Management of Acute Vertebral Compression Fracture Patients

A protocol to Expedite and Improve Functional Outcomes using The Meeks Method

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My Journey…

OT in a PT World !

- Developed a reimbursable 7 week out-patient program
- Individual patient treatments
- In-Patient Experience…
  - Untrained staff
  - Lack of guidelines for safe management of VCF's

Evolution of a Protocol

How are Acute Vertebral Compression Fracture Patients Managed at Your Facility?

… Mismanaged?

- Research and Networking
- Interdisciplinary Program
- *Evidence Based*

Sara Meeks PT

"Movement From and For the Bones…"

www.SaraMeekspt.com

OSTEOPOROSIS-RELATED FRACTURES

- Occur in 1 of 2 women; 1 of 4 men
- Happens every 20 seconds
- Can be immediately life-altering and life-threatening
- Annual Fracture Incidence
  - Vertebral—700,000
  - Hip—300,000
  - Wrist—250,000
  - Other Sites—300,000
- Cost
  - >$46 million per day
  - By 2025 -$25 Billion/yr NOF

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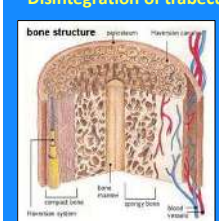
Osteoporosis Effects All Bones

A disease characterized by low bone mass and bone matrix deterioration leading to increased fragility and risk of fracture. (World Health Organization 2011)

Disintegration of trabecular structure and structure of the marrow

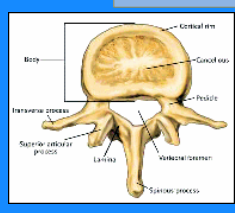


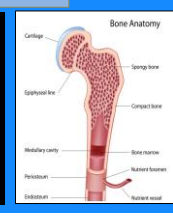
Why are some bones more likely to break than others?

Cortical Bone

vs.

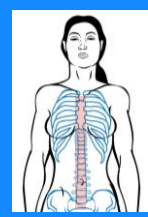
Trabecular Bone

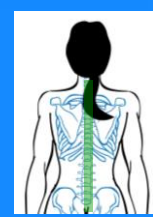




Consider the Vertebrae as

FRONT





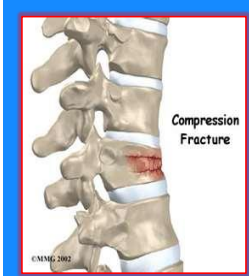
BACK

soft
spongy

← *Two Bones* →

firm
solid

Vertebral Compression Fractures



- Bones of ***anterior spine*** usually *first* to show signs of osteoporosis
- **Most common fracture** occurring with osteoporosis
- Occur in **30-50%** of people **over age 50**
- Only **20 -30%** are **painful…**
- **70-80%** are **silent!**
- Only **25-30%** clinical attention

Christiansen, Bouxsein, 2010

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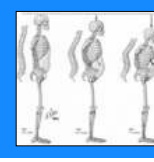
What Causes Vertebral Compression Fractures?

When the ***applied load*** *exceeds the* ***strength*** of the bone

- Rate, direction, or magnitude of force
- Trauma, falls, bending or compression
- Bone density and quality
- Size, shape, internal bone structure



Adapted from: National Osteoporosis Foundation's International Symposium on Osteoporosis (ISO12) Wendy Katzman, PT

- **VCF's are often associated with moderate trauma such as a car accident, lifting, and falling**
- **50% were reported as occurring "spontaneously" with *64% noticed when getting out of bed***
- ***37%* occurred during *trivial housework*, and *17% were due to moderate or severe injury***
- **In men, *73.8% of clinical VCF's were precipitated by no known trauma or by low-energy trauma*, including *falls in 57.3%***

- **Hip fracture patients - 25-30% have had previous VCF's which they didn't know about**
- **Bimodal distribution with most VCF's occurring T7-8 and T11-L1**
  - Maximum thoracic kyphosis occurs T7-T8
  - Thoracolumbar junction - the rigid thoracic spine gives way to the more mobile lumbar spine

Christiansen, Bouxsein, 2010, Briggs et al 2007

Thoracic Kyphosis Increases Spinal Loads
(Briggs et al. 2006, 2007, Keller et al. 2003)

Thoracic Load

1. Peak flexion moments T8
2. Apex of curve T8
3. Cervical Shift

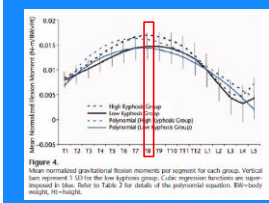


Figure 4.
Mean normalized gravitational flexion moments per segment for each group. Vertical bars represent 1 SD for the low kyphosis group. Cubic regression functions are superimposed in blue. Refer to Table 2 for details of the polynomial equation. BW=body weight, Ht=height.

