PBNHC
Musculoskeletal System
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Overview

- Fundamental Concepts
- Osteoporosis
- Inflammatory Arthropathies
- Regeneration
- Athletic applications of PBN
“Healing is a matter of time but it is sometimes also a matter of opportunity” - Hippocrates
Musculoskeletal system is a dynamic, integrated, interconnected system held together by fascia.

Influenced by environmental factors including: Diet, activity/mobility, imbalance, stress, weather, posture, habits, genetics/epigenetics.

Healing is multifactorial.
Osteoporosis
Osteoporosis-Bone Health

Multifactorial

- Weight Bearing Activity-remodeling
- Dietary-Polyphenols
  - NFκβ, BMP, RANKL
- Stress-via cortisol
- Habits
  - Tobacco

Intake
  Calcium rich foods-greens, seeds, beans

Absorption
  Vitamin D, gastric pH

Assimilation
  Minerals, antioxidants, phytochemicals

Retention/losses
  Protein, salt, stress, osteoblast/osteoclast
Osteoporosis-Dietary Influence

Density
- Calcium Metabolism
- Minerals
  - Boron, Manganese, Zn, Silica, copper, Mg, strontium
- Phytochemicals
- Osteoblast stimulators—eg. curcumin, gentisin
- Animal/Human cell culture, few Human intervention, no large human trials

Density
- Calcium inhibitors
- High protein diet
- Acidosis
- Salt
- Medications

Healthful Sources of Calcium

- Collard greens-2 cups 600mg
- Turnip Greens-2 cups 500mg
- Kale-2 cups 350 mg
- Broccoli-2 cups 190mg
- Soybeans
- Sweet Potato
- Lettuce

Calcium Metabolism

How much Calcium do you need?

Yale Study: Analyzed 34 published Studies in 16 countries

- Highest level of dairy and AP highest levels of Osteoporosis
- South Africans average 196mg/day 9x less likely to suffer hip fracture

Plant based foods provide Micronutrients: Boron, Manganese, Silica, Magnesium, Zinc, Copper, Vitamin K

Phytochemicals like polyphenols assist in strengthening bone via multiple mechanisms

Phytochemicals synergistic effect

1 meal contain 150 types

Suppress bone resorption

Animal studies

Stimulate osteoblasts

Induce stem cell differentiation into osteoblasts

Sharan, Kunal; Siddiqui, Jawed A.; Swarnkar, Gaurav; Maurya, Rakesh; Chattopadhyay, Naibedya Role of Phytochemicals in the Prevention of Menopausal Bone Loss: Evidence from In Vitro and In Vivo, Human Interventional and Pharmacokinetic Current Medicinal Chemistry StudiesVolume 16, Number 9, March 2009, pp. 1138-1157(20)
Osteoporosis

Phytochemicals-Stimulate Osteoblasts, down regulate Osteoclasts

- Isoflavones (soy), Lignans (strawberries, flax, broccoli), Stilbenes (berries and grapes)

Animal studies strongly suggest: higher bone mass, trabecular bone volume, number, and thickness, and lower trabecular separation through enhancing bone formation and suppressing bone resorption, resulting in greater bone strength.


Sharan, Kunal; Siddiqui, Jawed A.; Swarnkar, Gaurav; Maurya, Rakesh; Chattopadhyay, Naibedya Role of Phytochemicals in the Prevention of Menopausal Bone Loss: Evidence from In Vitro and In Vivo, Human Interventional and Pharmacokinetic Current Medicinal Chemistry StudiesVolume 16, Number 9, March 2009 , pp. 1138-1157(20)

**Losses**

- **SAD-** 50-100 meq of excess acid daily resulting in low level acidosis
  - AP associated with in bone loss postmenopausal women

- **Artic People groups**
  - Premature demineralization and bone loss
  - Compression fractures
  - Bone resorption
  - Urinary calcium losses


*Teucher B, Fairweather.*

Phytochemicals Effect on Bone

- Stem cell
- Messenchymal stem cell
- RANKL
- Osteoclast
- Apoptosis
- Osteoblast
- Cell proliferation
- Bone mass

Suppression and Stimulation mechanisms are illustrated.
Bone Density in Plant Based Diets

- Decreased losses up to 50%
- Improve bone density and health
- Lan, Nguyen et al. comprehensive review of available studies on bone health in Vegans/Vegetarians
  - “in some cases bone density is slightly lower but the association is clinically insignificant”


Lan T Ho-Pham, Nguyen D Nguyen, and Tuan V Nguyen Am Effect of vegetarian diets on bone mineral density: a Bayesian meta-analysis J Clin Nutr October 2009 vol. 90 no. 4 943-950
Arthropathies
<table>
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<th>Arthropathies</th>
<th>Autoimmune</th>
<th>Degenerative</th>
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Inflammatory Drivers

