

Osteoporosis

ROAD MAP

- ✗ Pillars of supportive care
- ✗ Factors that impact the bone
- ✗ Over view of Calcium supplements and their safety

SUPPORTIVE TREATMENTS

- ✗ Once osteoporosis is diagnosed, medications are paramount in the treatment whereas food and exercise play an important, but only supportive, role.
- ✗ The use of medications--often in the form of estrogen, selective estrogen receptor modulators(SERM), bis-phosphonates, or teriparatide--often result in significant increases in bone density that food alone will not achieve.

PILLARS OF SUPPORTIVE CARE



FACTORS IMPACTING THE BONE

SALT IS BAD FOR THE BONE!

- ✗ Excesses in sodium intake have a negative impact on calcium balance by increasing the urinary calcium excretion.
- ✗ For every 100 mmol of sodium excreted, approximately 1 mmol loss of urinary calcium is observed.
- ✗ Limit sodium to 2,300 milligrams a day – equal to a teaspoon of salt



CAFFEINE

- ✗ In a 12-year follow-up to Framingham study, the risk of hip fracture over each 2-year period was found significantly increased by the consumption of ≥ 2.5 units of caffeine per day (one cup of coffee = one unit of caffeine, and one cup of tea = 0.5 unit of caffeine).
- ✗ Caffeine increases urinary and faecal calcium losses and may provoke a negative calcium balance in presence of a low calcium diet
- ✗ Caffeine at a dose of 330 mg/day (i.e. four cups (600 ml)) possibly might be associated with a modestly increased risk of osteoporotic fractures.
- ✗ No study has been done with decaffeinated coffee.

HIGH PHOSPHORUS INTAKES

- ✗ High phosphorus intakes are associated with lower levels of calcium urinary excretion, but a slightly higher intestinal calcium excretion. These opposite effects neutralize themselves and does not seem to negatively impact calcium balance .

Effects of nitrogen, phosphorus, and caffeine on calcium balance in women. *Heaney RP, Recker RR J Lab Clin Med. 1982 Jan; 99(1):46-55.*

ROLE OF PROTEINS

- ✗ The role of protein intake remains controversial in the development of osteoporosis.
because at one end
- ✗ Excessive protein intake can be responsible for a metabolic increase of acid production and acid renal excretion, with increased calciuria potentially favouring bone loss and hip fracture

Dietary factors and the incidence of hip fracture in middle-aged Norwegians. A prospective study. Meyer HE, Pedersen JI, Løken EB, Tverdal A, Am J Epidemiol. 1997 Jan 15; 145(2):117-23.

WHILE AT OTHER END OF SPECTRUM

- ✗ In a study on postmenopausal women and men , a positive association between protein intakes and BMD was observed a mean loss of BMD of -4.61% and -3.72% was observed in patients with the lowest quartile of protein intake (17–53 g/day), versus a loss of -2.32% and -1.11% in patients with the highest quartile (84–152 g/day) at the femoral neck and spine.

Effect of dietary protein on bone loss in elderly men and women: the Framingham Osteoporosis Study. Hannan MT, Tucker KL, Dawson-Hughes B, Cupples LA, Felson DT, Kiel DPJ *Bone Miner Res.* 2000 Dec; 15(12):2504-12.

ANIMAL VERSUS VEGETABLE PROTEINS

- ✗ A prospective cohort study showed that a high diet ratio of dietary proteins of animal origin over vegetable protein could induce a higher rate of bone loss at the femoral neck and an increased risk for hip fractures (relative risk = 3.7) in women aged more than 65 years.

A high ratio of dietary animal to vegetable protein increases the rate of bone loss and the risk of fracture in postmenopausal women. Study of Osteoporotic Fractures Research Group. Sellmeyer DE, Stone KL, Sebastian A, Cummings SR, Am J Clin Nutr. 2001 Jan; 73(1):118-22.

PROTEIN CONESUS OVERALL

- ✗ Finally, protein might play a role in maintenance of BMD by different mechanisms, e.g. by increasing Insulin like growth factor (IGF-I), calcium absorption, and muscle strength and mass, which all could benefit the skeleton.

Optimizing bone health in older adults: the importance of dietary protein. Surdykowski AK, Kenny AM, Insogna KL, Kerstetter JE, *Aging health*. 2010 Jun 1; 6(3):345-357.

