UCSF Department of Physical Therapy and Rehabilitation Science

Move Better, Feel Better, What Physical Therapy Can Do For You

Osher Mini-Medical School

Lowen Cattolico, PT, MS, OCS
Assistant Director of Outpatient Rehab
UCSF Medical Center

Physical Therapy Series Lectures

- Train the Brain: Neuro Rehab
- When your World Spins: Vestibular Rehab
- Under your Skin: Fascia in Movement and Function
- Back to Basics: Healthy Spines
- Rebooting Pelvic Health

- Tonight: " Too Fit to Fracture" Guidelines for Skeletal Health and Aging with Dr. Wendy Katzman

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PhysFit Health and Wellness Center

- Mission Bay
- 1675 Owens St.
- PT Classes
  - High Intensity PD
  - Balance Fit
  - Back Fit
  - Stand Tall
- Individualized PT programs

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Research at UCSF Department of Physical Therapy and Rehabilitation Science

- SHEAF investigated effects of a spine strengthening exercise and postural training on thoracic spine curvature (kyphosis) in community dwelling men and women ≥ 60 years old with hyperkyphosis.
  - Results: Significant improvements in kyphosis and self- esteem.
- SCOR investigated sex differences in response to a kyphosis-specific exercise and posture training program in community dwelling men and women ≥ 60 years old with hyperkyphosis.
  - Results: Kyphosis improved, and there were no sex differences in response to the intervention.
- ***New study:*** Technology-assisted postural training (TAPT) to investigate wearable technology to improve posture in older adults

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"Too Fit to Fracture" Guidelines for Skeletal Health and Aging

Osher Mini-Medical School

Wendy Katzman, PT, DPTSc (DSc), OCS
Professor
UCSF Department of Physical Therapy & Rehabilitation Science

Disclosures

UCSF license Stand Tall™ exercise program and DVD

- Thanks to Dr. Lora Giangregorio and Osteoporosis Canada

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Learning objectives

- Understand why we develop osteoporotic fractures
- Review the best evidence for exercise and physical activity in the prevention of osteoporotic fractures
- Learn the guidelines for physical activity essential to healthy aging
- Learn how these guidelines change for skeletal health, and the prevention and treatment of osteoporosis and osteoporotic fractures

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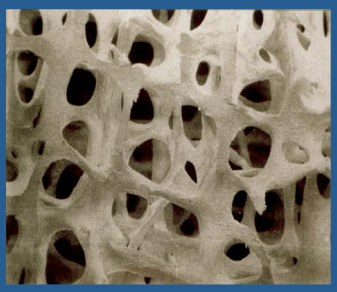
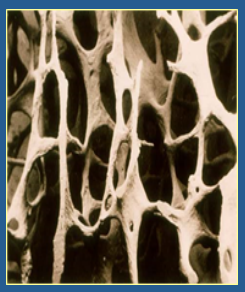
Osteoporosis

A skeletal disorder characterized by compromised bone strength predisposing to an increased risk of fracture.

NIH Consensus Conference, 2004





Painless and often unnoticed until a fracture or height loss occurs.

Osteoporosis

- 44 million people in US are at risk for fracture
  - 10 million Americans have osteoporosis
  - Another 34 million have low bone mass
  - 4 out of 5 are women
  - All ethnic groups are affected




Osteoporotic fractures have higher incidence than stroke, breast cancer and heart attack combined.

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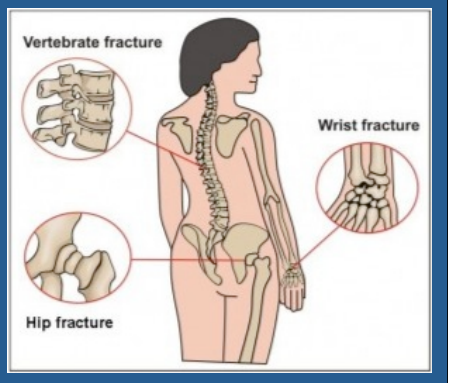
Risk of Fracture with Aging

- 1 in 2 women and 1 in 5 men, after the age of 50 will sustain an osteoporotic fracture in their lifetime.
- Once any fracture occurs, a future fracture is more likely.

