Osteoporosis and Exercise: What’s the Evidence?
December 7, 2011
Marie A. Kardys Kelly PT DHS OCS FAAOMPT
Unit Coordinator Outpatient Orthopedic Physical Therapy
Helen Hayes Hospital, West Haverstraw, NY

Osteoporosis Course Objectives
• Identify risks of osteoporosis
• Identify patient education information
• Identify effect of postural exercise
• Identify effect of resistance exercise
• Identify effect of weightbearing exercise
• Identify exercise program to decrease risk of osteoporosis and fracture

Osteoporosis
• Signs & symptoms... the silent disease
  – Loss of ht of 1 ½”
• Diagnosis: Bone Mineral Density

Risks
• Non- modifiable
  – Female, age, genetics, Caucasian, Asian, menopause, diseases
• Modifiable
  – Low Ca/Vit D diet, fiber/antacid interference with Ca absorb, low activity, low BMI, low sex hormones, smoking, high alcohol, meds, but not high salt/protein/caffeine/phosphorus if Ca intact ok,

Patient Education
• Calcium 1200 mg if > 50 yo...8 oz milk 300 mg Ca & 100 IU Vit D
• Vit D 600 IU (age 1-70), 800 IU (71+)
• Caffeine ≤ 300mg; avg... 8 oz coffee 130 mg, 8 oz tea 50 mg, 12 oz coke 50 mg
• Alcohol < 3 drinks (8-10 g alcohol) Papathanou
• Sodium, Protein, Phosphorus
• Vit A, K, C Cummings, Cooper, NOF, NYSOPEP, ods.od.nih.gov/factsheets/calcium

• Falls Risks
  – Lower body weakness...exercise
  – ↓ vision...enough lighting
  – gait/balance problems...clear spaces to walk
  – Impaired hearing...aid
  – 4+ medications.. Ck for side effects
  – Slippery high heeled shoes...flat non-skid
  – Long loose pant legs...hem
  – History of falls

• Ask MD about
  – Loss of more than 1-1/2 inches of height

Cummings, Cooper, NOF, NYSOPEP
Medications

- Alendronate - available as a generic medication (Brand name: Fosamax, Fosamax D)
- Calcitonin (Brand name: Miacalcin or Fortical)
- Denosumab (Brand name: Prolia)
- Estrogen therapy / hormone therapy (ET/HT)
- Ibandronate (Brand name: Boniva)
- Raloxifene (Brand name: Evista)
- Risedronate (Brand name: Actonel or Actonel with Calcium)
- Teriparatide or Parathyroid Hormone (Brand name: Forteo)
- Zoledronic acid (Brand name: Reclast)

National Osteoporosis Foundation

- Founded 1984
- Voluntary health organization
- Promotes programs of public and clinician awareness, education, advocacy and research.

Patient Education

- 1997 Osteoporosis Education
- New York State Osteoporosis Prevention Education Program (NYSOPEP) within the NYS DOH.
- All NYers learn prevention, diagnosis, and treatment of osteoporosis.

- Coor center: HHH
- Regional centers
  - Central: SUNY Upstate Med Univ
  - Hudson Valley: HHH
  - Long Island Winthrop University Hosp
  - Metro Hosp Special Surgery
  - Northeastern: Glens Falls Hosp
  - Western: Sisters of Charity Hosp

2010 Practice Guidelines Canada

- Assess 50+ w fragility fx
  - For ↓BMD, BMI, meds, alcohol, smoking, falls, fx, ↓ ht
- Calculate 10 yr fx risk
  - http://www.shef.ac.uk/FRAX/
- Treatment
  - Exercise
  - Fall prevention
    - Home assess, vision, hip protectors
    - Calcium & Vit D
  - Drugs