- **After one VCF, the risk for having a 2nd fracture increases 5 fold!**
- **20% of women will sustain a 2nd vertebral fracture within 1 year**

- *International Osteoporosis Foundation 2005*
- *Report of the Surgeon General on Bone Health Oct 2004*

Under-diagnosis of VCF's Worldwide

- **False-negative rates:** North America - 45.2%
- **False-positive rate** was 5% globally.
- **Under diagnosis** is attributable in part to a lack of radiographic detection, use of ambiguous terminology in the radiology report, or both.

Delmas PD 2005

DEXA /BMD - T Score

O to -1……Normal Bone

-1 to -2.4……Osteopenia

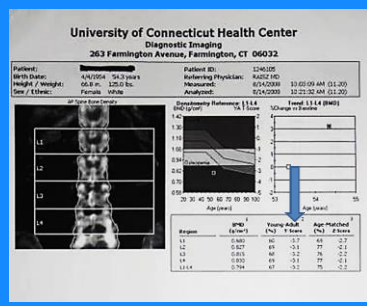
-2.5 & Below……..Osteoporosis

Below -2.5 in presence of fracture…
……Severe Osteoporosis

Z Score

Men under 50, Children, Pre-Menopausal

BMD/DEXA Vertebral Column Bone Density Report A/P View



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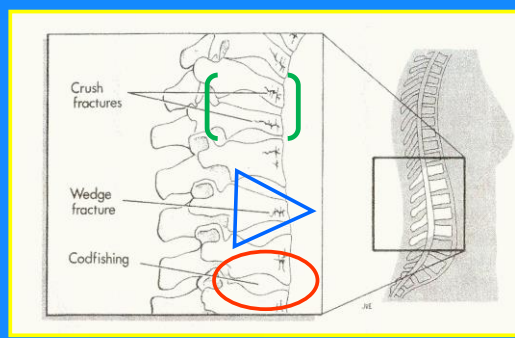
STAGES OF VERTEBRAL FRACTURE

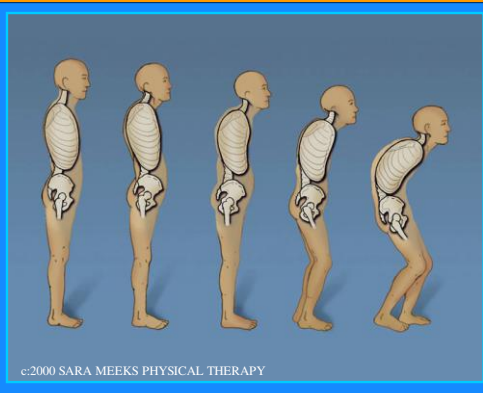


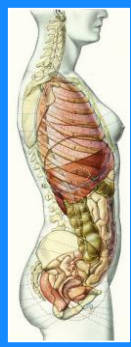
From: STAND TALL by Morris Notelovitz, M.D.
Triad Publishing, Gainesville, Florida

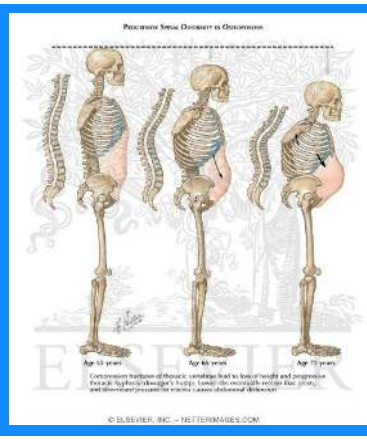
Lateral Vertebral Assessment

MRI COMPRESSION FRACTURES T 12 / L1

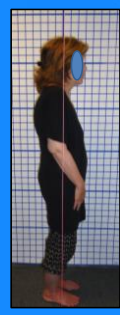
PATTERNS OF POSTURAL CHANGE







Compression Fractures and Postural Change



Vertebral Fracture Cascade

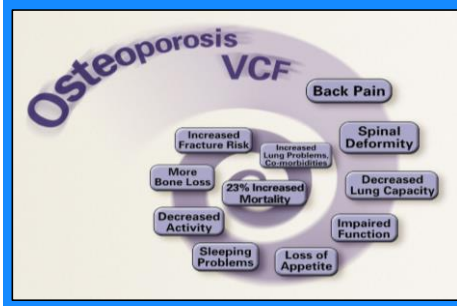
Christiansen, Blaine, Bouxsein 2010. Briggs 2006. Lyles 1993

