TREATMENT AND PREVENTION OF “VCFs” VERTEBRAL COMPRESSION FRACTURES
Oklahoma State University
Medical Center
Overview

• 700,000 vertebral compression fractures in U.S. annually
• Most heal in 4-6 weeks
• Some have symptoms that persist and develop chronic pain
• Some have retropulsion of portion of fractured vertebra
• Other causes: mets, myeloma, hemangioma, XRT
History

• 1989 Dr. Herve Deramond in France treated hemangioma at C-2 by injecting methyl methacrylate by direct puncture
• Later he utilized same technique to treat osteoporotic fractures
• Now there are large case series documenting excellent results for VP
Epidemiology U.S.A.

- 13-18% postmenopausal women (4-6 million) – osteoporosis
- 30-50% women (13-17 million) - low bone mass
Definitions (WHO)

- Osteoporosis – BMD 2.5 SD below normal young adult
- Low bone mass – BMD is 1-2.5 SD below normal young adult
Common Etiologies

- Senile osteoporosis
- Steroid Use
- Smoking
Senile Osteoporosis

- Risk factors
  - Osteoporotic fracture in patient or first degree relative
  - White, female, cigarette smoker, low body weight, sedentary life style, alcoholism, low calcium intake, poor health, dementia
  - Low estrogen early menopause (<45), prolonged premenopausal amenorrhea (>1 yr)
Most Frequent Fractures Associated with Osteoporosis

- 700,000 vertebral fractures/year (1.5 million total)
- Cost 5 – 10 billion
- Associated with 15 % increased death rate/5 years
Pre-procedure Assessment

- History
- Physical Exam
Surgical/Medical Alternatives

- Arrest osteoporosis with meds
- Pain management
- Body brace
- Epidural injections
- Stabilize spine with instrumentation
Why offer KYPHOPLASTY/VERTEBROPLASTY?

• Little else to offer
  – Medical therapy too late and too slow
  – Surgical therapy- increased morbidity in this population and suboptimal in advanced osteoporosis

• Now large evidence that KP/VP works well in appropriately selected patients
Indications

- Painful OP vertebral compression fracture
- Painful vertebral fracture related to benign or malignant tumor
- Reinforcement of the vertebral body or pedicle prior to surgery
- Pts with multiple OP compressions in whom further collapse would result in respiratory compromise
Indications (con’t)

• Pts with anterior column instability by fluoroscopy
• Pts with Kummel’s disease (avascular necrosis)
• Failure of conventional management
• Deep pain with imaging evidence of new or worsening vertebral compression fx or lytic mets
• Lack of radicular pain or loss of function as primary symptom
Imaging Evaluation

- Plain film with comparisons
- CT
- MR
- Nuclear medicine bone scan
Selection: Quantitative Measures of Pain/Disability

• Painful OP fractures or painful vertebral compressions secondary to benign/malignant tumor
  – Causing major disability (inability to walk/transfer/perform ADL)
  – Causing prolonged (> than 4 wks) minor disability (inability to sit/stand for > 1 hr., inability to perform some routine ADL)
  – Causing prolonged pain (>4 wks) requiring narcotics, and not improving or worsening
Limitations

• Contraindications (absolute)
  – Allergy to PMMA
  – Progressive clinical improvement since onset of fracture
  – Retropulsion of fracture with signs of cord compression
Limitations

• Contraindications (relative)
  – Moderate or severe CCS at involved level(s)
  – Radicular pain
  – Tumor extension into spinal canal
Objective

• Relieve pain
• Return patient to self sufficiency
• Reduce pain medications
• Prevent further compressions and progressive kyphotic spinal deformity
Procedure-VP

- Sedation/analgesia with local anesthetic to pedicle
- Patient prone on IR table, sterile prep drape
- Needle advanced under fluoro into involved vertebra through pedicle or parapedicular/lateral approach
- Stylet removed and opacified PMMA injected under fluoro control
- When PMMA hardens patient transferred to bed supine, monitored for 1 hr., then advance activity as tolerated
Complications

• Cement leak into canal or neural foramina
• Pulmonary embolism
• Fracture into central spinal canal or neural foramina
• Infection
• Hypotension
Results

• 80-85% of well selected patients will have complete or near complete pain relief
Future Directions

• New osteoinductive (promotes adjacent bone growth) and osteoconductive (replaced by bone) agents
• Kyphoplasty
• Treatment of bone pathologies other than vertebra (benign and malignant lesions) in conjunction with RFA
Vertebral Body Compression Fracture Treatment Options
Why have we been content to leave the spine in a physiologically and biomechanically compromised condition?
Fracture Treatment Objectives

