disease

Demographic Factors

- Woman postmenopausal
- Woman premenopausal
- Man > 65 Years
- Man < 65 Years

Lab / X-ray thoracic/lumbar spine in 2 planes

- ? Primary Osteoporosis
- ? Secondary Osteoporosis or other bone disease

Bone Densitometry

- Vertebral fracture, T ≤ -2.0 or peripheral fracture, T ≤ -2.5 or steroid-induced osteoporosis, T ≤ -1.5
- Vertebral fracture, T > -2.0 or peripheral fracture, T > -2.5 or steroid-induced osteoporosis, T > -1.5

Consultation

Fall evaluation and prevention
Basic treatment (Calcium + Vitamin D)
Special pharmaceutical treatment
(Alendronat / Risedronat / Etidronat / Ibandronat)
(Raloxifen / Teriparatid / Strontium)

Further evaluation
Fracture
Management

Acute

Chronic
Acute management

- Surgical repair and/or appropriate orthopaedic management
- Pain relief
- Physiotherapy
Management

Acute

Chronic

Reduce the risk of further fractures
Call for action
What to do?

4 steps:

• Identification
• Prevention
• Pharmacological intervention
• Follow-up and rehabilitation
Fracture
Fracture

Accident pattern
Assessment of fracture risk

Risk factors

Ten-year fracture risk

Absolute risk

Key risk factors for fractures (RR > 2)

- Age
- Bone mineral density
- Prior fragility fracture
- Family history of osteoporotic fracture
Age and osteoporosis

Distribution of bone mineral density in women of different ages, and the prevalence of osteoporosis (blue)

Bone Mineral Density (BMD) and fracture rate

Bone mineral density (BMD), osteoporotic fracture rate, and number of women with fractures.

Strong risk factors for fractures (RR ≥ 2)

- Menopause < 45
- Glucocorticoids
- Immobilization
- BMI < 19
- Anorexia Nervosa
- Propensity to fall
- Malabsorption
- Chronic renal failure
- Transplantation
- Hypogonadism

Moderate risk factors (1 < RR < 2)

- Rheumatoid arthritis
- Bechterew disease
- Anticonvulsants
- Calcium intake < 500 mg/d
- Diabetes mellitus
- Estrogen deficiency
- Primary hyperparathyroidism
- Hyperthyroidism
- Smoking
- Alcohol excess

Accident pattern / Risk assessment

Fracture

adequate trauma without risk factors

No further evaluation
Accident pattern / Risk assessment

- inadequate trauma with / without risk factors
- adequate trauma with risk factors
- adequate trauma without risk factors

No further evaluation

History / Physical examination

Fracture
History / physical examination

- Weight / height
- Menarche / menopause
- Nutrition
- Medication (past and present)
- Level of activity
- Fracture history
- Fall history
- Risk factors for secondary osteoporosis
High risk for secondary osteoporosis

- Severe chronic liver or kidney disease
- Steroid medication (>7.5mg for more than 6 months)
- Malabsorption (e.g. Crohn’s disease)
- Rheumatoid arthritis
- Systemic inflammatory disorders
- Hyperthyroidism
- Primary hyperparathyroidism
- Antiepileptic medication
Accident pattern / Risk assessment

- Inadequate trauma with / without risk factors
- Adequate trauma without risk factors

History / Physical examination

- Secondary Osteoporosis or other bone disease
- Fracture

No further evaluation

Further evaluation
Accident pattern / Risk assessment

- inadequate trauma with / without risk factors 
or adequate with risk factors
- adequate trauma without risk factors

History / Physical examination

- ? Primary Osteoporosis
- ? Secondary Osteoporosis or other bone disease

Fracture

No further evaluation

Further evaluation
Accident pattern / Risk assessment

inadequate trauma with / without risk factors
or adequate with risk factors

adequate trauma
without risk factors

No further evaluation

History / Physical examination

? Primary Osteoporosis

? Secondary Osteoporosis
or other bone disease

Further evaluation

Demographic Factors
Demographic factors

- Man vs. woman
- Woman premenopausal vs. postmenopausal
- Man older than 65 years vs. younger than 65 years
- Ethnicity
  Caucasian or Asian compared to Black
Osteoporosis in men