ROLE OF POTASSIUM

- ✗ Potassium content, high in fruits and vegetables has a protective effect against urinary calcium loss. However, this positive effect can be completely offset by a low calcium intake or a reduction in intestinal absorption. The best way to preserve the body calcium economy is to encourage the consumption of foods such as dairy products, which are rich in calcium, proteins, phosphorus, and potassium

Review Nutrient effects on the calcium economy: emphasizing the potassium controversy. *Rafferty K, Heaney RP, J Nutr. 2008 Jan; 138(1):166S-171S.*

ROLE OF VITAMINS AND MINERALS

- ✗ In postmenopausal women, an increased intake of some minerals and vitamins have been proven to be able to decrease bone loss.
- ✗ Favorable effects has been suggested for magnesium, boron (contained in dried-plums), vitamin C, vitamin K, and fluoride, preference should go to the use of complete supplements or foods.

Review Delay of natural bone loss by higher intakes of specific minerals and vitamins. *Schaafsma A, de Vries PJ, Saris WH, Crit Rev Food Sci Nutr. 2001 May; 41(4):225-49.*

FIBER

- ✗ High-fibre diets (≥ 30 g/day) could provoke a 20–30% decrease in intestinal calcium absorption . A lowered plasma estradiol (an estrogen steroid hormone) level has also been attributed to fibre excess, but the effect on the skeletal integrity has not been clearly settled .

Soybean phytate content: effect on calcium absorption. *Heaney RP, Weaver CM, Fitzsimmons ML, Am J Clin Nutr. 1991 Mar; 53(3):745-7.*

Low follicular oestrogen levels in New Zealand women consuming high fibre diets: a risk factor for osteopenia? *Feng W, Marshall R, Lewis-Barned NJ, Goulding A N Z Med J. 1993 Oct 13; 106(965):419-22.*

SOY ISOFLAVONES

- ✗ In vitro and animal studies have suggested that phytoestrogens act on both osteoblasts and osteoclasts through genomic and non-genomic pathways.
- ✗ several epidemiological studies and clinical trials suggest that some soy isoflavones have beneficial effects on bone turnover markers and bone mechanical strength in postmenopausal women.

Alexandersen P, Toussaint A, Christiansen C, Devogelaer JP, Roux C, Fechtenbaum J, Gennari C, Reginster JY (2001) Ipriflavone in the treatment of postmenopausal osteoporosis: a randomized controlled trial. JAMA 285:1482–1488

Atmaca A, Kleerekoper M, Bayraktar M, Kucuk O (2008) Soy isoflavones in the management of postmenopausal osteoporosis. Menopause 15:748–757

CARBONATED SODA DRINKS

- ✗ Colas has been associated with lower bone mass. Besides displacement of more nutrient- and calcium-rich beverages, caffeine, and phosphoric acid content in colas have also been implicated as contributing to the adverse skeletal effects.

Iuliano-Burns S, Saxon L, Naughton G, Gibbons K, Bass SL (2003) Regional specificity of exercise and calcium during skeletal growth in girls: a randomized controlled trial. *J Bone Miner Res* 18:156–162

ALCOHOL CONSUMPTION

- ✗ Alcohol consumption is generally recognized as a secondary cause of osteoporosis and as a risk factor for fracture
- ✗ Alcohol may interfere with bone metabolism through direct toxic effects on osteoblasts and indirectly through adverse skeletal effects of nutritional deficiencies in calcium, vitamin D, and proteins that are prevalent in heavy drinkers.
- ✗ Around 2 units per day (1 unit=10 g ethanol) for the association of alcohol intake and fracture risk was reported in earlier studies.

Kanis JA (2008) Assessment of osteoporosis at the primary health-care level. Technical report, University of Sheffield, South Yorkshire

PATIENTS WITH GOUT MAY BE MORE LIKELY TO DEVELOP OSTEOPOROSIS

- ✗ People with gout face a modestly increased risk, of about 20%, for developing osteoporosis, compared to people without gout.
- ✗ Those with gout had significantly higher baseline rates of morbid obesity, smoking-related diagnosis, alcohol use disorder, hypertension, dyslipidemia, diabetes, kidney disease, and rheumatoid arthritis.

Population-based study to examine a possible association between gout and subsequent osteoporosis, Dr. Victor C. Kok of Asia University (Taiwan)- Medscape 2018

SMOKING

- ✗ Smoking is associated with an increased fracture risk.
- ✗ Adverse effects on BMD are apparent after the age of 50 and increase with age.