National Osteoporosis Foundation



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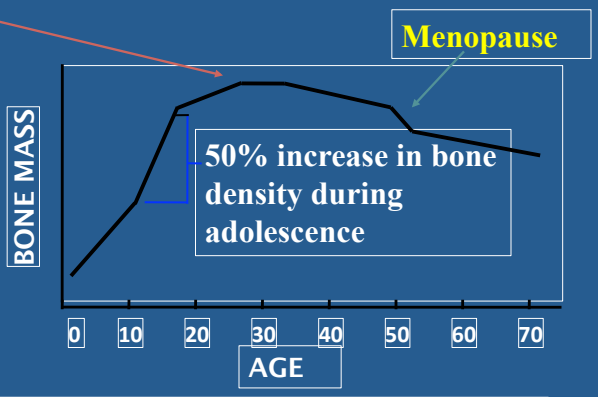
Determinants of Adult Bone Mineral Density

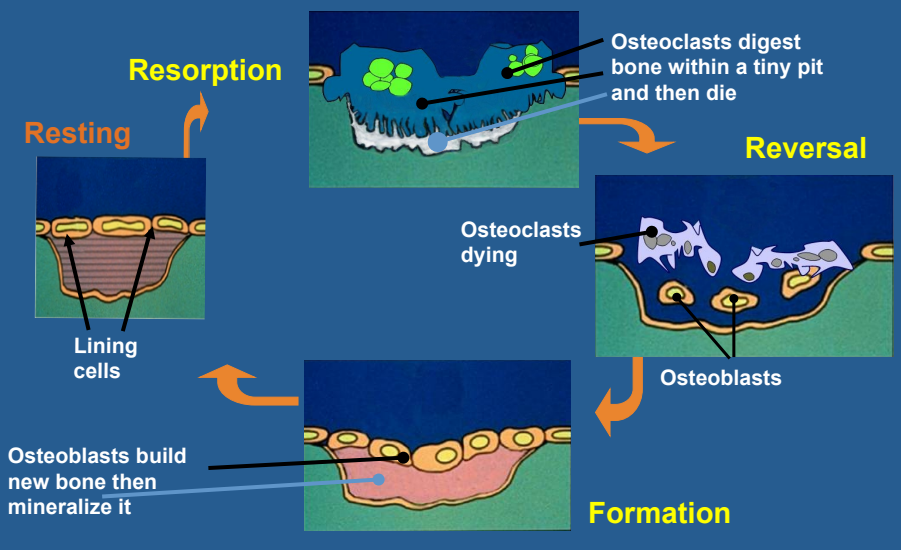
Peak bone mass

- genetics
- gender
- race & ethnicity
- body weight
- timing of puberty
- calcium intake
- exercise



Bone density = peak bone mass – bone loss

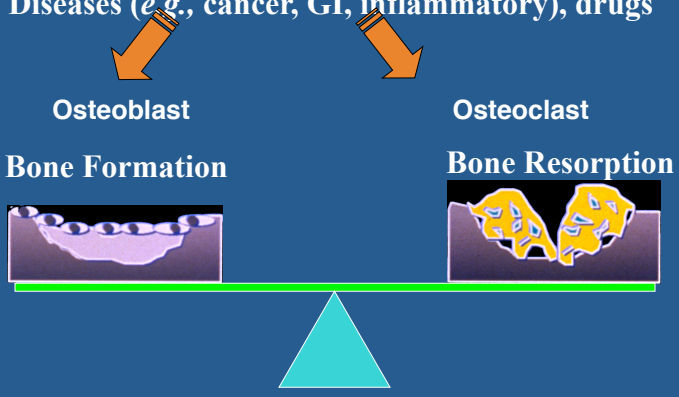
Normal Bone Remodeling



Courtesy A. Schafer

Balance: Formation vs. Resorption

Hormones (especially estrogen)
Physical activity (skeletal "loading"), diet
Diseases (*e.g.*, cancer, GI, inflammatory), drugs



NORMAL: balanced

Courtesy A. Schafer

A Simple Test (DXA) Measures Bone Density

- Bone Mineral Density (BMD) is one factor used to estimate adult fracture risk
- T-score compares an individual BMD with a 30-year old who has reached peak bone density
- T-score is expressed as a standard deviation (SD)
  - +1 to -1 SD you have normal bone
  - -1 to -2.5 SD you have low bone density
  - -2.5 SD or lower you have osteoporosis

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Am I at Risk for a Fracture ?

- Low bone density
- Age, gender
- Body mass index
- Prior adult fracture
- Parent fractured a hip
- Steroid medications
- Smoking, alcohol
- Rheumatoid Arthritis
- Secondary osteoporosis

World Health Organization FRAX http://www.shef.ac.uk/FRAX/

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Am I at Risk for a Fracture?

Other Factors

- Poor physical conditioning
- Tendency to fall
- Too much load when lifting
- Excessive spinal curvature
  - hyperkyphosis

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Why Do We Fracture?