Primary osteoporosis (50%)
- Idiopathic

Secondary osteoporosis (50%)
- Glucocorticoid excess (15%)
- Hypogonadism (10%)
- Alcoholism (7%)
- Hypercalciuria (2%)
- Smoking
- Gastrointestinal disorders
- Immobilization
- Others

Bilezikian. J Clin Endocrinol Metab, 1999; 84:3431-3434
Men and women have equivalent risks of fracture for a given level of bone mineral density

Accident pattern / Risk assessment

- inadequate trauma with / without risk factors or adequate with risk factors
- adequate trauma without risk factors

History / Physical examination

- ? Primary Osteoporosis
- ? Secondary Osteoporosis or other bone disease

Demographic Factors

- Woman premenopausal
- Man < 65 Years

Fracture

Further evaluation

No further evaluation
Accident pattern / Risk assessment

- inadequate trauma with / without risk factors or adequate with risk factors
- adequate trauma without risk factors

History / Physical examination

- ? Primary Osteoporosis

Demographic Factors

- Woman postmenopausal
  Man > 65 Years
- Woman premenopausal
  Man < 65 Years
- ? Secondary Osteoporosis or other bone disease

No further evaluation
Further evaluation
Further evaluation
Fracture

Accident pattern / Risk assessment

- inadequate trauma with / without risk factors or adequate with risk factors
- adequate trauma without risk factors

History / Physical examination

- ? Primary Osteoporosis
- ? Secondary Osteoporosis or other bone disease

Demographic Factors

- Woman postmenopausal Man > 65 Years
- Woman premenopausal Man < 65 Years

Lab / X-ray thoracic/lumbar spine in 2 planes

Further evaluation

No further evaluation
Laboratory tests

- SR / CRP
- Blood count
- Calcium
- Phosphate
- Alkaline Phosphatase (AP)
- GGT
- Creatinin
- Basal TSH
- Protein-Immunolectrophoresis
X-Ray

Thoracic and lumbar spine in 2 planes for patients with:

- Back pain
- Progressive kyphosis
- Loss of height > 4 cm
- -2.5 < Bone Mineral Density < -1.0
Accident pattern / Risk assessment

- inadequate trauma with / without risk factors or adequate with risk factors
- adequate trauma without risk factors

History / Physical examination

Demographic Factors

- Woman postmenopausal
  Man > 65 Years
- Woman premenopausal
  Man < 65 Years

Lab / X-ray thoracic/lumbar spine in 2 planes

- ? Primary Osteoporosis
- ? Secondary Osteoporosis or other bone disease

Further evaluation

No further evaluation
Accident pattern / Risk assessment

- Inadequate trauma with / without risk factors or adequate with risk factors
- Adequate trauma without risk factors

History / Physical examination

- ? Primary Osteoporosis
- ? Secondary Osteoporosis or other bone disease

Demographic Factors

- Woman postmenopausal, Man > 65 Years
- Woman premenopausal, Man < 65 Years

Lab / X-ray thoracic/lumbar spine in 2 planes

- ? Primary Osteoporosis
- ? Secondary Osteoporosis or other bone disease

Bone Densitometry

No further evaluation

Process according to evidence-based DVO-guidelines

Further evaluation
Fracture risk depending on bone mineral density
Fracture risk depending on bone mineral density

Age > 65 years:

Cummings et al. Lancet 1993; 341:72-75

Relative risk hip fracture

T= -2.5  BMD (SD)

hip
calcaneus
radius
Ten-year probability of hip fracture in Swedish men and women, according to age and T-score assessed at the femoral neck by dual X-ray absorptiometry

Green dotted line = probability at which intervention is cost-effective

Kanis et al. Osteoporos Int 2001; 12: 989-95
Bone densitometry

- Vertebral fracture, $T > -2.0$ or
- Peripheral fracture, $T > -2.5$ or
- Steroid-induced osteoporosis, $T > -1.5$
Bone densitometry

- Vertebral fracture, T > -2.0 or
- Peripheral fracture, T > -2.5 or
- Steroid-induced osteoporosis, T > -1.5

- Consultation (general recommendation)
- Basic treatment (calcium + vitamin D)
- Fall evaluation and prevention
General recommendations

- Regular physical activity and daily outdoor activities (at least 30 minutes)
- Adequate nutrition
- Sufficient basic intake of calcium (1000-1500 mg calcium per day) through adequate nutrition (milk, milk products, green vegetables, calcium-rich mineral water)
- Avoidance of cigarettes, alcohol intake (<30g per day)
Basic treatment