Four AO principles\(^1\)

- **Fracture reduction** and fixation to _restore anatomical relationships_
- **Stability** by fixation or splintage, as the nature of the fracture and the injury requires
- Preservation of blood supply to soft tissues and bone by careful handling and _gentle reduction techniques_
- **Early and safe mobilization** of the part and the patient

\(^1\) Ruedi & Murphy, AO Principles of Fracture Management, Thieme, Stuttgart, New York, 2000

*Arbeitsgemeinschaft Osteosynthesefragen*  
(English translation: Association for the Study of Internal Fixation - ASIF)
Vertebral Body Compression Fracture (VCF)

Normal

Wedge-shaped

Depressed endplate(s)

Fractured

Spine shorter, tilted forward
Deformity Progression

Lieberman et al., Spine 2001
VCF Treatment Options

Medical Management

■ Treatment Protocol
  – Bed rest
  – Narcotic analgesics
  – Braces

■ Shortcomings
  – May fail to relieve pain
  – Does not provide long-term functional improvement
  – May exacerbate bone loss
  – Does not attempt to restore the anatomy
Open Surgical Treatment

- **Indication**
  - Only if neurologic deficit (very rare, only 0.05%)
  - Instrumented fusion, anterior or posterior

- **Shortcomings**
  - Invasive
  - Poor outcomes in osteopenic bone
VCF Treatment Options

Vertebroplasty

- Designed to stabilize painful VCFs

- Shortcomings
  - Risk of filler leaks (27-74% reported\(^1,2,4,5,6,7,8,9,10\))
    - High pressure injection
    - Uncontrolled fill
    - High complication rate (1-20% reported\(^3,4,5\))
  - Freezes spinal deformity
    - Does not reduce fracture or restore anatomy
    - Not designed to reposition bone

1 Cortet et al., J Rheum 1999
2 Alvarez et al., Eurospine 2001
3 Padovani et al., AJNR 1997
4 Weill et al., Radiology 1996
5 Jensen et al., AJNR 1997
6 Cotten et al. Radiology 1996
7 Gaughen et al., AJNR 2002
8 Grados et al., Rheumatology 2000
9 Peh et al., Radiology 2002
10 Ryu et al., J Neurosurgery 2002
Why Fracture Reduction?

- **What is orthopedic reduction?**
  - The restoration, by surgical or manipulative procedures, of a part to its normal anatomical relation

- **What is the goal?**
  - To produce optimal outcomes with early diagnosis and treatment
  - To accommodate the frail physical status and co-morbidities of geriatric patients

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2 Brakoniecki, Anesthetic Management of the Trauma Patient with Skeletal Injuries, Skeletal Trauma, W.B. Saunders Company, 1998, 1:7:171-172
New VCF Treatment Option

Minimally Invasive Fracture Reduction
Minimally Invasive Fracture Reduction

KyphX® Inflatable Bone Tamp (IBT)
For use as a conventional bone tamp for the reduction of fractures and/or creation of a void in cancellous bone in the spine, hand, tibia, radius and calcaneus.
KyphX® Introducer Tool Kit

Allows precise, minimally invasive access to the vertebral body and provides a working channel.
Reduces the fracture, compacts the bone, and may elevate the endplates.
Leaves a defined cavity within the vertebral body
Minimally Invasive Fracture Reduction

Clinical Experience

- Over 8 years of orthopedic fracture reduction
- As of 2006
  - Fractures reduced > 270K
  - Patients > 250K
Minimally Invasive Fracture Reduction

KyphX® Inflatable Bone Tamp has been developed for patients with symptomatic VCFs
Possible causes of VCFs

- **Primary osteoporosis**
- **Secondary osteoporosis**
  - Drug-induced (corticosteroids, tobacco, barbituates, heparin)
  - Endocrine (hyperparathyroidism, diabetes)
  - Miscellaneous (renal failure, COPD, rheumatoid arthritis, hepatic disease or transplant)

Possible causes of VCFs

- Osteolytic lesions
  - Multiple Myeloma
  - Bone metastases
  - Paget’s disease

- Trauma
  - \(\frac{1}{2}\) of all trauma cases are misclassified
prevention

- Weight bearing and muscle strengthening exercise 3-5X/wk
- Smoking cessation
- Diet of calcium rich foods, Vit. D 400-800 IU/D
- Meds: bisphosphonates, raloxifene, calcitrol, calcitonin, teriparatide, ERT
- OMM/PT/OT
The general goal for fracture treatment is restoration of anatomy and early return to function.