- **Diet**: Meat greater than 1-2 times per week associate with increased inflammatory markers and increased symptoms
  - Linked more than any other dietary factor to RA
  - Increased ROS: ↑ omega 6, iron, excess calories
  - Neu5Gc-only in animal cells and antibody-antigen response can drive chronic inflammation

*Hailu A, Knutsen SF, Fraser GE. Associations between meat consumption and the prevalence of degenerative arthritis and soft tissue disorders in the Adventist Health Study, California, USA. J Nut Health Aging, 2006 Jan-Feb;10(1):7-14*

*Grant, W The role of meat in the expression of rheumatoid arthritis. British Journal of Nutrition(2000),84, 589±595*


SAD Increases Inflammatory Mediators

Arthropathies

Key to joint inflammation NF-κB-Nuclear Factor Kappa Beta

- Pivotal step in cell signaling that control inflammation
- Cytokines: IL-1, IL-2, IL-6, TNF-α
- Chemokines: IL-8, MIP-1α, RANTES, etc
- Adhesion molecules: ICAM, VCAM, E-selectin
- Inducible enzymes such as COX-2, iNOS
Aging individuals afflicted with rheumatoid arthritis are at 60% greater risk of dying from heart disease than the general population. Vascular damage seen in rheumatoid individuals appears to be an accelerated form of atherosclerosis.

Similar analysis shows that over time, rheumatoid arthritis sufferers also sustain damage to the eyes, lungs, and skin.

Plants via Phytochemicals inhibit NF-κB

- Lignans
- Flavenoids-anthrocyanins, carotenoids, quercetin
- Polyphenols-resveratrol, EGCG
- Curcumin, Capsaicin, Eugenol (cloves), gingerol (ginger), Anethol (cumin, anise, fennel), ursolic acid (basil, Rosemary),

Naturally Occurring NF-κB Inhibitors: Mini Reviews in Medicinal Chemistry, Volume 6, Number 8, August 2006, pp. 945-951(7)


Bright JJ. Curcumin and autoimmune disease. Adv Exp Med Biol. 2007;595:425-
Phytochemicals reduce inflammation through inhibition of NF-κB

- Arthritis
- Alzheimer’s
- Colitis, GI disease
- Autoimmune disease
- Aging
- Cancer
- Diabetes
- Atherosclerosis
- Asthma/ Allergies

Impacts 400 genes inflammation

NF-κB
Arthopathies

Improved symptoms and inflammatory markers over omnivore diet

Statistically significant numbers report less pain, higher level of function, require significantly fewer medication


Plant Based Nutrition and Omega balance

- Ideal Omega 6:3= 1:1-3:1
- Plant Based Historically-1:1-2:1
- 2:1 suppressed inflammation in RA
- Average American 20-40:1
  - Pro-inflammatory
  - Animal based meals high in Omega 6
  - Vegetable oils 69:1
  - Trigger inflammation-compete Omega 3 enzyme and overexpression of COX2

Omega 3 Fatty Acids

- Flax/Chia seeds
- Pumpkin seeds
- Wild fatty fishes
- Greens
- Walnuts
- Spinach
Regeneration

- Phytochemicals like isothiocyanate from broccoli stimulate mesenchymal stem cells in amounts commonly found in a serving-
  **Hormesis**

- High concentrations exacerbate DNA damage

Zanichelli, Fulvia, et al. "Low concentrations of isothiocyanates protect mesenchymal stem cells from oxidative injuries, while high concentrations exacerbate DNA damage." *Apoptosis* 17.9 (2012): 964-974.
Green Tea and grapes stimulate chondrocytes to produce cartilage

Vegetable soup decreased inflammation, initiates cartilage healing, decreases joint damage


Chen CH, Ho ML, Chang JK et al (2005) Green tea catechin enhances osteogenesis in a bone marrow mesenchymal stem cell line. *Osteoporos Int* 16(12):2039–2045
PBN in Athletics

- Recovery
- Prevention
Delayed Onset Muscle Soreness-DOMS

- Limits progression
- Overuse injuries
- Intense exercise-systemic inflammation DNA damage
- Free Radical Formation
  - Hypoxia
  - Connective tissue injury
  - Micro tears

Antioxidant systems like glutathione attempt to repair the damage. Can be suppressed for up to 2 weeks after vigorous exercise bout.

Bicep Study
- Maximum Reps-DOMS
  - Placebo group 22% loss of strength and peak pain 48 hours
  - Cherry group 4% loss strength and peak pain 24 hours

Polish Rowers
- 4 week trial vs Placebo
  - Group consuming chokecherry decreased free radicals in first 24 hours


Illness
- Immune system of athletes can be suppressed for 1-2 weeks following intense bout
  - Further impaired by diet
  - Increased risk for illness

Disease Prevention
- Cardiovascular disease incubation is decades
- Cancer, Neurodegenerative

Treating Musculoskeletal Pain

Physical therapy
Chiropractic Massage
Trigger Point Injections Graston Acupuncture Low level laser
Prolotherapy
PRP
Stem Cells
Surgery
Questions?