When the **load** applied
rate, direction of fall bending,
compression
spinal curvature
weak back muscles

Exceeds the **strength**
bone density, quality
size, shape, structure
distribution of mass

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Effects of Exercise and Physical Activity on Skeletal Health

- Fractures
- Bone mineral density
- Falls
- Mechanical load
- Hyperkyphosis

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Exercise for preventing and treating osteoporosis in postmenopausal women

Pooled results from randomized controlled trials

Outcome	Participants	Quality	Comments
Total number of fractures	539 (4 studies)	high	4% absolute difference, but not statistically significant
Bone mineral density % change: spine	1441 (24 studies)	high	Significant difference between groups +0.85%
Bone mineral density % change: femoral neck	1338 (19 studies)	low	No significant difference between groups

Howe et al, 2012 *Cochrane Database Syst Rev*

Effect of Exercise on Bone Density in Postmenopausal Women

Howe et al, 2012 *Cochrane Database Sys Rev*

Effect of exercise may vary by activity	Hip	Lumbar
General (all studies pooled)	-	+
High force dynamic (running, jumping)	+	-
Low force dynamic (walking)	-	+
Progressive resistance	+	+
Resistance (low weights)	-	-
Combination: High impact/Progressive resistance	+	+

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Regular Physical Activity May Reduce Fracture in Older Adults

Lower risk of hip fracture with:

- Increased standing
- Regular walking
- Brisk walking pace

The Nurse's Health Study, 60,000 post-menopausal women followed for 12 years

Feskanich D, 2002

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Regular Physical Activity May Reduce Fracture in Older Adults

Activity and lowered risk:

- Standing 10 or more hours/week reduced risk more than 30%
- 4 hours/week walking reduced risk 41%
- 8 hours/week walking reduced risk 55%
- Fast pace reduced risk 65% more than slow

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Regular Physical Activity May Reduce Fracture in Older Adults

Moderate to vigorous activity reduced incidence of hip fracture 45 percent among older adults.

Meta-analysis of 13 prospective cohort studies. Potential increased risk for the least and most active.

Moayyeri A, 2008

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Physical Activity is Good for Bone Long Term

Lifelong physical activity continuing after age 65 maintains better bone health.

Rianon NJ, AGES-Reykjavik Study. 2012

Positive association of bone measures & self-reported physical activity in mid-life (mean age, 50 years), in old age (≥65 years) & throughout life in 2,110 men and 2,682 women.

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Physical Activity is Good for Bone Long Term

Less bone loss and better balance among habitually active elderly men and women.

Daly RM, 2008

Approximately 360 men and women followed for 10 years. Rate of bone loss was 0.6% per year less in active individuals.

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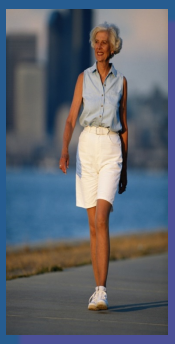
Effect of Exercise on Falls

- **Exercise-focused interventions for community-dwelling older people**
- **Tai chi, gait, and balance training**
- **Home safety assessment (effective in those at high risk for falls)**
- **Cataract removal**



Gillespie LD, et al. *Cochrane Database Syst Rev* 2009; Cameron ID, et al. *Cochrane Database Syst Rev* 2010; McClure RJ, et al. *Cochrane Database Syst Rev* 2008

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Effect of Exercise on Falls

The pooled estimate of the effect of exercise on the rate of falls indicates a 16% reduction (pooled rate ratio 0.84, 95% CI 0.77 – 0.91, 54 trials)

Component type or dose (number of studies)	Reduction in falls	
	Reduced rate (%)	95% CI
Exercise with moderate or high challenge to balance (43)	22	14 - 30
Exercise with a high challenge to balance (30)	25	15 - 43
Total exercise dose more than 50 hours (30)	23	13 - 32
Inclusion of walking training (30)	10	0 - 22
A high risk population (39)	10	0 - 20

Sherrington et al., 2011, NSW Public Health Bulletin

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New! Effect of Exercise on Falls

Catherine Sherrington et al. Br J Sports Med, 2016

Results of multivariate meta-regression exploring impact of trial-level characteristics on the effect of exercise on falls in community-dwelling older populations.