Conventional therapy is not always effective.

KyphX® IBT is a new option for VCFs designed to:
- reduce the fracture
- move cancellous bone (elevate endplates)
- create void inside vertebral body

As with hip fracture surgery, early diagnosis and intervention are important for fracture reduction.

Education of all patients, especially those at risk, in prevention strategies and if VCF occurs prompt evaluation and treatment.
Case Studies
Case Study

Patient: 55 YO Male
Diagnosis: Secondary osteoporosis
Fracture Reduced: L-1, 3 day old

Courtesy of Ulrich Berlemann, M.D., Germany
Case Study

Patient: 79 YO Female
Diagnosis: Primary osteoporosis
Fracture Reduced: L-2, 8 days old

*Courtesy of Hunt Bobo, M.D., Jackson, MS*
Case Study

Patient: 89 YO Female
Diagnosis: Primary osteoporosis
Fracture Reduced: T-7, 1 year old

Courtesy of Wade Wong, DO, La Jolla, CA
Case Study

Patient: 80 YO Male
Diagnosis: Steroid-induced osteoporosis
Fracture Reduced: T-8, 10 weeks old

*Courtesy of Eric Truumees, M.D., Southfield, MI*
Case Study

Patient: 76 YO Female
Diagnosis: Primary osteoporosis
Fracture Reduced: L-1, 3 month old

Courtesy of Fraser Landreneau, M.D., Baton Rouge, LA
Case Study

Patient: 75 YO Female
Diagnosis: Primary osteoporosis
Fracture Reduced: L-3, 4 week old

*Courtesy of Jonathan Hyde, M.D., Miami Beach, FL*
Case Study

Patient: 82 YO Male  
Diagnosis: worker comp low-energy fracture  
Fracture Reduced: T-12, 2 weeks old

*Courtesy of Stuart Hutchinson, M.D., Santa Barbara, CA*
Case Study

Patient: 61 YO Male
Diagnosis: Multiple Myeloma
Fracture Reduced: T-11, 5 weeks old

Courtesy of Donald Schomer, M.D., Houston, TX
Case Study

Patient: 49 YO Male
Diagnosis: Secondary Osteoporosis, heparin-induced (AIDS)
Fracture Reduced: T-9, 4 months old

Courtesy of John Regan, M.D., Los Angeles, CA
Case Study

Patient: 61 YO Female
Diagnosis: Multiple Myeloma
Fracture Reduced: T11-L2, 1 ½ yrs old

Courtesy of Kent Grewe, M.D., Portland, OR
Case Study

Patient: 80 YO Female
Diagnosis: Primary Osteoporosis
Fracture Reduced: L1, 2 months old

Courtesy of James Hazel, M.D., Richland, WA
Case Study

Patient: 71 YO Female
Diagnosis: Primary Osteoporosis
Fracture Reduced: T9, 7 days old

Courtesy of Vivek Kushwaha, M.D., Houston, TX
Case Study

Patient: 57 YO Male
Diagnosis: Trauma
Fracture Reduced: L1, 3 weeks old

Courtesy of Peter Bono, D.O., Farmington Hills, MI
Case Study

Patient: 76 YO Female
Diagnosis: Metastatic Lung Cancer
Fracture Reduced: T8, 8 weeks old

Courtesy of Henry Small, M.D., Houston, TX
Case Study

Patient: 65 YO Female
Diagnosis: Primary Osteoporosis
Fracture Reduced: L2, 9 weeks old

Courtesy of Vito Loguidice, M.D., Phillipsberg, NJ
Case Study

Patient: 73 YO Female
Diagnosis: Primary Osteoporosis
Fracture Reduced: L1, 6 months old

*Courtesy of Mohammad Majd, M.D., Jeffersonville, IN*
Case Study

Patient: 78 YO Female
Diagnosis: Primary Osteoporosis
Fracture Reduced: T7, 4 weeks old

Courtesy of David McKalip, M.D., St. Petersburg, FL
Case Study

Patient: 73 YO Female
Diagnosis: Primary Osteoporosis
Fracture Reduced: L1, 2 weeks old
T11, 5 year old refracture

Courtesy of James Olson, M.D., Sparks, NV
Case Study

Patient: 61 YO Male
Diagnosis: Multiple Myeloma
Fracture Reduced: T11, 5 weeks old

Courtesy of Paul Pagano, M.D., Houston, TX
StabiliT™ Vertebral Augmentation System

Redefining The Treatment of Vertebral Compression Fractures
THANK YOU