10 yr fx risk
- Low < 10%
- Medium 10-20%
- High > 20% or ho fragility fx

Osteoporosis Prevention and Management

<table>
<thead>
<tr>
<th>Therapy Goal</th>
<th>Intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td>Promote bone formation/prevent loss</td>
<td>Indiv ex program</td>
</tr>
<tr>
<td>Fall prevention</td>
<td>Indiv ex, mobility aids, ergonomic advice, environmental mod, education</td>
</tr>
<tr>
<td>Fracture prevention</td>
<td>Ergonomic advice, protective equipment, education</td>
</tr>
<tr>
<td>Post fx rehab</td>
<td>Manual therapy, indiv ex, mobility aids, ergonomic advice, environmental mod, education</td>
</tr>
<tr>
<td>Treatment other relevant m-skel cond that limit mobility or incr fall/fx</td>
<td>Manual therapy, indiv ex, mobility aids, ergonomic advice, education</td>
</tr>
</tbody>
</table>

Summary Sran
Osteoporosis Prevention and Management

- Postural ex
- Flexibility ex
- Strengthening ex
- Weight-bearing ex
- Balance ex
- Pain modalities & Manual therapy
- Ergonomic & Environmental advice

Ex for Osteoporosis PTJ 1987

- Contraindicated ex
- Exn & Isometric abdom ex

Summary paper Aisenbrey

Osteoporosis & Posture

- Effect of hyper-kyphosis on falls risk
  - Decr str
  - Incr sway
  - Gait unsteadiness
  - Incr falls risk
  - Descriptive Sinaki 2005

HHH Handout 1989

- Ingrid Baruch

Assessment of Posture

- Occiput to wall distance
  - Pain↓ spine mobility without osteoporosis
  - Vert fx & ↓ BMD without ↓ clinical or func status
  - Severe forward head asso with
    - ↓ str spine extn, ankle off & pf
    - ↓ bal & gait
    - Gait ↑ base of support ↓ velocity
    - ↓ func scores
    - Not related to BMD or fxs
  - Balzini L 2003

Ingrid Baruch
Assessment of Posture

- **Rib Pelvis distance**
  - Examiner inserts fingers between ribs and pelvis at midaxillary line
  - Likelihood ratio of fx 4 fingers 0.1 (min)
  - Likelihood ratio 0 distance 11.5 (conclusive)
  - ≤ 2 fingerbreaths sensitivity for fx 87% & specificity 47%
  - If neg x-ray → PT for str/flexibility (Siminoski 2003)

Posture & Exercise

- **Improved C & T curves**

Postural Exercise

- **Exercisers**
  - improve (↓) kyphosis
  - ↑ body height
- **Non-exercisers**
  - worsened (↑) kyphosis
  - ↓ body height (Ball 2008)

Postural Exercises Routine #1

- Warm up standing
  - AROM shl, chest, upper back
- Strength
  - Prone trunk lift to neutral
  - Quadruped arm leg lift
  - Shl flex on roller
  - Sidelic thoracic rot
- Stretching
  - chest stretch on roller
  - Prone rectus stretch with hip extn
  - Supine SLR
  - Quadruped Thoracic extn and chest stretch
- Postural correction
- Cool-down
  - wall pushup
  - off the wall
  - calf stretch
- Home postural correction

Postural Routine #2

- Warm up standing
  - AROM shl, chest, upper back
- Strength
  - Prone trunk lift to neutral
  - Quadruped arm leg lift
  - Shl flex on roller
  - Sidelic thoracic rot
- Stretching
  - chest stretch on roller
  - Prone rectus stretch with hip extn
  - Supine SLR
  - Quadruped Thoracic extn and chest stretch
- Postural correction
- Cool-down
  - wall pushup
  - off the wall
  - calf stretch
- Home postural correction
Other Posture Exercises

- Rib Lift
- Chin Tuck

Mobilization & Osteoporosis
Thoracic Spine PA Loading

- In vitro mechanical failure load 200-728 N, avg 479 N \(\pm 162\) wfx T6 SP x 11, T7 SP x 1
- In vivo loads PA mobs to humans force 106-263 N, avg 145 \(\pm 38\) N
- High invivo are similar to low invitro forces
- Whole cadaver PT max load 135N; unable to fx.

