

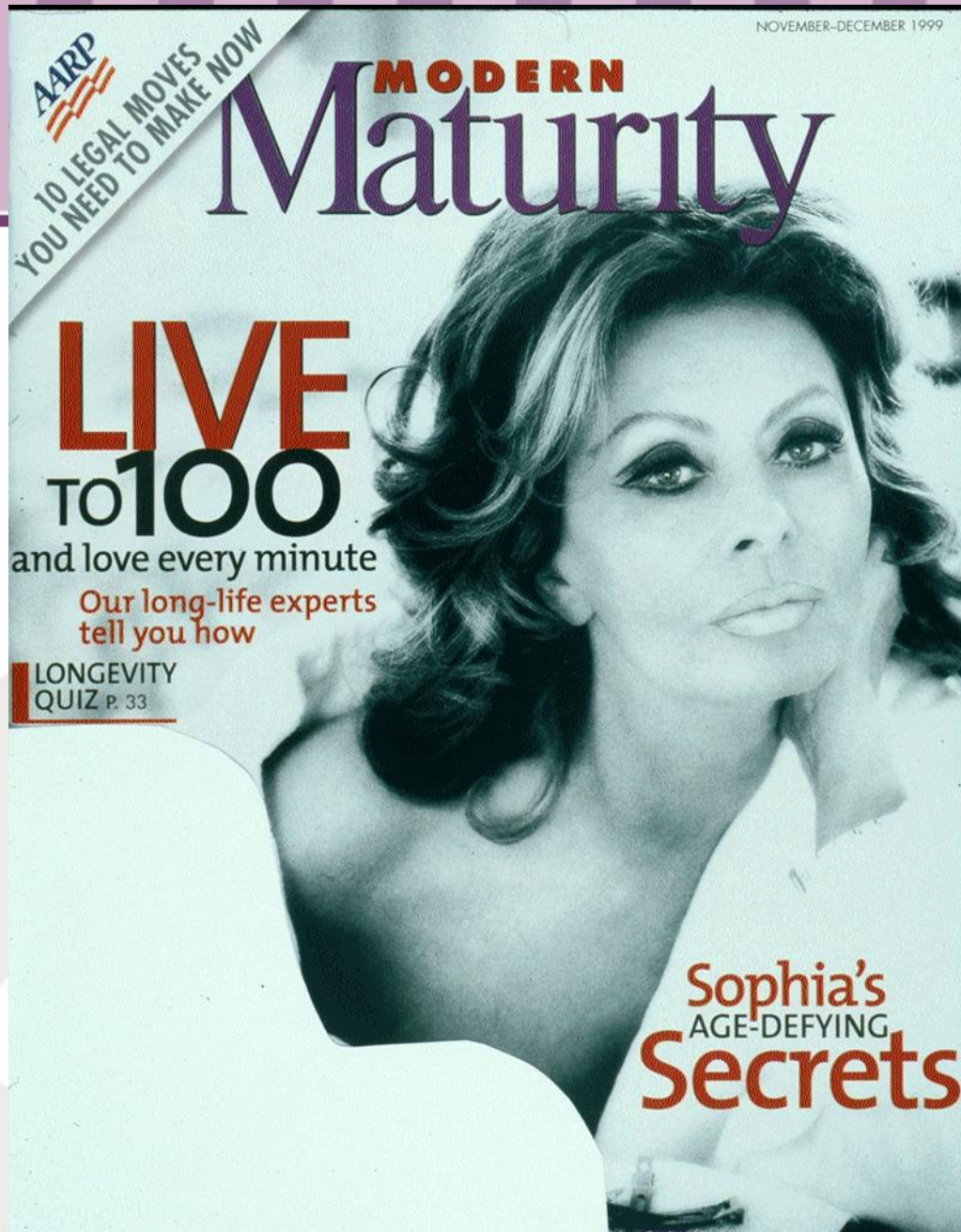
# Orthopaedic Issues in Adults with CP: If I Knew Then, What I Know Now

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**Washington, DC**

# Epidemiology



- **87-93% of children born with CP survive into adulthood (Nielson 2002)**
- **85% of cohort alive at 20 survived to age 50 (Hemming 2006)**
- **Exact number of individuals in US unknown, estimate 700,000 to 1 million**
- **Number increasing due to increased survival of low-birth-weight infants and increased longevity of adults**



**Essential to  
assume that  
ALL patients  
will outlive us**

# Curmudgeon's Perspective



- **Paradigm shift in how disability is viewed. We have moved from a largely medical to a social model**
- **That is great for many disorders, but not cerebral palsy**
- **Pain from contractures, fractures, subluxations/dislocations, sores, etc must be a health delivery priority if individuals with cerebral palsy are to live long and live well**