Law MR, Hackshaw AK (1997) A meta-analysis of cigarette smoking, bone mineral density and risk of hip fracture: recognition of a major effect. *BMJ* 315:841–846

VITAMIN D3

- ✗ A major source of vitamin D3 is synthesis in the skin under influence of UV light.
- ✗ serum vitamin D half-life is known to be 15 to 24 hours.
- ✗ The low sun exposure in elderly persons is related to an indoor style of living and/or clothing leaving little skin exposed. In this regard, there are groups that are at higher risk of vitamin D deficiency, already at younger age, as a consequence of their habit to wear clothing that (nearly) completely covers the skin for traditional cultural and/or religious reasons.
- ✗ Vitamin D deficiency during pregnancy is of particular concern in view of the potential adverse skeletal consequences for mother and child.

Gannage-Yared MH, Chemali R, Yaacoub N, Halaby G (2000) Hypovitaminosis D in a sunny country: relation to lifestyle and bone markers. J Bone Miner Res 15:1856–1862

SERUM 25-HYDROXYVITAMIN D AS A PREDICTOR OF MORTALITY AND CARDIOVASCULAR EVENTS

- ✗ A 20-year, community-based cohort study. Examined serum 25(OH)D as a predictor of total mortality and cardiovascular outcomes in Australia
- ✗ Period was from 1994/1995, n = 3946, baseline age 25–84 years).
Participants 889 participants died (including 363 from CVD) and 944 experienced a CVD event (including 242 with heart failure).
serum 25(OH)D below 65 and 55 nmol/L was associated with higher total mortality and higher CVD mortality/heart failure.

Vitamin D level	Vitamin D status	Health effect	Management
<30 nmol/L	Deficient	Rickets, Osteomalacia	High dose colecalciferol then maintenance treatment
30- 50 nmol/L	Insufficient	Associated with disease risk	Maintenance vitamin D supplements
50–75 nmol/L	Adequate	Healthy	Lifestyle advice
>75 nmol/L	Optimal	Healthy	None

VITAMIN D3 SUPPLEMENTATION

- ✗ Oral supplementation remains a more practical solution to prevent or treat vitamin D insufficiency.
- ✗ A Single randomized controlled trial in a geriatric institution in the Netherlands showed that UV irradiation of 1,000 cm skin of the back of elderly subjects three times per week was as effective as a daily oral dose of 400 IU vitamin D3 to raise serum levels of 25-hydroxyvitamin D and suppress secondary hyperparathyroidism.

Chel VG, Ooms ME, Popp-Snijders C, Pavel S, Schothorst AA, Meulemans CC, Lips P (1998) Ultraviolet irradiation corrects vitamin D deficiency and suppresses secondary hyperparathyroidism in the elderly. J Bone Miner Res 13:1238–1242

Treatment regimes

1. Treatment of deficiency (25-OHD <30 nmol/L) - loading regime of colecalciferol followed by long term maintenance treatment