• Postmenopausal women whose nutrition does not provide appropriate daily calcium intake of 1500 mg:
  – Daily supplement of 1000 mg of calcium

• For institutionalized and/or immobile women over 65 years of age, and for all women over 75:
  – Daily supplement of 1200 mg of calcium + 800 IE vitamin D3 (Cholecalciferol)
Fall evaluation

- History of circumstances surrounding the fall
- Drugs, acute or chronic medical problems, mobility levels
- Examination of vision, gait and balance, function of the leg joints
- Examination of basic neurological function, including mental status, muscle strength, peripheral nerves of the legs, proprioception, reflexes, and tests of cortical, extrapyramidal, cerebellar function
- Assessment of basic cardiovascular status, including heart rate and rhythm, postural pulse and blood pressure and, if appropriate, heart rate and blood pressure responses to carotid sinus stimulation

Woolf et al. BMJ 2003; 327:89-95
Risk factors for falling

Intrinsic factors

General deterioration associated with ageing
- Poor postural control
- Defective proprioception
- Reduced walking speed
- Weakness of legs
- Slow reaction time
- Various comorbidities

Problems with balance, gait, or mobility
- Joint disease
- Cerebrovascular disease
- Peripheral neuropathy
- Parkinson’s disease
- Alcohol
- Various drugs

Visual impairment
- Impaired visual acuity
- Cataracts
- Glaucoma
- Retinal degeneration

Impaired cognition or depression
- Alzheimer’s disease
- Cerebrovascular disease

“Blackouts”
- Hypoglycaemia
- Postural hypotension
- Cardiac arrhythmia
- Transient ischaemic attack, acute onset
- Cerebrovascular attack
- Epilepsy
- Vertebrobasilar insufficiency
- Carotid sinus syncope
- Neurocardiogenic (vasovagal) syncope

Woolf et al. BMJ 2003; 327:89-95
Risk factors for falling

Extrinsic and environmental factors

**Extrinsic factors**

Personal hazards
- Inappropriate footwear or clothing

Multiple drug therapy
- Sedatives
- Hypotensive drugs

**Environmental factors**

Hazards indoors or at home
- Bad lighting
- Steep stairs, lack of grab rails
- Slippery floors, loose rugs
- Pets, grandchildren’s toys
- Cords for telephone and electrical appliances

Hazards outdoors
- Uneven pavements, streets, paths
- Lack of safety equipment
- Snowy and icy conditions
- Traffic and public transportation

Woolf et al. BMJ 2003; 327:89-95
Accident pattern / Risk assessment

- inadequate trauma with / without risk factors or adequate with risk factors
- adequate trauma without risk factors

History / Physical examination

- ? Primary Osteoporosis
- ? Secondary Osteoporosis or other bone disease

Demographic Factors

- Woman postmenopausal Man > 65 Years
- Woman premenopausal Man < 65 Years

Lab / X-ray thoracic/lumbar spine in 2 planes

- ? Primary Osteoporosis
- ? Secondary Osteoporosis or other bone disease

Bone Densitometry

- Vertebral fracture, T > -2.0 or peripheral fracture, T > -2.5 or steroid-induced osteoporosis, T > -1.5

Consultation
Fall evaluation and prevention
Basic treatment (Calcium + Vitamin D)
Bone densitometry

• Vertebral fracture, $T > -2.0$ or
• Peripheral fracture, $T > -2.5$ or
• Steroid-induced osteoporosis, $T > -1.5$
Bone densitometry

- Vertebral fracture, $T > -2.0$ or
- Peripheral fracture, $T > -2.5$ or
- Steroid-induced osteoporosis, $T > -1.5$

- Consultation (general recommendation)
- Basic treatment (calcium + vitamin D)
- Fall evaluation and prevention
- Special pharmacotherapy
Special pharmacotherapy

- Inhibitors of bone turnover
  - Bisphosphonates, Calcitonin, Estrogens and SERMs

- Stimulators of bone formation
  - Fluoride salts, Androgens, Growth Hormon, Parathyroid Hormone, Strontium Ranelate
Special pharmacotherapy

Bisphosphonates
- Alendronate (FOSAMAX®)
- Risedronate (ACTONEL®)
- Ibandronate (BONVIVA®)
- Zoledronate (ACLASTA®)