# Orthopaedic Core Concepts:

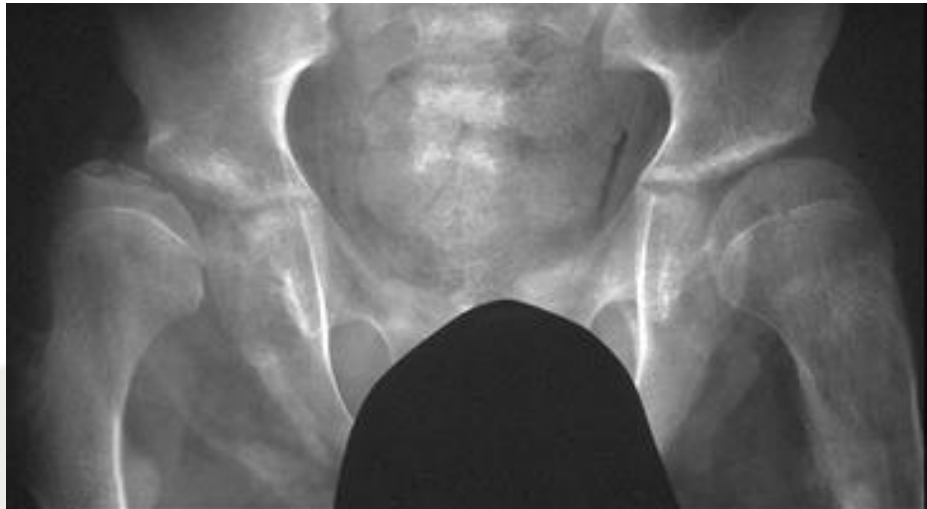


- **Our first responsibility is to prevent pain**
- **Bones, muscles, and joints are the most important parts of the body**
- **Move it, or lose it**

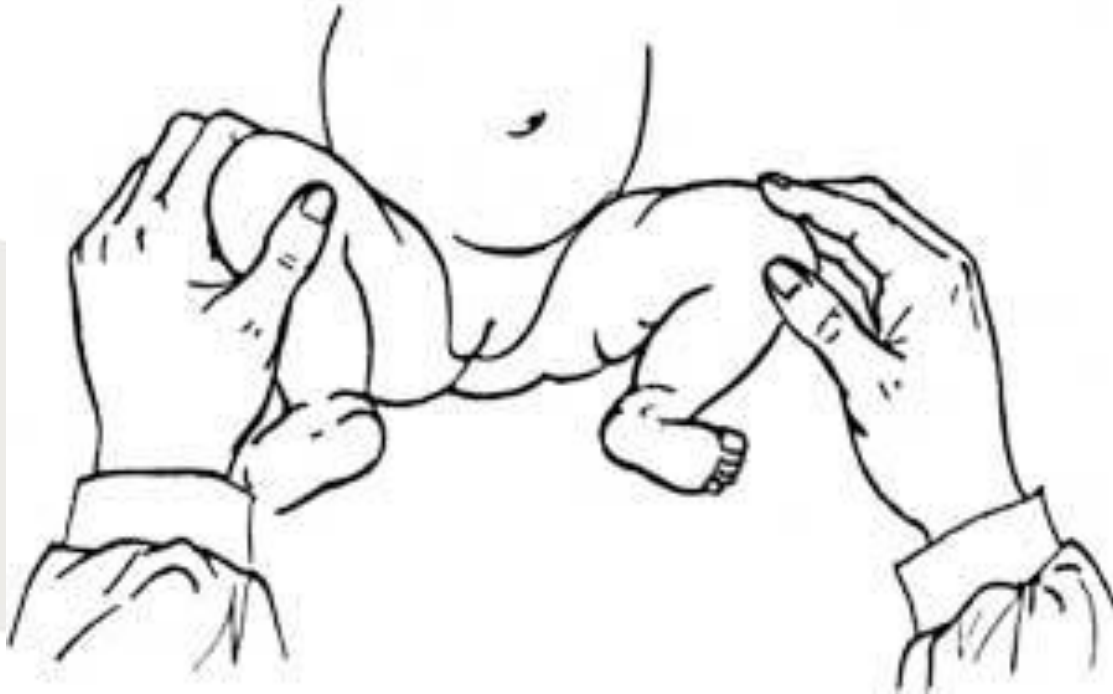
**#1 I would ensure that every child with cerebral palsy had a complete musculoskeletal exam annually**