Decreased Quality of Life with VCF

- Increased number of VCF's
- VCF's cause physical dysfunction
- Lumbar fractures had greater impact than Thoracic fractures
- Greater loss with multiple vertebral fractures and when combined with a hip fracture

Lips, et al 2005

Downward Spiral of Health and Quality of Life Secondary Consequences



Other Problems
- Cardiac
- Swallowing
- GERD
- Speech
- Digestion
- Elimination

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EVIDENCE BASED TREATMENT

Frost HM. (1966) *Personal Experience in Managing Acute Compression Fractures, their Aftermath, and the Bone Pain Syndrome, in Osteoporosis.*

Sinaki M, et al. (2002) Stronger Back Muscles Reduce The Incidence Of Vertebral Fractures: A Prospective 10 Year Follow-up Of Postmenopausal Women.

Briggs AM, et al.(2006) *The Vertebral Fracture Cascade in Osteoporosis: A Review of Aetiopathogenesis.*

Kishikawa (2012) Initial Non- Weight Bearing Therapy

Conventional Relative Rest Therapy	Initial Non-weight-bearing Therapy
• Bed Rest	• Complete bed rest (2wks)
• Soft Brace wearing	• No weight-bearing to spine for two weeks followed by wearing soft brace
• Minimization of weight bearing to spine	• At 12 weeks vertebral body union 100%
• At 12 Weeks: Vertebral union 97%	• No back pain 37%
• No back pain 12%	• Mild back pain 62%
• Mild back pin 75%	• Moderate back pain 1%
• Moderate back pain 13%	• Length of stay 49.2 days
• Length of stay 37.9 days	

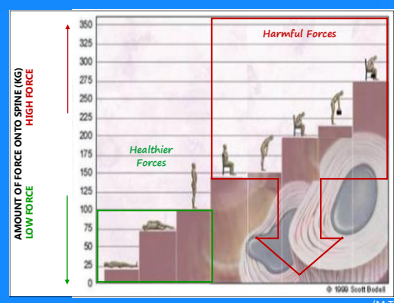
Unweighting of the Spine

BODY POSITION AND MOVEMENT

Can Result in Harmful or Healthy Forces

FRONT OF SPINE
REDUCE HARMFUL FORCES

BACK OF SPINE
HEALTHIER FORCES



(M Tassinari)

Nachemson, A. *The Load On Lumbar Disks In Different Positions Of The Body.* Clinical Orthopaedics and Related Research: March/April 1966; 45: 107-122.

CAUTIONARY / CONTAINDICATED MOVEMENT OF THE SPINE

- ❖ Forward Bending*
- ❖ Side Bending
- ❖ Twisting

- Sinaki-Mikkelsen 1984*
- Lewis 1997
- Davis 2000
- Bassey 2001
- Wu 2003

QUESTIONS...???

THE PROTOCOL FOR MANAGEMENT OF ACUTE COMPRESSION FRACTURES

ACUTE PHASE - First 1-5 Days

Hospitalist Package of Information

- Copy of the Protocol
- Evidence - Based Treatment Program
- Nachemson A. - The Lumber Spine - An Orthopedic Challenge: Spine 1:59 - 71, March 1976
- Copies of Frost, Sinaki, Briggs, & Huntoon , Kishikawa articles
- Reference list

Referral

- PT/ OT Evaluation and Treatment
- ➢ NO Bed to Chair Orders
- Activity Orders - Active bed rest
  … Standing/Ambulation as tolerated

TEAM APPROACH

- ➢ Physician/Hospitalist
- ➢ PT / PTA
- ➢ OT / OTA
- ➢ Nursing 24/7
  - Bed positioning
  - Reinforce the protocol of treatment
  - Precautions
  - Safe transfers

General Assessment

- Medical Chart Review
- 🚩 Co-Morbidities
- Fracture(s) Location
- How did the fracture occur?
- Pain - Location, Intensity
  Pain Algorithm

- Functional ROM
- Functional Mobility - Prior
- Discharge Plan

Initial Treatment Goals

1. Decrease *Pain* and *Spasm*
2. *Decompress/Reduce Fracture*
3. *M*aximize S.A.F.E. Functional Movement

Pain Management

- Pain Medication Schedule
- Positioning to Unload the Spine
- Monitor *Pain*
- Heat / Ice
- Modalities – IFC
- Soft Tissue Mobilization