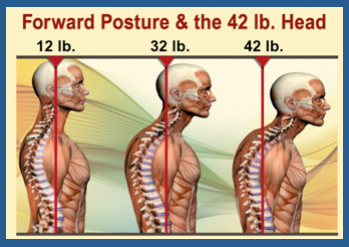
Variable	Effect on falls, IRR (95% CI), p-value
High challenge balance training*	0.79 (0.71 - 0.88), <0.001
3+ hours per week of intervention	0.70 (0.60 - 0.83), <0.001
Neither high challenge or 3+ hours	0.90 (0.82 - 0.99), 0.03
High challenge balance training AND 3+ hours per week of intervention**	0.61 (0.53 - 0.72), <0.001

* High challenge includes: movement of center of mass, narrowing of the base of support and minimizing upper limb support. **Note: 72% heterogeneity explained by both variables; statistically significant comparisons in italics

- **Exercise reduces fall rates in community-dwelling older adults by 21%.**
- **3 hours per week AND high challenge to balance reduces falls by 39%!**

Effect of Mechanical Loads on Vertebral Fracture Risk

- Body posture or activity
- Falls
- Height & weight
- Muscle forces
- Spinal curvature
- Disc degeneration
- Neuromuscular control



Christiansen & Bouxsein, Current Osteoporosis Reports. 2010; 8:198–204

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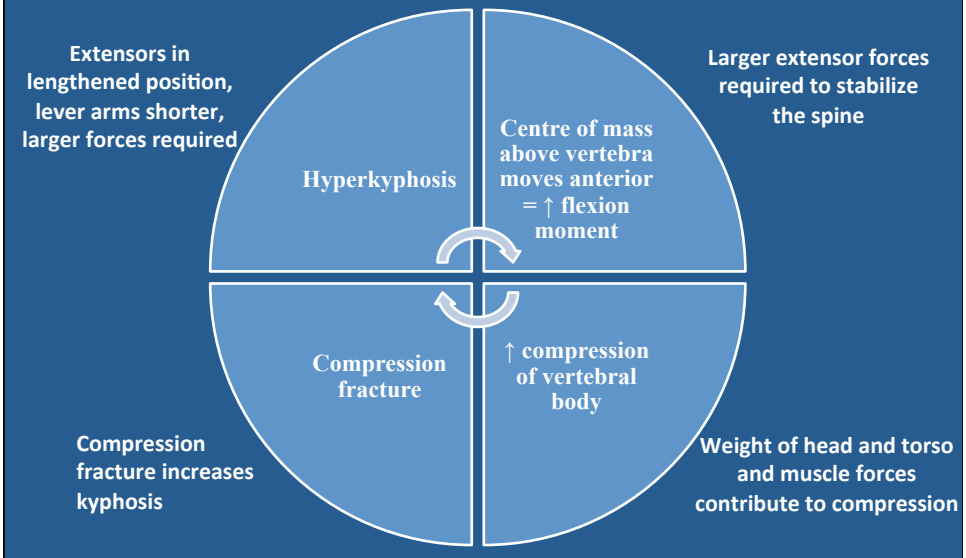

Slide courtesy of L. Giangregorio and Osteoporosis Canada

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Effect of Exercise on Hyperkyphosis

- Small # of clinical trials report modest improvements in kyphosis with exercise
- Emphasis on back extensor muscle strength/endurance
- Limitations: Limited # trials, variable trial quality
- New! SHEAF high quality randomized trial results report significant improvement in kyphosis with spine strengthening exercise and postural training

Bansal S, Katzman WB, Giangregorio LM. Arch Phys Med Rehabil. 2014;
Katzman, WB, et al. Publication in review, 2017

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American College of Sports Medicine
Center for Disease Control

Guidelines for physical activity essential to healthy aging

If you're 65 years of age or older, are generally fit, and have no limiting health conditions follow the guidelines listed below for physical activity recommendations.

- 150 minutes of moderate-intensity aerobic activity (i.e., brisk walking) OR 75 minutes of vigorous-intensity aerobic activity (i.e., jogging or running) every week
- weight training muscle-strengthening activities on 2 or more days a week that work all major muscle groups (legs, hips, back, abdomen, chest, shoulders, and arms)

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American College of Sports Medicine
Center for Disease Control
National Osteoporosis Foundation

Guidelines for physical activity essential to healthy aging, and prevent and treat osteoporosis.