**AND that non- ambulating children had a hip xray**

# Rationale



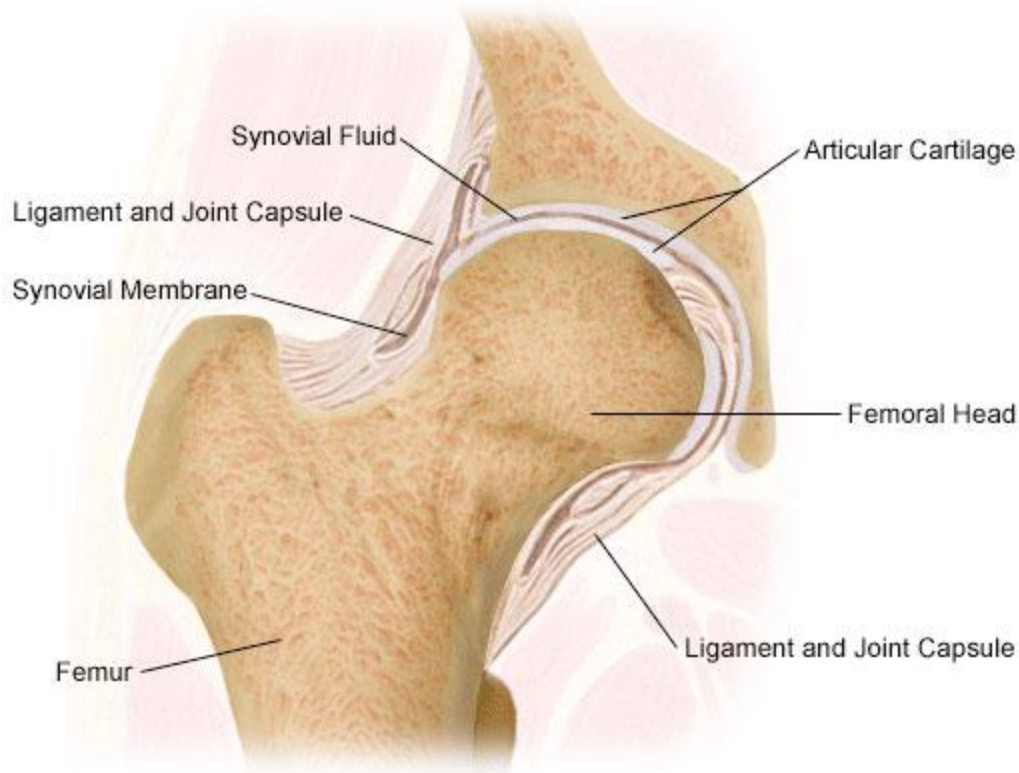
# Hip subluxation is highly correlated with limited hip abduction