POSITIONING to REDUCE PAIN and SPASM

- Optimum Spinal Alignment
- Un - Load/Elongate in Supine
- Emphasis Alternating Positions of Comfort in Bed
  - Start Supine , then side lying

PRINCIPLES OF MOVEMENT OF THE MEEKS METHOD

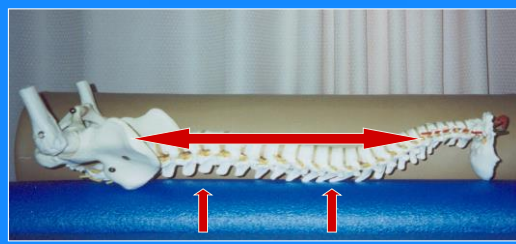
1. **UN-**load the **Spine** and **Hip**

2. **Strengthen the Support Structures**
"Fountain of Youth Muscles"- Back Extensors, Abdominals, Diaphragm, Pelvic Floor, Hip Abductors & Extensors

3. **THEN**, begin **SAFE** loading, considering the clinical condition of the patient

#1. UN-Load the Vertebral Bodies

FRONT of the Backbone



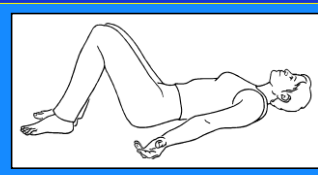
Fracture Reduction

Fyhrie, et al. (1994) Failure mechanisms in human vertebral cancellous bone.

- Removal of the load to the bone, in all specimens, recovered at least 94% of their original height!

UN-Load the Vertebral Bodies to REDUCE the FRACTURE
Start Immediately!

Decompression Position



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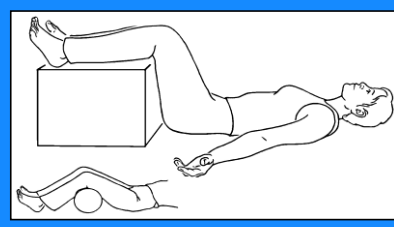
Lower Extremity Positioning



- DVT Compression Therapy
  Venodyne - Intermittent Pressure

Bed Positioning

- Decompression Position
  - Pre-morbid Posture
  - Co-Morbidities
    - COPD, GERD, Vertigo, Obesity
  - Bed Angle - Measurable Goal
    - Patient Controlled Progression
  - Head Position - Cervical Alignment
  - Upper Extremity Support

Side Lying Considerations

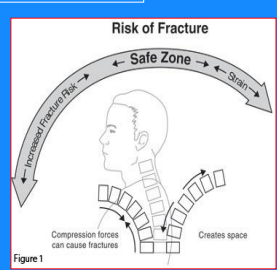
- Spinal Alignment
  - NO Spinal Rotation
  - NO Fetal Position
- Additional Support/Positioning
  - Legs, Waist, Arms, Neck

Patient Education

- What is a Compression Fracture?
- Spine/Skeleton
- What postures to avoid
- Why they need to avoid
- Goals of therapy
- Family Education

AVOID

- Forward Bending
- Side Bending
- Twisting

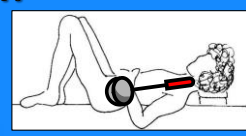


During *ALL* Activity

Breathing Methods

Fracture Location?