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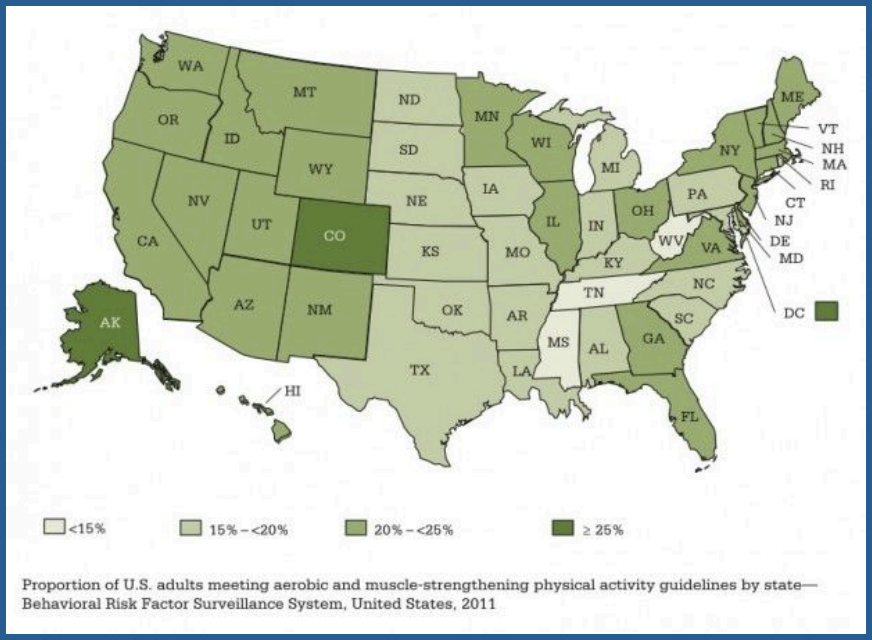
- weight training muscle-strengthening activities on 2 or more days a week that work all major muscle groups (legs, hips, back, abdomen, chest, shoulders, and arms)
- daily posture exercise and balance training to prevent falls



Proportion of U.S. adults meeting aerobic and muscle-strengthening physical activity guidelines by state—Behavioral Risk Factor Surveillance System, United States, 2011

Source: 2014 Survey by the Center for Disease Control and Prevention

TRUE or FALSE?

I do ***moderate or vigorous intensity aerobic physical activity*** for at least 30 min on 5 or more days per week, in bouts of 10 minutes or more.

I do activities to increase ***muscle strength***, such as lifting weights or working with resistance exercise bands, twice a week or more.

I do activities that challenge my ***balance*** on most days of the week.

I do exercises to improve my ***posture*** daily.

I pay attention to my ***posture*** during daily activities.

I *progressively increase the intensity* of the exercises I do over time, so that they are always challenging me.

What exercises are safe for me to do?

Is it safe for me to do ab exercises?

How do I get rid of this "humped" back?

Can I do yoga?

How much can I lift?

Can I still golf?

My doctor told me not to bend or twist – does that mean I have to walk around like a robot?

Researchers and health care professionals:

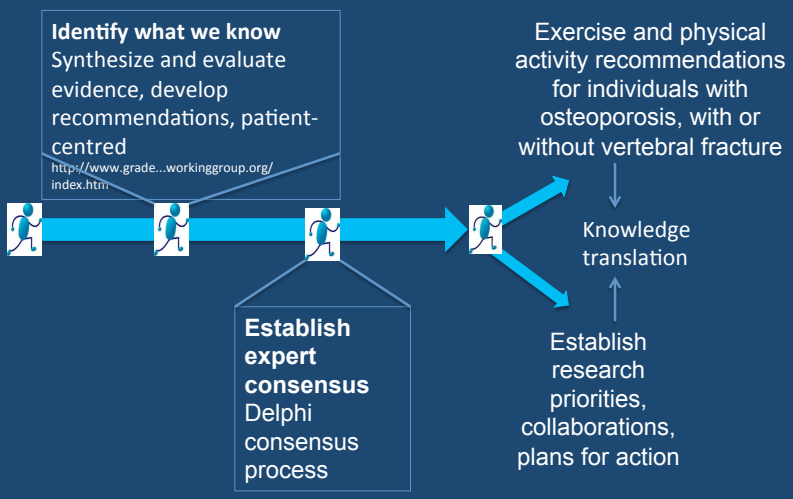
What is best evidence for preventing fractures?

Can exercise increase BMD in my patient/client?

I know the exercises I should do, but they're boring. The things I like to do I can't do anymore.

Slide courtesy of L. Giangregorio and Osteoporosis Canada

What is "Too Fit To Fracture"?



Slide modified and courtesy of L. Giangregorio and Osteoporosis Canada

"Too Fit to Fracture" Exercise Recommendations

Expert consensus and best evidence support:

1. Accumulation of ≥ 30 minutes/day moderate/vigorous aerobic physical activity*
2. Strength training ≥ 2 times a week*
3. Balance training **daily**
4. Exercises for back extensor muscles, posture **daily**
5. Spine sparing strategies like hip hinge and step-to turn can ↓ spine loads → how ***to*** move, rather than how ***not*** to move

**If vertebral fracture: moderate, not vigorous intensity; alignment more important than intensity*

Giangregorio LM, et al Too Fit To Fracture: outcomes of a Delphi consensus process on physical activity and exercise recommendations for adults with osteoporosis with or without vertebral fractures. Osteoporos Int. 2014 Dec 16.