**#2 I would only allow  
wheelchairs to be used for  
transportation**

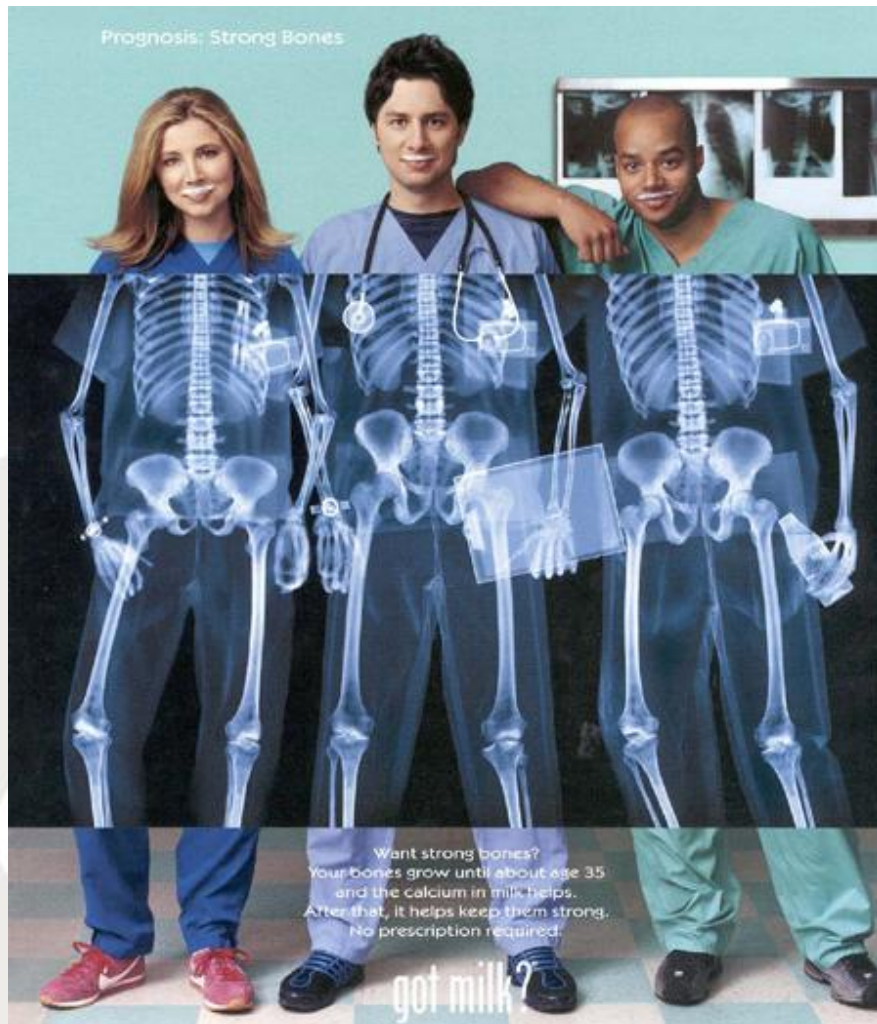
## Hip Joint



**Cartilage nutrition depends on joint motion – individuals who sit all day are starving their cartilage**

# **#3 I would encourage parents and caregivers to learn about Bone Health**

# Bone is Unique



Structure & protection

Major storage form of calcium in body

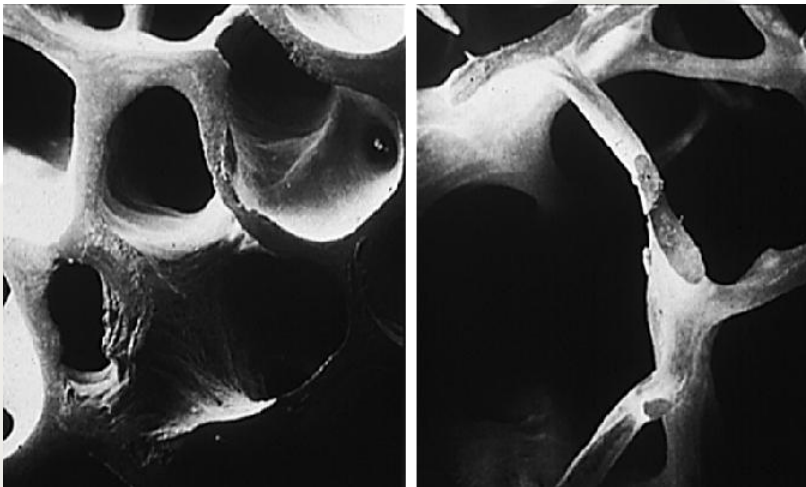
Only organ able to heal w/o scarring



# Strong bones are not a right

- **Key elements of peak bone mass**

- Weight bearing exercise
- Nutrition
- Genetics
- Ethnicity



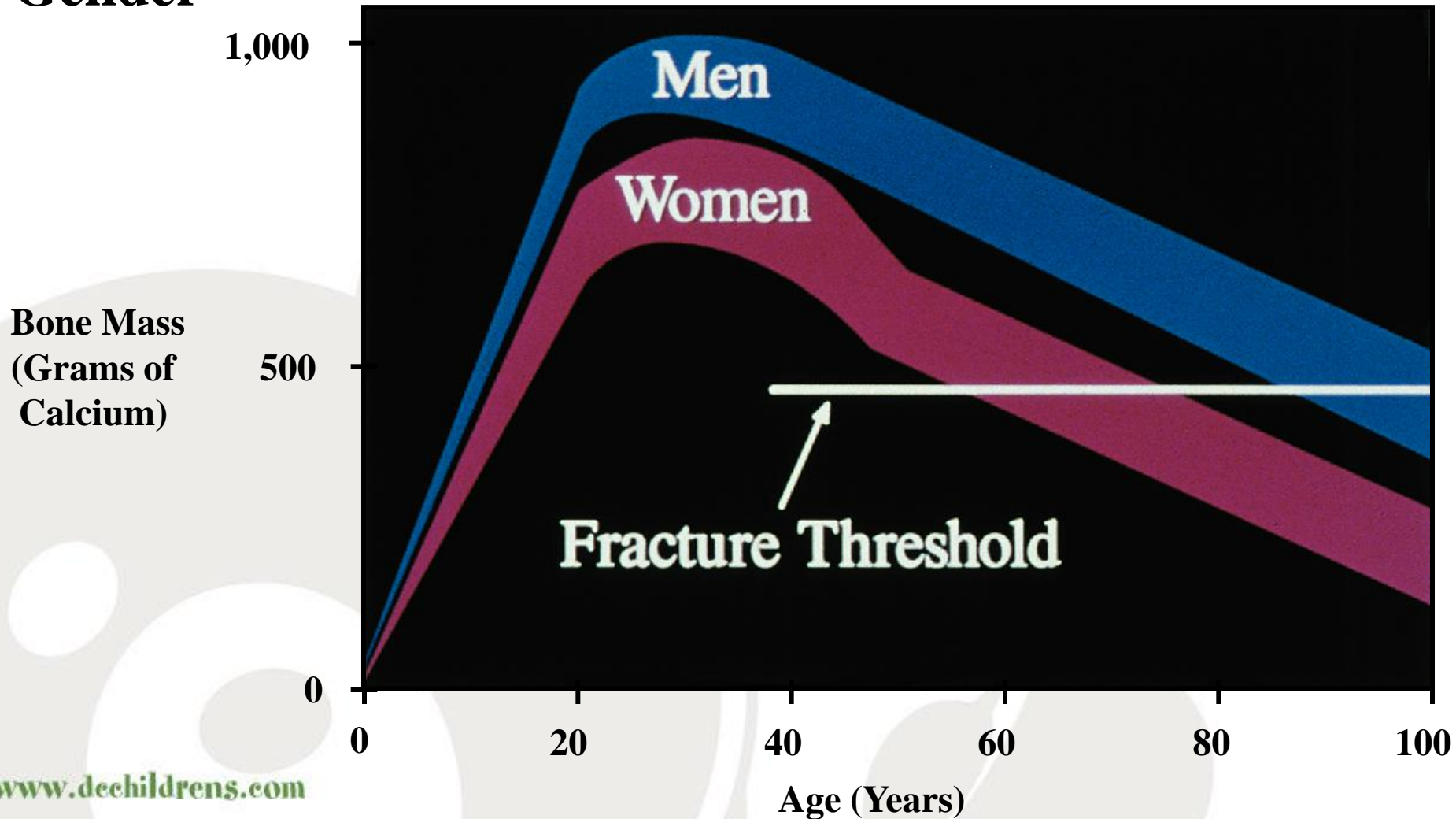
**Normal**

**Osteoporotic**

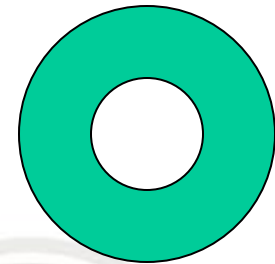
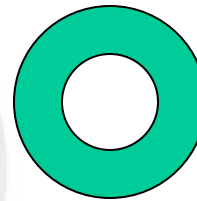
# PEAK BONE MASS