SERMs
- Raloxifene (EVISTA®)

Stimulators of bone formation
- rh-PTH (FORTEO®)
- Strontium Ranelate (PROTELOS®)
Accident pattern / Risk assessment

- inadequate trauma with / without risk factors
- adequate trauma with risk factors

History / Physical examination

- ? Primary Osteoporosis
- ? Secondary Osteoporosis or other bone disease

Demographic Factors

- Woman postmenopausal
- Man > 65 Years

- Woman premenopausal
- Man < 65 Years

Lab / X-ray thoracic/lumbar spine in 2 planes

- ? Primary Osteoporosis
- ? Secondary Osteoporosis or other bone disease

Bone Densitometry

- Vertebral fracture, $T \leq -2.0$ or
  peripheral fracture, $T \leq -2.5$ or
  steroid-induced osteoporosis, $T \leq -1.5$

- Vertebral fracture, $T > -2.0$ or
  peripheral fracture, $T > -2.5$ or
  steroid-induced osteoporosis, $T > -1.5$

Consultation

Fall evaluation and prevention
Basic treatment (Calcium + Vitamin D)
Special pharmaceutical treatment
(Alendronat / Risedronat / Etidronat / Ibandronat)
(Raloxifen, Teriparatid, Strontium)

Consultation

Fall evaluation and prevention
Basic treatment (Calcium + Vitamin D)
Exercise

Strengthening of muscles
Improving muscle function
Group experience
Social function
Exercise

Strengthening of muscles
Improving muscle function

Falls

Bone mass

Fractures

Quality of life
Exercise

Strengthening of muscles
Improving muscle function

Falls

Bone mass

Fractures

Quality of life
Tai Qi reduces fall risk

Exercise

- Strengthening of muscles
- Improving muscle function

Falls

Bone mass

Fractures

Quality of life
Low mechanical signals strengthen long bones

- Low magnitude mechanical signals are anabolic to bone if applied at a high frequency (15–90 Hz)
- Low-magnitude mechanical signals can increase:
  - cancellous bone volume fraction
  - trabecular thickness
  - trabecular number
  and enhance bone stiffness and strength

Rubin et al. Nature 2001; 412:603-604
Prevention of postmenopausal bone loss by low-magnitude, high-frequency mechanical stimuli

One-year prospective, randomized, double-blind, and placebo-controlled trial of 70 postmenopausal women:

Brief periods (<20 minutes) of a low-level (0.2g, 30 Hz) vibration applied during quiet standing can effectively inhibit bone loss in the spine and femur.
Exercise

- Strengthening of muscles
- Improving muscle function

Falls → Fractures

Fractures → Bone mass

Bone mass → Quality of life

Quality of life → Falls
Established pathways
Glasgow Fracture Discharge Program

Objectives:

- To identify patients at increased risk of osteoporotic fracture
- To offer these patients appropriate information on osteoporosis and its management
- To provide advice to GPs on suitable interventions
Glasgow Fracture Discharge Program

A comprehensive service

- Identify prospective patients >50 years who sustain a fracture
- Use DXA to identify those with OP and at highest risk of future fracture
- Provide advice to GPs on appropriate interventions
- Provide lifestyle modification advice to individual patients
- Provide information for patients on fall prevention
- Refer patients to physiotherapy-led exercise classes
- Facilitate investigation and treatment of OP after admission to orthopaedics and introduce this into ICP
- Collect data for audit
Results of the Glasgow experience

- Better awareness of fragility fractures
- Improved rate of post-fracture follow-up
- Better management
- Better patient satisfaction
Osteoporosis clinical pathway (OCP) Geneva

- Enrolment of patients with low trauma fracture
- Collection of data, additional diagnostic examination
- Educational program for patients and their families
- Advice on specific anti-osteoporotic therapy

Chevalley et al. Osteoporos Int. 2002; 13:450-455
“Writing a guideline may be difficult, but determining how best to implement the guideline is even more difficult”

Gross et al 2001
The surgeon’s responsibilities

- Identify the orthopaedic patient with risk factors and fragility fractures
- Inform the patient about the need for an osteoporosis evaluation
- Investigate whether osteoporosis is an underlying cause of the fracture
- Ensure that appropriate intervention is initiated
- Educate the patient and their family