- Thoracic Fracture
  - Balloon/Ladle/Scoop



- Lumbar Fracture
  - Upper/Mid Accordion

- Rate, Depth, Nose/Mouth

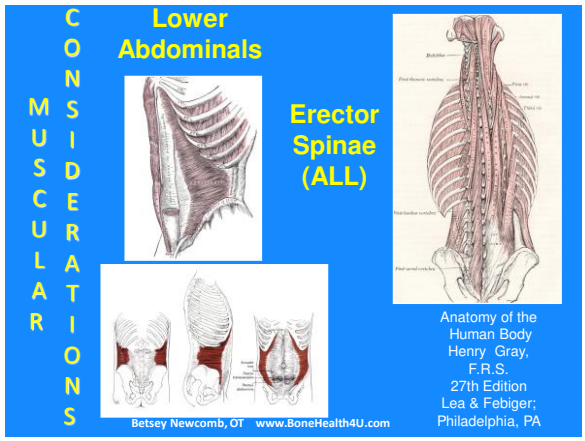
Positioning for Eating

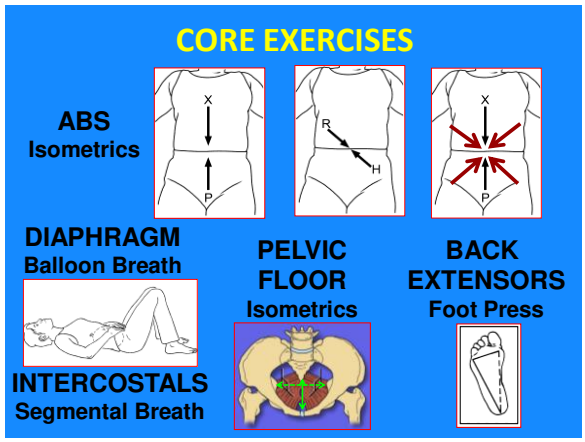
- Raise head of bed as needed
- Side Lying

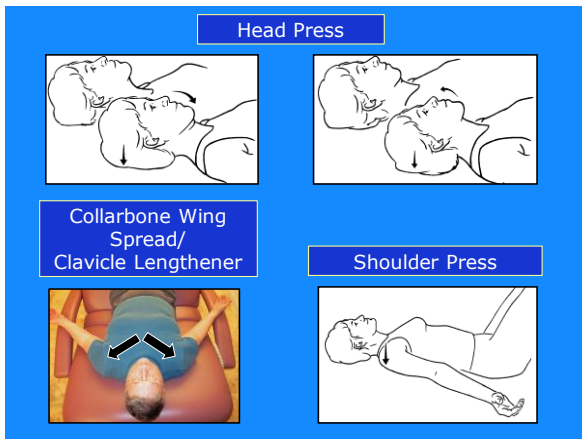
#2. Strengthen Support Muscles in Decompression Position

- Diaphragm & Intercostals
- Neck
- Back Extensors
- Abdominals
- Pelvic Floor
- Gluteus Maximus
- Gluteus Medius

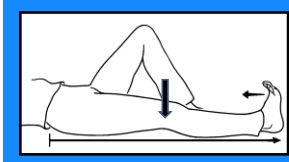
SARA MEEKS PHYSICAL THERAPY


MUSCULAR CONSIDERATIONS
Lower Abdominals
Erector Spinae (ALL)
Anatomy of the Human Body
Henry Gray, F.R.S.
27th Edition
Lea & Febiger; Philadelphia, PA
Betsey Newcomb, OT www.BoneHealth4U.com

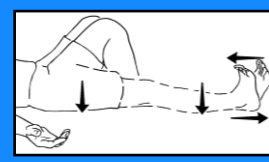

CORE EXERCISES
ABS
Isometrics
X
P
R
H
DIAPHRAGM
Balloon Breath
INTERCOSTALS
Segmental Breath
PELVIC FLOOR
Isometrics
BACK EXTENSORS
Foot Press


Head Press
Collarbone Wing Spread/ Clavicle Lengthener
Shoulder Press

Leg Straightener/ Lengthener

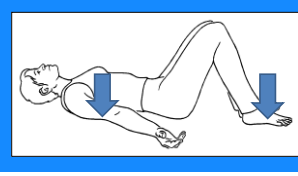


Leg Press



Functional Strengthening

- Preparation for bed mobility
- Unilateral/Contralateral/Bilateral Presses
  - Foot Press with leg bent and foot flat
  - Arm/Elbow Press with elbow at 90 degrees



OBSERVE where the pain is coming from…

- ✓ Activating weak muscles that have not been used?
- ✓ Stretching areas of restriction?
- ✓ Muscle Spasm?

PROGRESS slowly and gently

- Ankle pumps
- Leg squeeze/Leg press – bilateral / unilateral
- Quad sets
- Gluteal Strengthening
- NO straight leg raises
- Watch for compensatory motions

Progression of exercises - Walk Tall by Sara Meeks

#3 Begin SAFE LOADING
TRANSFER TRAINING

- TOILETING
  - Elevated Commode
  - Ambulate to Bathroom
- To Chair for EATTING

Methods of Getting In and Out of Bed

- Educate/Demonstrate
- Cueing for Spinal Alignment
- Activate Core Muscles
- Log Roll

Instruct in the *LOG ROLL*

Move shoulders, hips and knees at the same time

SUPINE to SIT

- May don brace prior to sitting up
- Tighten the core
- Sit up sideways
- Swing legs down to counterbalance
- Assist for success

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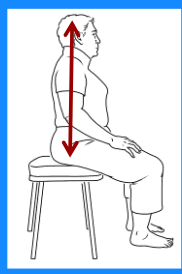
Functional Mobility
SIT to STAND
Internal Plumb Line