Gender



# Dominant vs Non-dominant Arm



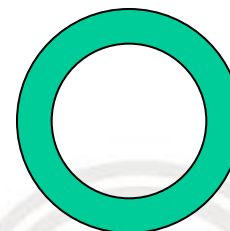
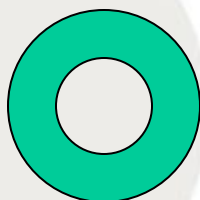
# Calcium PLUS Exercise



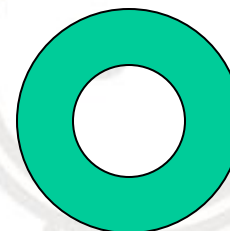
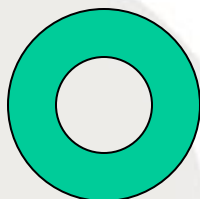
Fine motor

Gross motor

Placebo



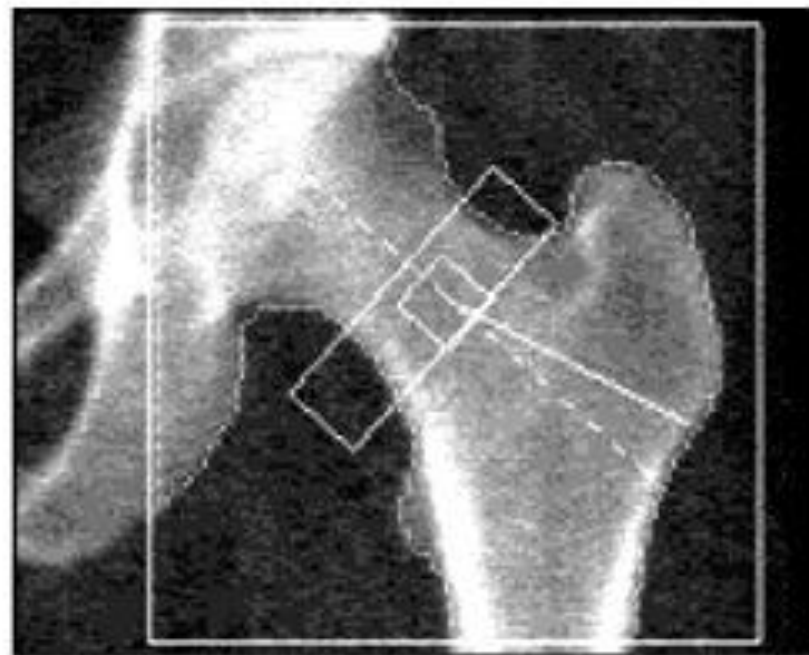
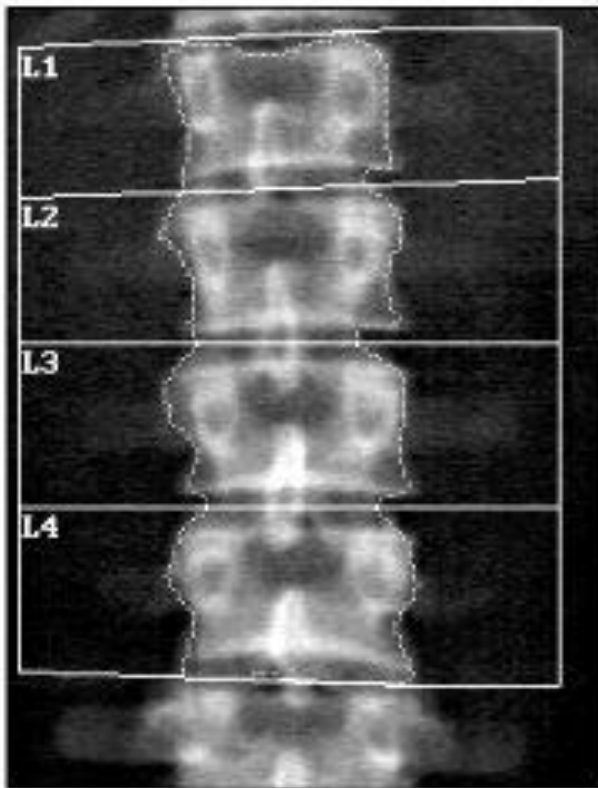
Calcium  
supplement



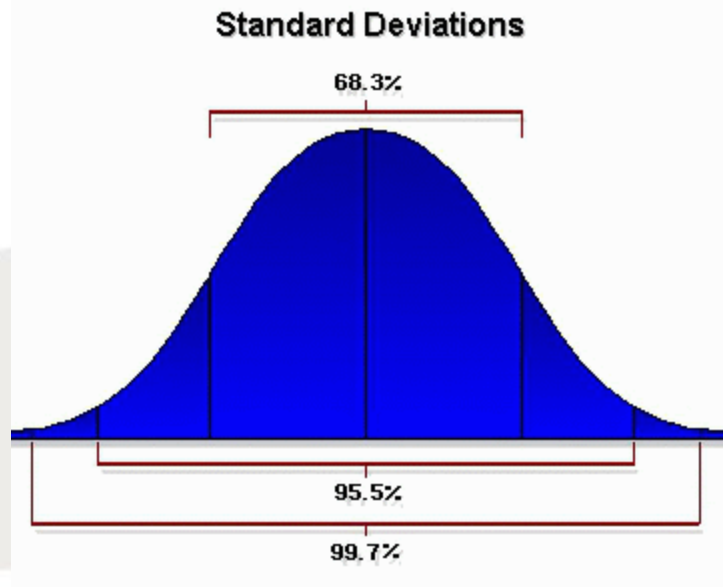
Specker & Binkley, J Bone & Min Research 2003