"Too Fit To Fracture" Exercise Recommendations

Recommendations for older adults with osteoporosis or osteoporotic vertebral fracture:

- Engage in a multicomponent exercise program that includes **resistance training** in combination with **balance training**.
- Do not engage in aerobic training to the exclusion of resistance or balance training.

Consult a physical therapist to ensure safe and appropriate exercise if you have a spine fracture.

Giangregorio LM, et al. Osteoporos Int. 2014 Mar;25(3):821-35.

For Better Balance



Static and dynamic balance challenge

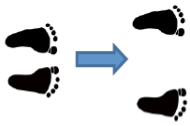
- Movement of the center of mass (shifting weight to limits of stability, 3-dimensional movement like Tai Chi, dynamic balance like figure 8, squat steps)
- Narrow the base of support (one-legged, tandem)
- Minimizing upper limb support (finger-tip or no support)

WALKING IN A PATTERN

Osteoporosis Canada / Ostéoporose Canada
UNIVERSITY OF WATERLOO

☐ HEEL TO TOE

☐ STEP AEROBICS –
TWO NARROW STEPS, THEN TWO WIDE STEPS



☐ SIDEWAYS OR GRAPEVINE

Try walking in an unusual pattern to challenge your balance.

Walk with this pattern for _____.

Here are some other ones you can try:
- ☐ Step over cones or cups
- ☐ Walk in a figure 8
- ☐ Walk forward or backward, and count forward by 6s
- ☐ Walk forward or backward, and count backward by 6s

Too Fit To Fracture: outcomes of a Delphi consensus process on physical activity and exercise recommendations for adults with osteoporosis with or without vertebral fractures Giangregorio et al, 2014. Osteoporos Int,

For Stronger Back Muscles

What type of activity?
Supine presses/holds → prone extension to neutral → core activation in standing

How often each week?
- 5-10 minutes per day of posture exercises
- Attention to posture during daily activities

Tools: Floor mat or soft but supportive surface, mirror, wall

Individuals with a history of a spine fracture:
- Might need a pillow under head if spine is curved
- Supine lying at intervals throughout the day "unloads" spine, promotes spinal extension and stretches front shoulders and chest.
- Consultation with a trained professional

Giangregorio LM, et al Too Fit To Fracture: Outcomes of a Delphi consensus process on physical activity and exercise recommendations for adults with osteoporosis with or without vertebral fractures.Osteoporos Int. 2014

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For Stronger Back Muscles
For those with spine fractures and pain

For pain, supine lying 15-20 min, 2-4x/day
Lie on your back, bend both knees with feet flat on the floor. Use a pillow if your head does not touch the floor. Place both arms out from your side, about 30-45 degrees, with palms facing up.

When beyond acute stage, can begin to add exercises for back extensors.

Lift the breastbone while keeping your back in contact with the floor. Hold for 3-5 seconds and repeat 8-12 times.

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For Stronger Back Muscles
Alphabet exercise

Ball, JM, et al. Osteoporos Int, 2009

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For Stronger Back Muscles

More demanding positions
More complex moves
- Add therabands or weights for increased strength
- Increase duration or repetitions for increased endurance

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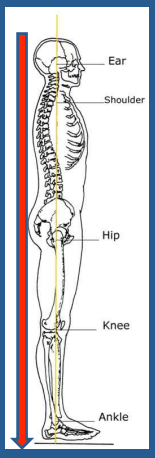
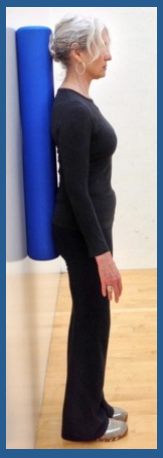
For Better Posture

Align:
- **Back of head**
- **Shoulder blades**
- **Rib cage**
- **Buttocks/sacrum**
- **Feet**





Practice best posture throughout the day

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Posture Cues

Target	Example Cues
Forward head posture	• Imagine the head aligned over the shoulders, pelvis and feet • Lengthen through the crown of the head
Hyperkyphosis, rounded shoulders	• "Romeo and Juliet" abdominals up and shoulders down • Show off jeweled necklace • Breathe into the concavity of your back and pelvis.
Core stability	• Gently brace your abdomen as if someone were about to poke you in the stomach.

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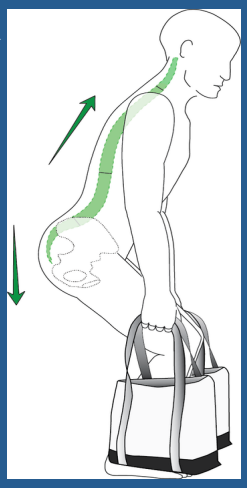
What is "spine sparing"?