Pain Mgt w Ex & Manual PT

- Pop: osteoporotic fx, n=20, Female =17
- Treatment grp n=11
  - 10 wks
  - In clinic 3x/wk posture taping & awareness, STM, PA T spine, ed, back care, str & trunk contrl
  - HEP daily posture & rom
- Outcomes measures
  - Numeric rating scale pain & restriction daily activities, generic & disease specific Qol, TUG, Kyphosis, Timed loaded Standing Test (TLST)for arm/trunk endurance
- Results treatment grp
  - ↓ pain @ rest & w motion
  - ↑ Qol phys func
  - ↑ TLST

Osteoporosis & Exercise
Effect on Bone Density
Resistance & Weightbearing

- Incr BMD
  - Aerobic ex (calisthenics)
  - Resistance ex
  - Walking
  - Combined aerobics (calisthenics) & WB ex

- For positive effect
  - Intensity for JRF 8RM
  - Intensity for GRF 85% HR max

- Equal positive BMD effects when
  - Low intensity or 40% 1RM at 2x/wk
  - High intensity of 80% 1RM at 3x/wk

- Site specific effects weight training
  - Fem troph: JRF
  - Fem troph & intertroph: JRF
  - Fem troph, neck, Ward’s triangle, total hip: JRF
  - Fem neck, L2-4: GRF

Osteoporosis & Exercise
Effect on Bone Density

- For positive effect
  - Intensity for JRF 8RM
  - Intensity for GRF 85% HR max

- Equal positive BMD effects when
  - Low intensity or 40% 1RM at 2x/wk
  - High intensity of 80% 1RM at 3x/wk

- Site specific effects weight training
  - Fem troph: JRF
  - Fem troph & intertroph: JRF
  - Fem troph, neck, Ward’s triangle, total hip: JRF
  - Fem neck, L2-4: GRF

Review Zehnacker
Osteoporosis & Exercise
Effect on Bone Density

- 4 types of effective ex
  - Weighted squats, hack squats, leg press, hip extn, hip add, hip abd, knee extn, ham curls.
  - Stair-climbing/step boxes with weighted vest, jumping ex, beverage boxes.
  - Military press, lat pull down, seated rows, rotatory torso.
  - Back extn with weighted backpacks, leg press, bench press, trunk extn, elbow flex, wrist curl, reverse wrist curl, triceps extn, forearm pro and sup

Review Zehnacker

Exercise Machines Used in Research Studies

Free Weight Exercises Used in Research Studies

Radius

matched ex & contrl Ayalon

Osteoporosis & Exercise
Effect on Bone Density

- Incr BMD lumbar & positive change hip
  - Resistance ex at 60-70% 1RM
  - 8-12 reps, 1 or more sets
  - 2-3 days/wk
  - Treatment effect with HRT & calcium intake

Meta-analysis Martyn-St James

Osteoporosis & Exercise

- Line dancing, +squats, & +stamping
  - Line dance 1x/wk x 1 yr
  - Dance & squats 8 x 2 5x/wk
  - Dance & squat & stamp x4 2x/dy 5x/wk
  - BMD incr but not signif
  - Balance incr all grps
  - TUG decr all grps
  - # squats inc stamp>squat> dance

RCT Young
Long Term Effects of Ex vs Control

• At 7 yr f/u signif benefit to Ex grp vs contrl for
  – Less hip fx
  – Lower death rate
  – Less postural sway
  – Faster walking speed
  – Improved Frenchay Activities Index Score

Osteoporosis & Exercise

Flexion vs Extension Exercise

- RCT Korpelainen 2010

Trunk Strength & BMD

• Correlation Strength with BMD
  – Trunk extn > flex
  – Ecc extn torque correlates w BMD
  – 4 yr study: OR of maintain BMD 10 x > in top vs bottom tertile