# Measuring Bone Density



# Interpreting DXA's



- T score refers to how the patient compares to a cohort of healthy young females
- Z score compares the patient to individuals of their same age and sex

**Prevalence of reduced bone mass in children and adults  
with spastic quadriplegia** King W et al. Dev Med Child Neurol 2003

**Reviewed 48 patients 5-48 years (median 15)**

**Lumbar spine Z score:  $-2.37 \pm 0.21$**

**58% had z- score:  $< - 2$**

**39% had history of fracture**

**Those with history of fracture had significantly lower z score**

**with history of fracture:  $-2.82 \pm 0.29$**

**without history of fracture:  $-2.11 \pm 0.26$**

**Age and Vitamin D level not significant**

## **Bone Density and Metabolism in Children and Adolescents**

**With Moderate to Severe Cerebral Palsy** Henderson et al

*Pediatrics* 2002

**117 subjects 2-19 yrs old (mean 9.7)**

- Osteopenia in femur of 77% of population based cohort**
  - Older than 9 years old: prevalence of 86% (19 out of 22)**
    - Of the 3 who did not have osteopenia—2 were capable of assisted ambulation**
- BMD severely diminished in distal femur**
  - z-score  $-3.5 \pm 0.2$**



**Bone Density and Metabolism in Children and Adolescents**  
**With Moderate to Severe Cerebral Palsy** Henderson et al  
*Pediatrics* 2002 continued

**15% had already fractured (of those, 38% multiple fx) f**  
**Fractures occurred in 28% of children older than 10 yrs**

**BMD z score correlated strongly with Gross Motor**  
**Function Level**

**96% of level 5 children had osteopenia**

**43% of level 3 children had osteopenia**



**Is this a push for  
standing frames?**

**Well, yes and no**

**A randomized controlled trial of standing programme on bone mineral density in non-ambulant children with CP**

Caulton et al *Arch Dis Child*. 2004

**26 children with CP; 14M, 12F; age 4.3-10.8 yrs**

**Intervention group increased their standing duration by 50% for the academic school year**

**Results: 6% increase in vertebral BMD**

**no BMD increase in tibia—authors conclude standing program does not decrease risk of long bone fracture**

# Implications for children and adults with CP

## **Axial skeleton 4%**

Skull 1%  
Vertebrae 2%  
Pelvis 1%

## **Upper Limb 14%**

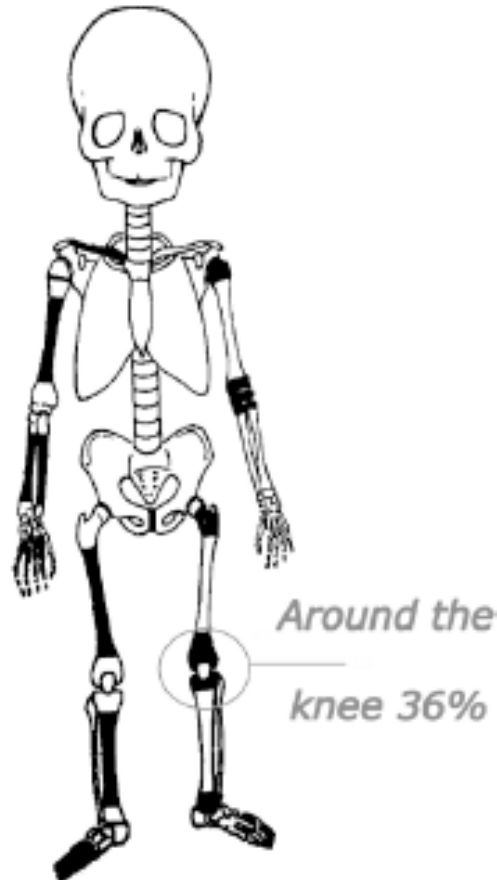
Clavicle 1%  
Humerus 8%  
Radius 2%  
Hand 3%