Recommend that patient modify activities that apply *rapid, repetitive, weighted or end-range* ***flexion*** (forward bending) or ***twisting*** torque to the spine.

How?

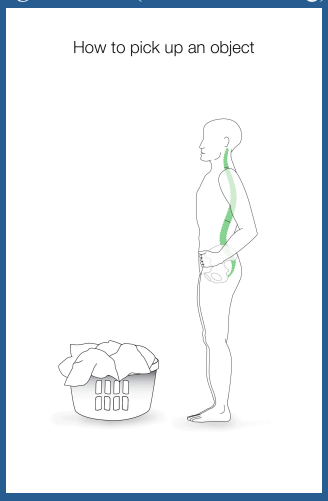
- Hip hinge
- Step-to-turn
- Avoid lifting from/lowering to floor
- Slow, controlled twist, not to end of range of motion
- Balance loads on either side of body
- Support trunk when flexing
- Hold weight close to body, not overhead

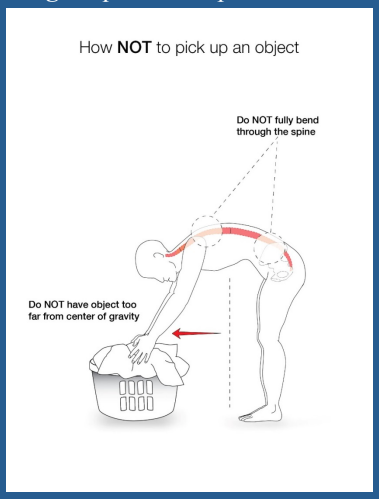


Slide courtesy L. Giangregorio; Osteoporosis Canada

Teach "spine sparing" during ADL and physical activity

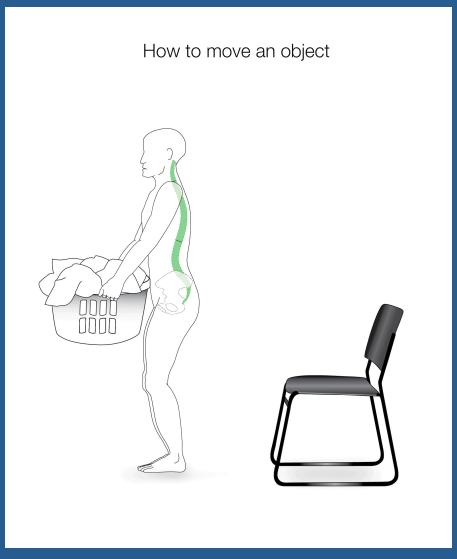
Recommend that patient modify activities that apply *rapid, repetitive, weighted or end-range* **flexion** (forward bending) or **twisting** torque to the spine.

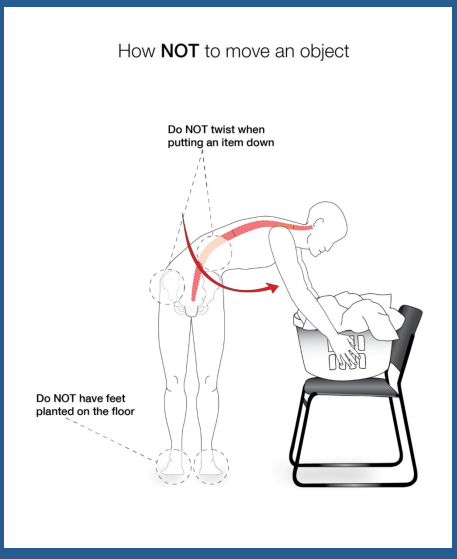




Saying "Don't bend or twist" doesn't teach how TO move → instills fear, disincentive to physical activity.

Slide courtesy L. Giangregorio; Osteoporosis Canada



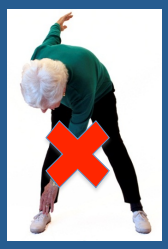


Slide courtesy L. Giangregorio; Osteoporosis Canada

Harms of Exercise?

- Unsafe exercises
- Unsafe transitions
- Tailor to ability, preference, health status
- Appropriate progression

AVOID: flexion, rounding, twisting




Photos: Do It Right, American Bone Health, Sherri Betz, PT, OCS

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Should physical activity recommendations vary across individuals?

Consider: vertebral fracture, current health, physical function, activity history, desire

Osteoporosis, no vertebral fracture:

If history or strong desire: can you modify?

Spine sparing!