PERCH POSTURE

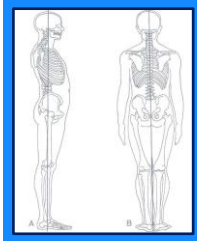
HIP HINGE

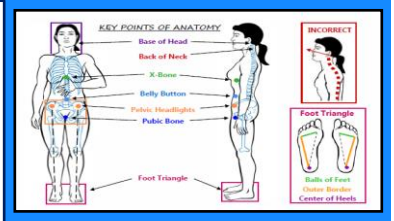
S.A.F.E. FUNCTIONAL MOVEMENT during TRANSFERS

AVOID

Best Alignment

Standing Body Alignment





Swing/SNF Level

Standing Balance

- Assistive Device – Rolling Walker
- Standing Body Alignment
- Body Sway ↔ ↕
- Weight Shifting
- Foot Press

Gait Training

- Progress Safely
- Always Use an Assistive Device
- Walker Pushup
  - Spinal Elongation - 2- 4" taller
- Feather Feet
- Lengthen Stride
- Heel/Toe Ambulation
- Gaze forward, not down at floor!

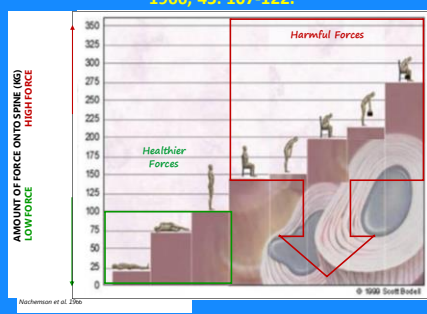
Seating Considerations

- Teach Sit-to-Stand-to-Sit
- Recliner - Lumbar Support
- Full Vertical Support
- Perch - Hip Chair
- "Active" Sitting
- Arm Rest Support

Positioning for Eating

- Sit briefly for the meal then back to bed
- Stand or Perch if supervised

Nachemson, A. *The Load On Lumbar Disks In Different Positions Of The Body.* Clinical Orthopaedics and Related Research: March/April 1966; 45: 107-122.



Habitual Slouched Posture

Bone Creep Damages Anterior Vertebral Body

(Adams and Pollintine, et al. 2009)

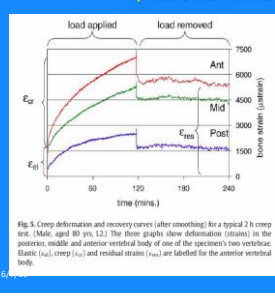
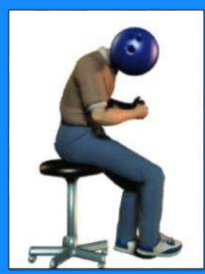
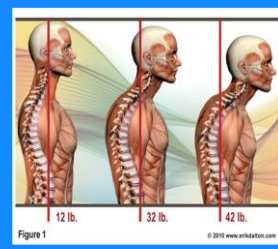


Fig. 5. Creep deformation and recovery curves (after smoothing) for a typical 2 h creep test. (Male, aged 80 yrs, L2.) The three graphs show deformation (strains) in the posterior, middle and anterior vertebral body of one of the specimen's two vertebrae. Elastic (ε_{el}), creep (ε_{cr}) and residual strains (ε_{res}) are labelled for the anterior vertebral body.

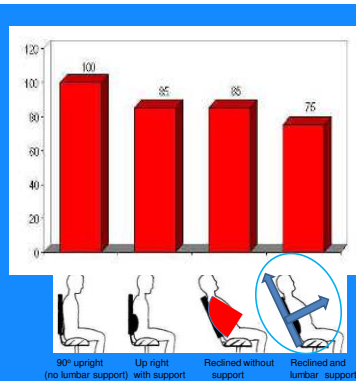
- Highest creep anterior
- Smoothness = minor fxs
- Threshold phenomenon
- Full recovery 20 times longer than load time
- BMD no significant effect



The average head weighs between 10 to 15 lbs.