## **Lower Limb 82%**

**Femur 48%**  
Proximal metaphysis 26%  
Shaft 24%  
Distal metaphysis 50%

**Tibia 27%**  
Proximal metaphysis 46%  
Shaft 36%  
Distal metaphysis 18%

**Foot 7%**



**Fractures in Patients  
with Cerebral Palsy**  
Presado et al *J Pediatr Orthop.*  
2007



**Children's**  
*National Medical Center*







**Children's**  
*National Medical Center*



# Will these individuals do better?

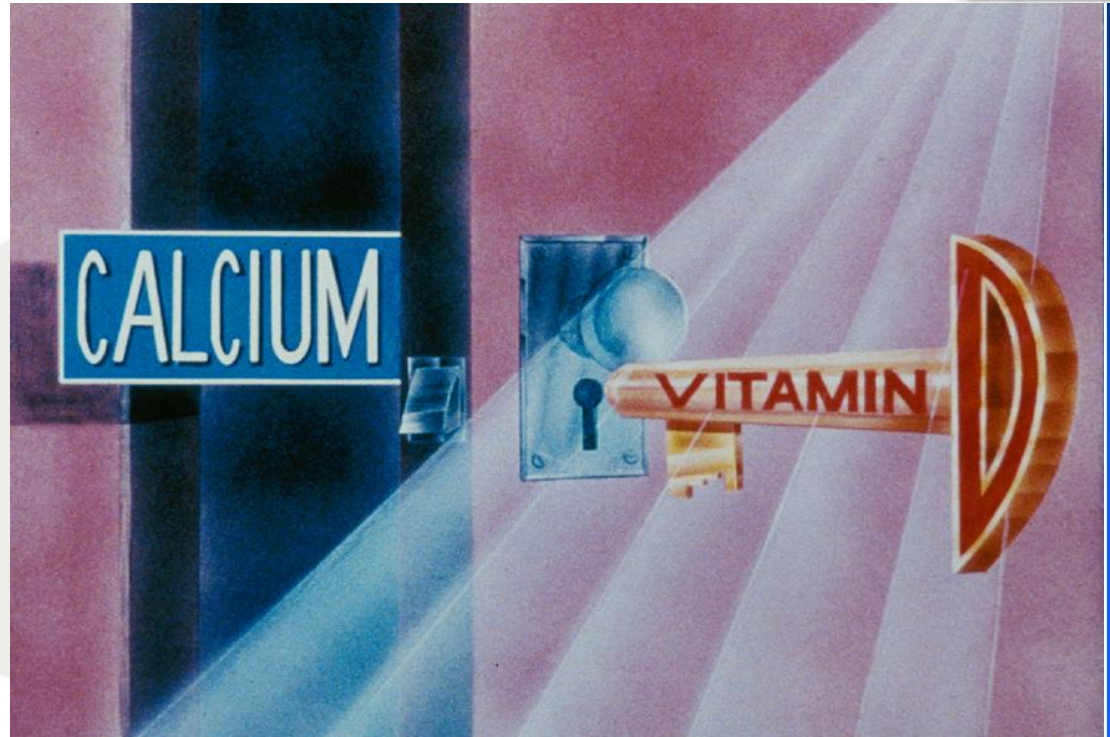
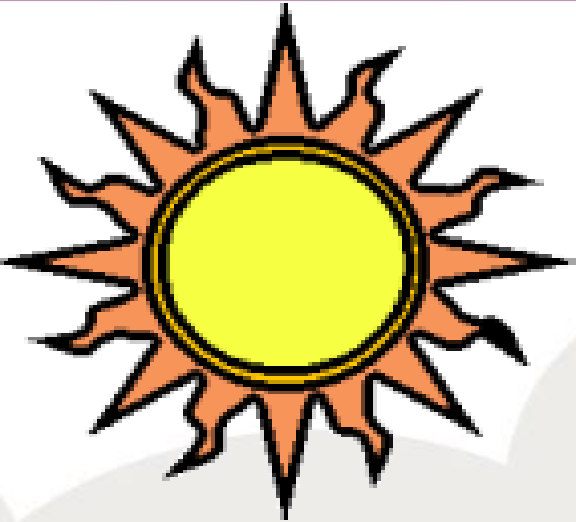