Vibration Ex & Osteoporosis

• Vibration exercise vs walking
• Reciprocation platform
• 3x/wk x 8 mos
• Incr BMD fem neck vib grp
• Incr balance vib grp
• Cost $495
• Hi vs Lo intensity vibration vs contrl
• No between grp diff

Vibration Ex & Osteoporosis

• 108 women RCT
  – Rotational vibrating device
  – Vertical vibrating device
  – Contrl sham relax ex
• Ex routine
  – 15 min 3x/wk
  – Dynamic leg ex on platform
• Results
  – ↑BMD lumbar spine in Rot
    Vib grp
  – No change BMD fem neck in Vib grps
  – ↑ max isometric leg str in both vib grps
  – No change power in jump in vib grps
• Conclusions
  – ↓fx risk by ↑ BMD & m str

Prospective non-randomized Sinaki 1984
Healthy Men & Ex & Vit D

- RCT 4 grps
  - Ex & fortified milk
  - Ex alone
  - Fortified milk alone
  - Control

- Results
  - Milk grps sigf more Ca w Vit D intake
  - Milk no change BMD
  - Ex ↑ BMD

- Conclusions for 50-79 yo healthy men w normal Ca & Vit D
  - Ca & Vit D above nl without incr BMD
  - Ex is safe & effective to ↑ BMD fem neck & lumbar spine

Exercise Other Effects

- Falls in community
  - Decr risk
  - Decr #
  - Decr serious injury

- Pain in with low bone density
  - Decr

- Quality of life in with low bone density
  - Improved

Conclusions for 50-79 yo healthy men w normal Ca & Vit D

- Ca & Vit D above nl without incr BMD
- Ex is safe & effective to ↑ BMD fem neck & lumbar spine

Exercise Other Effects

- Falls in community
  - Decr risk
  - Decr #
  - Decr serious injury

- Pain in with low bone density
  - Decr

- Quality of life in with low bone density
  - Improved

Conclusions for 50-79 yo healthy men w normal Ca & Vit D

- Ca & Vit D above nl without incr BMD
- Ex is safe & effective to ↑ BMD fem neck & lumbar spine

Osteoporosis & Exercise

- Quality of Life women with osteoporosis
  - Trunk extn x 10, 5x/wk vs no ex
  - Signif incr str ex grp vs contrl
  - Signif incr QoL only ex grp

How Do You Work on Balance?

- Postural ex
- Avoid flexion ex, torsion ex, military press
- Progressive resistive ex 40-80% 1RM 2-3x/wk for hip
- Aerobic WB ex at 85% max HR for fem neck and lumbar spine
- WB multi load for wrist
- Balance ex

Conclusions

- Exercise improves posture
  - Decrease fall risk
  - Decrease fracture risk
- Exercise increases bone density, prevents loss
- Exercise type is site specific for BMD
- Wrist ex must be multi load type
- Exercise, Ex & manual therapy can ↓ pain
- Exercise can improve Q of L
References Osteoporosis


References Osteoporosis

- Kukuljan S, Nowson CA, Sanders KM, Nicholoff GC, Selbel MJ, Salmon J, Daly RM. Independent and Combined Effects of Calcium-Vitamin D and Exercise on Bone Structure and Strength in Older Men: An 18-Month Factorial Design Randomized Controlled Trial. J Clin Endocrinol Metab. 2011; 96:955-963

References Osteoporosis


References Osteoporosis

- Gois R, Raimundo A, Leal Alejo. Low-frequency vibratory exercise reduces the risk of bone fracture more than walking: a randomized controlled trial. BMC Musculoskeletal Disorders 2006;9.

References Osteoporosis

- National Osteoporosis Foundation 6/3/10
References Osteoporosis

- URL: http://ods.od.nih.gov/factsheets/calcium
- URL: http://www.nof.org/osteoporosis/diseasefacts.htm
- URL: http://www.nysopep.org.shtm
- URL: http://www.shef.ac.uk/FRAX/

References Osteoporosis