Every inch of forward head increases the weight of the head on the spine by an additional **10 lbs.** *Kapandji, Physiology of Joints, Vol. 3*



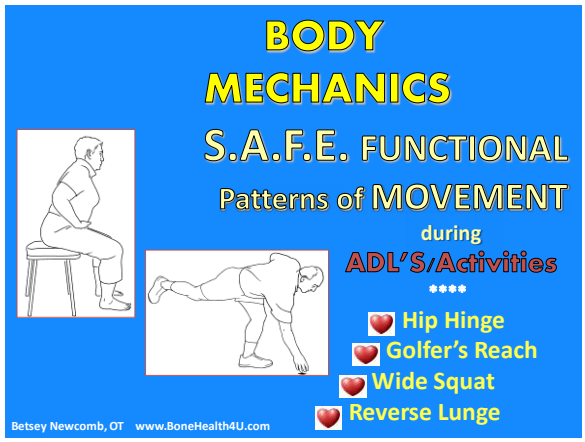
Best seated position is reclined with head supported, lumbar spine supported, and arms supported on arm rests. Feet/legs supported.

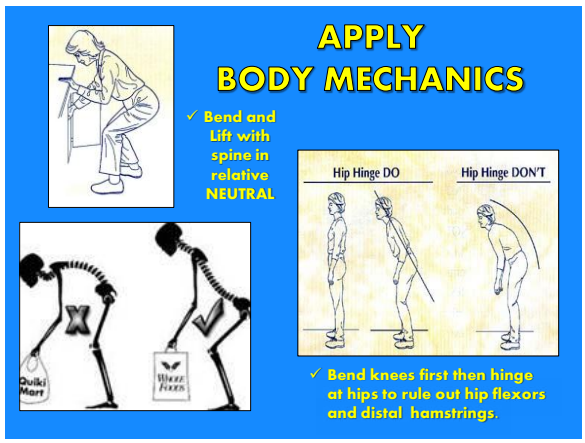
Activities of Daily Living

B ADL ⟶ I ADL's

- ADL Evaluation – Educate vs. Ask
  - Insure safety in movement
  - Berg Balance # 8, 9, 10
- Elevated Commode - bedside
- Hip Hinge/Dowel
- Integrate Core Muscles /Alignment

Adaptive Equipment
➢ Long Handled Equipment
➢ Stocking Aide
➢ Reacher
➢ Elastic shoe laces
➢ Step stool
AVOID
➢ Toilet Hygiene
➢ Self care
Betsey Newcomb, OT www.BoneHealth4U.com


BODY MECHANICS
S.A.F.E. FUNCTIONAL
Patterns of MOVEMENT
during
ADL'S/Activities
****
Hip Hinge
Golfer's Reach
Wide Squat
Reverse Lunge
Betsey Newcomb, OT www.BoneHealth4U.com


APPLY BODY MECHANICS
✓ Bend and Lift with spine in relative NEUTRAL
Hip Hinge DO
Hip Hinge DON'T
✓ Bend knees first then hinge at hips to rule out hip flexors and distal hamstrings.

Grooming/Hygiene

S.A.F.E.

S.A.F.E.

UN- S.A.F.E.

Activity Requirements

ROM

- ✓Ankle dorsiflexion
- ✓Hip flexor tightness
- ✓Hamstring tightness
- ✓Knee mobility

STRENGTH

- ✓Quadriceps strength
- ✓Back Extensor strength

BALANCE

Environmental Modifications to Facilitate Safety

- ❖**Provide Support** - Perch Seating, Foot Stool, etc.
- ❖**Assistive Devices** - Long Handle Reachers
- ❖**Relocate Frequently Used Items**
- ➢**AVOID**
  - Forward Bending
  - Side bending
  - Twisting
  - Reaching
  - Lifting

Discharge Planning

- Patient Education Package
- Advocate for Themselves

VCF'S OCCUR *PRIMARILY* DURING DAILY ACTIVITIES

- 50% reported as occurring "spontaneously", with 64% noticed when *getting out of bed.*
- 37% occurred during *trivial housework*.
- In men, 73% of clinical VCF's were precipitated by *no known trauma or by low energy trauma*, including falls in 57%.
- 25-30 % of hip fracture patients have had previous VCF's which they didn't know about.
- Most VCF's occur at T 7-8 and T11-L1

Christiansen, Bouxsein, 2010. Briggs et al 2007

Home Health

Acute …Post SNF

- ADL's/ IADL's with Good Alignment /Body Mechanics and Adaptive Aides
- AVOID Habitual Patterns of Movement that include Forward Posturing, Twisting, Side Bending, Reaching, Lifting …
- Facilitate Change - Modify the Environment
- FALL Prevention and Balance Training
- Patient and Family Education!!!

Functional Outcome Measure

- B.U. AM - PAC short form
  - Daily Activity for Self Care – In-patient
  - Basic Mobliity – Out-patient
- Tinetti
- Timed Up and Go
- Oswestry Back Pain
- S.F.M. Safe Functional Motion

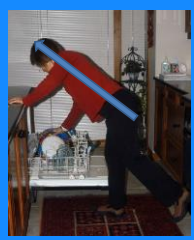
Activity Analysis… Modifications

What do they do all day?