NO

YES

Avoid high-impact sports, high fall risk, contact → do low impact, slower pace

Should physical activity recommendations vary across individuals?

Consider: vertebral fracture, current health, physical function, activity history, desire

Osteoporosis with vertebral fracture, gait & balance difficulties, hyperkyphosis or pain:

Alignment, spine sparing more important than intensity

Moderate intensity aerobic physical activity

May need trained instructor for classes, physical therapist re: ADLs

Get help beyond light ADLs, avoid sitting long periods

Supine lying "unloads" the spine, promotes extension, pain relief

KEY Messages

- Exercise may reduce fractures:
  - ***Can prevent falls, even in those at high risk***
  - ***May maintain bone density or bone strength***
  - ***Can improve posture and reduce applied loads***
- Strong and consistent evidence for effect on mortality, disability, other health outcomes…..
- Recommend multicomponent exercise programs – resistance, aerobic training, balance, posture

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What exercises are safe for me to do?

Is it safe for me to do ab exercises?

How do I get rid of this "humped" back?

Can I do yoga?

How much can I lift?

Can I still golf?

My doctor told me not to bend or twist – does that mean I have to walk around like a robot?

Researchers and health care professionals:

What is best evidence for preventing fractures?

Can exercise increase BMD in my patient/client?

I know the exercises I should do, but they're boring.
The things I like to do I can't do anymore.

Slide courtesy of L. Giangregorio and Osteoporosis Canada

Resources

Osteoporosis Canada Too Fit to Fracture
http://www.osteoporosis.ca/osteoporosis-and-you/too-fit-to-fracture/video-series-on-exercise-and-osteoporosis/

National Osteoporosis Foundation Health Professional's Guide to Rehabilitation of the Patient with Osteoporosis
www.nof.org

American Bone Health
https://americanbonehealth.org/what-you-should-know/exercise

WHO Fracture Assessment Tool
http://www.shef.ac.uk/FRAX/tool.jsp

Stand Tall exercise videos
www.geriatricspt.org/store/
wellness@ptrehab.ucsf.edu

Health and Wellness exercise classes (UCSF PT and Rehab Science)
wellness@ptrehab.ucsf.edu

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UCSF

University of California
San Francisco

Too Fit to Fall or Fracture

Strength Training At least 2 days/week

- Exercises for legs, arms, chest, shoulders, back
- Use body weight against gravity, bands, or weights*
- 8 - 12 repetitions per exercise

Try these to get started:
- ☐ *Classes at YMCA/community centre*
- ☐ *Consult a physical therapist/kinesiologist*
- ☐ *Contact Osteoporosis Canada*

Balance Exercises Every day

- Tai Chi, dancing, walking on your toes or heels
- Have a sturdy chair, counter, or wall nearby, and try (from easier to harder): shift weight from heels to toes while standing; stand heel to toe; stand on one foot; walk on a pretend line

Posture Awareness Every day

- Gently tuck your chin in and draw your chest up slightly
- Imagine your collarbones are wings - spread your wings slightly without pulling your shoulders back

Aerobic Physical Activity At least 150 mins/week

- Bouts of 10 mins or more, moderate to vigorous intensity*
- You should feel like your heart is beating faster and you are breathing harder
- You might be able to talk while doing it, but not sing

Examples:
- ☐ *Brisk walking*
- ☐ *Dancing*
- ☐ *Jogging*
- ☐ *Aerobics class*

*If you have a spine fracture, consult a physical therapist/kinesiologist before using weights, and choose moderate, not vigorous aerobic physical activity

Questions? Want a free physical activity booklet? Contact Osteoporosis Canada: English 1 800 463 6842 / French 1 800 977 1778 or www.osteoporosis.ca
Locate a Bone Fit™ trained instructor: English 1 800 463 6842 / French 1 800 977 1778 or www.bonefit.ca

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Strength Training (more examples) At least 2 days/week

Other exercises include:
- Upright row
- Step up

What are spine sparing strategies?

Spine sparing strategies help "spare" the spine from injury. Injuries to the spine can occur when we bend forward or twist the spine quickly or repeatedly, or if we lift something heavy, bend far forward (e.g., tying shoes) or twist the torso all the way to the side. Bending or twisting while holding a weighted object (e.g., groceries, grandchild) is also risky.
http://www.osteoporosis.ca/osteoporosis-and-you/too-fit-to-fracture/

Spine sparing strategies:
- Bend with your hips and knees, not your spine
- Turn your whole body rather than twisting your spine

Goals and next steps:

The information contained in this guide is not intended to replace health professional advice. Consult your healthcare provider or a physical therapist about what exercises are right for you.

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