# Low Magnitude Mechanical Stimuli are Anabolic to Bone



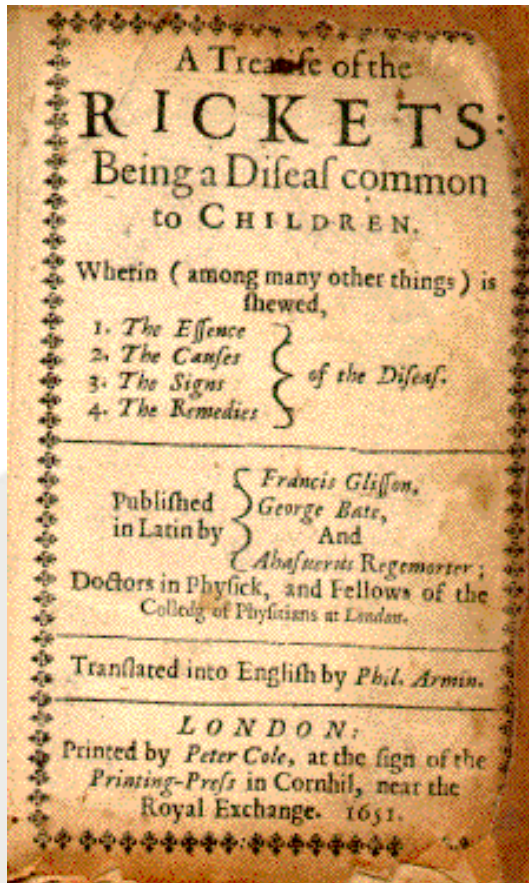


# So, what about nutrition?

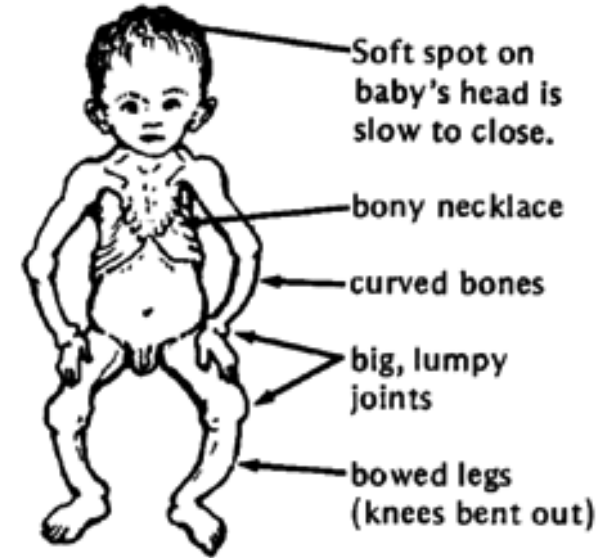


**Bone density and fracture studies are inconclusive about the role of low vitamin D in bone health in children with CP**

# What do I know? What do I see?



## SIGNS OF RICKETS



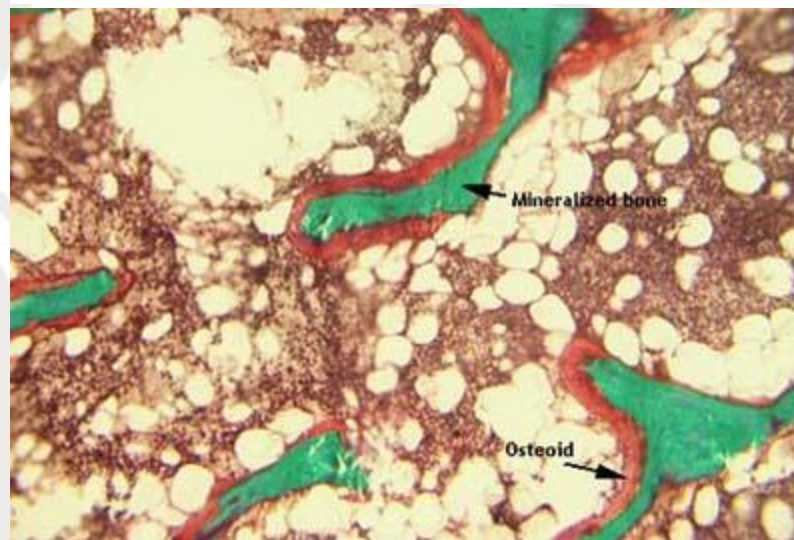




Normal anatomy



Rickets



# Clinical example



# #4 I would monitor spines more carefully

**Zaffuto-Sforza CD. Aging with Cerebral Palsy. *Phys Med Rehabil Clin N Am.*2005;**

**Because of its musculoskeletal origin, Scoliosis in CP patients can progress even after skeletal maturity is reached.**

**Curves over 50 degrees progress 1 degree a year (Bleck et al 1984).**

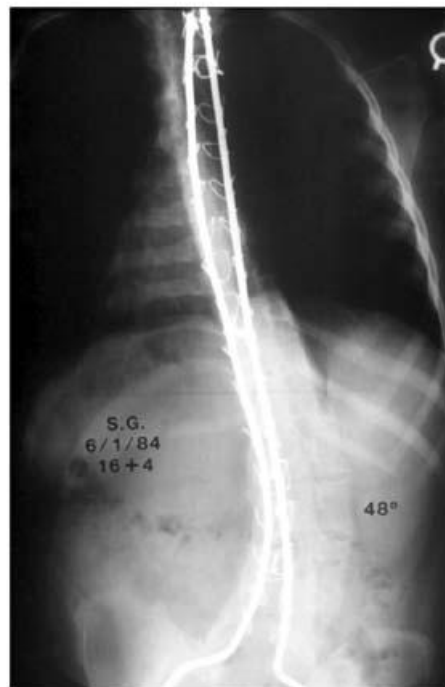
**Non-ambulatory ambulatory individuals are more likely to develop scoliosis than ambulatory individuals**



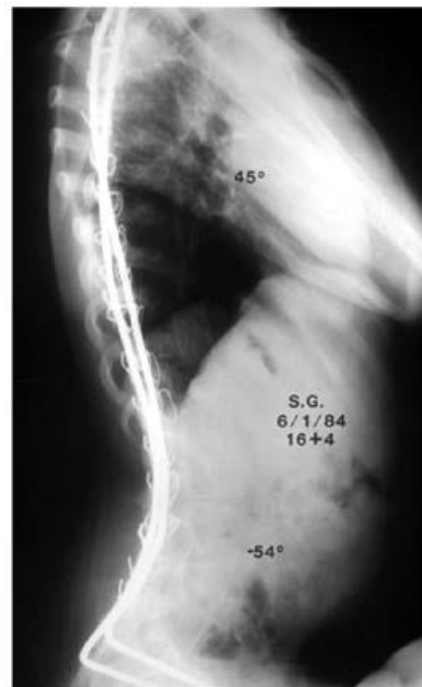
A



B



C



D





**#5 I would insist that stretching and a fitness program are as important as English!**