Puzzles, Cook, Needlework, Read, Crafts, Gardening , Crossword puzzles, TV, Video Games, … ??

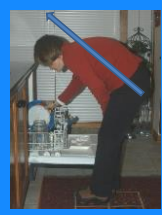
Betsey Newcomb, OT www.BoneHealth4U.com

Dish Washer



S.A.F.E.
Golfers Reach

S.A.F.E.
Lunge



UN-S.A.F.E.

Vertebroplasty

What would happen if you placed a cement block between two sponges (osteoporotic vertebrae)?

Fewer fractures with Back-Extensor-Strengthening Exercises following Vertebroplasty
(Huntoon 2008)

Betsey Newcomb, OT www.BoneHealth4U.com

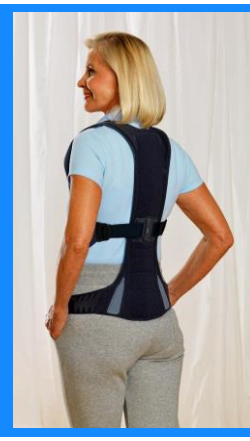
Kummell's Disease

- Avascular Necrosis of the Vertebral body
- Delayed post-traumatic osteonecrosis of the vertebral body – months or years post injury
- Initial minor trauma to vertebral body which may not cause a fracture, but damages the nutrition and leads to softening and resorption, and to progressive bone atrophy.
- Rarely reported clinical entity

H Li, C-Z Liang ans Q-X Chen .Kummell's Disease, an Uncommon and Complicated Spinal Disorder: A Review. Journal of Internal Medical Research. 2012

SPINOMED IV

Spinal Orthosis for Osteoporosis



Bracing is part of a comprehensive approach to the management of patients with osteoporosis

Purposes of Bracing

- Support and Protection
- Control of motion
- Prevent Fracture
- Allow weight-bearing activities

Bracing usually associated with weakening of the body part it is designed to protect

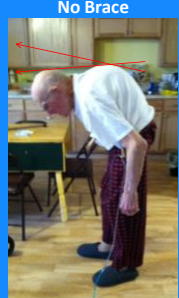
BRACING (with the Spinomed®)

- 73% Increase Back Extensor Strength
- 58% Increase Abdominal Strength
- 11% Decrease Thoracic Kyphosis
- 25% Decrease Body Sway
- 7% Increase Vital Capacity
- 38% Decrease in Pain
- 15% Increase in Well-Being
- 27% Decrease in Limitations ADL's
- Increase in Body Height

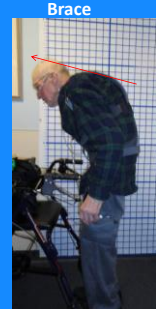
Pfeifer et al. Effects of a new spinal orthosis on posture Trunk strength, and quality of life in women with Postmenopausal osteoporosis. A randomized trial. Am J Phys Med & Rehabil Vol 83 #3 March 2004

Spinomed IV Brace Plus Meeks Exercise Progression = *PROGRESS*

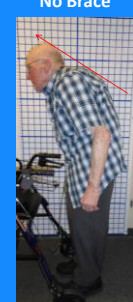
Best Posture
No Brace



Day 1 - Spinomed IV Brace



5 ½ weeks Later
No Brace

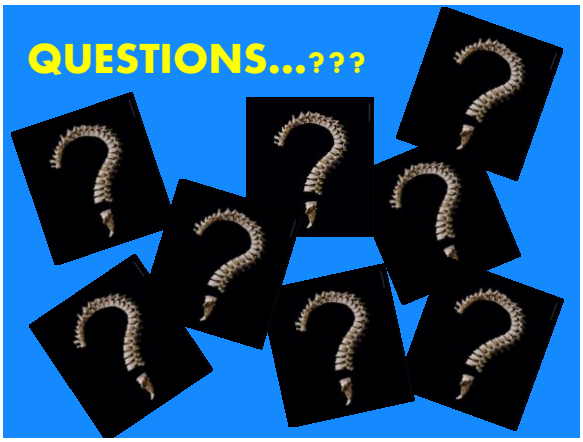


When you see your next patient …

THINK VCF Prevention

Shouldn't *all* patients at risk be handled in a manner that would avoid potential Compression Fractures?

QUESTIONS…???



THANK YOU!

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