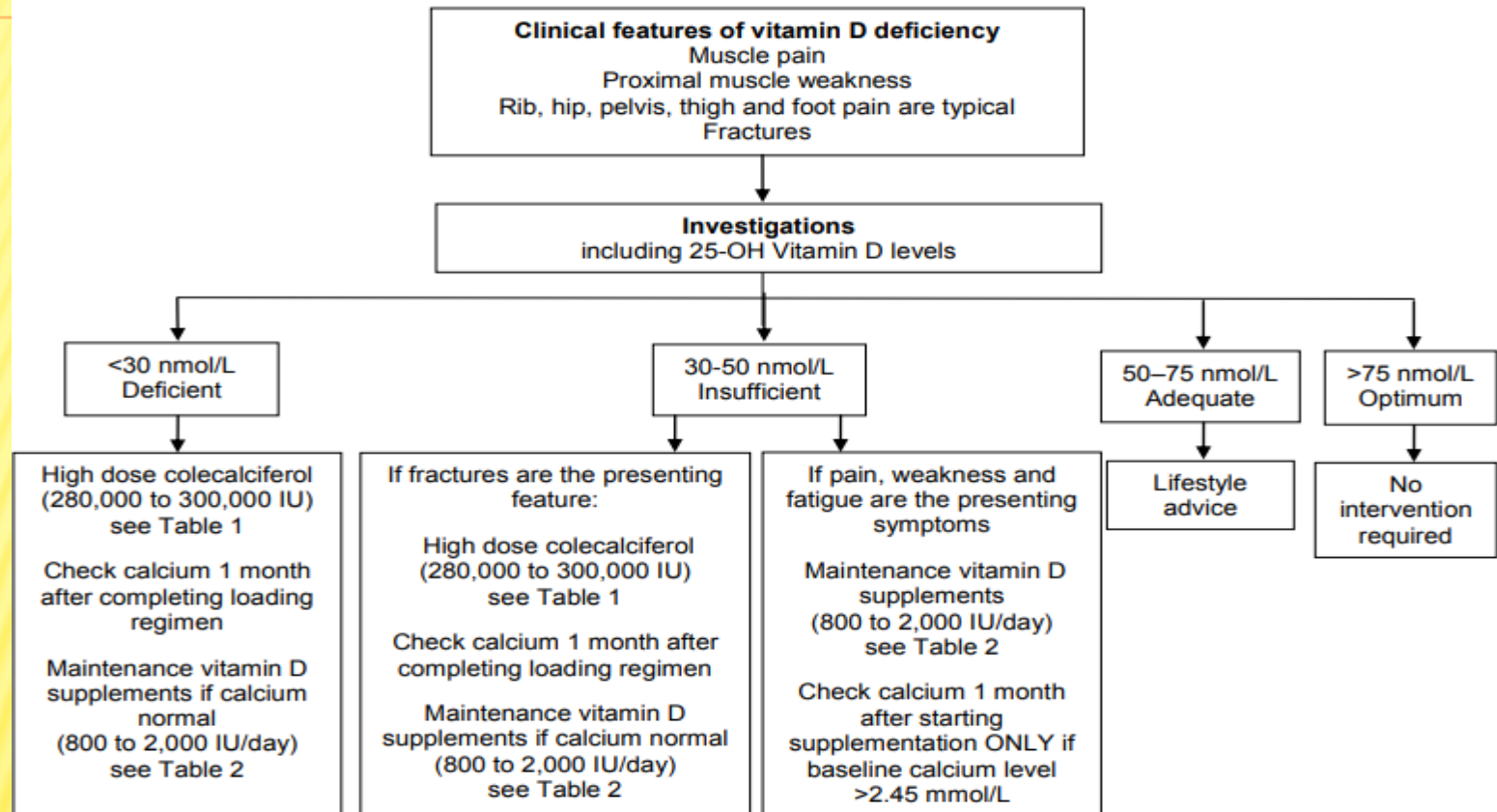
Used where rapid correction of vitamin D deficiency is required, e.g., symptomatic disease or before starting treatment with a potent antiresorptive agent (zoledronic acid, denosumab).

	Colecalciferol dose	Route	Length of course	Total loading dose
First line	40,000 IU weekly	Oral	7 weeks	28,0000 IU
Second line	50,000 IU weekly	Oral	6 weeks	30,0000 IU
Third line	4,000 IU daily	Oral	10 weeks	28,0000 IU

2. Treatment of insufficiency (25-OHD: 30-50 nmol/L) or long term maintenance after deficiency

Colecalciferol Dose	Route
800 – 2,000 IU daily (occasionally up to 4,000 IU daily) ¹	Oral

**Appendix 1: Quick guide to vitamin D levels and management
(for patients with risk factors AND clinical features)**



WOMEN AND MEN

Under age 50	400-800 international units (IU) daily**
Age 50 and older	800-1,000 IU daily**

**Some people need more vitamin D. According to the Institute of Medicine (IOM), the safe upper limit of vitamin D is 4,000 IU per day for most adults.

KEY MESSAGES

- ✗ Oral vitamin D3 (colecalciferol) is the treatment of choice in vitamin D deficiency.
- ✗ Where rapid correction of vitamin D deficiency is required, use a fixed loading dose followed by regular maintenance therapy.
- ✗ Where correction of vitamin D deficiency is less urgent maintenance therapy may be started without the use of loading doses.
- ✗ Adjusted serum calcium should be checked 1 month, in adults, or 6 months, in children, after completing the loading regimen or after starting vitamin D supplementation, in case primary hyperparathyroidism has been unmasked.

VITAMIN D INTERACTION WITH MEDICATION

- **Steroids**
can reduce calcium absorption and impair vitamin D metabolism. Results in development of osteoporosis associated with their long-term use .
- **Tetracycline, iron supplements, thyroid hormones**
Calcium binds to these substances, interfering with their effectiveness and also its own absorption.
- **Orlistat**
Weight reduction drug & cholesterol-lowering drug cholestyramine reduce the absorption of vitamin D and other fat-soluble vitamins .
- **Phenobarbital and Phenytoin**
used to prevent and control epileptic seizures, increase the hepatic metabolism of vitamin D to inactive compounds and reduce calcium absorption

CALCIUM

CALCIUM REQUIREMENT

Life Stage	Recommended Amount
Birth to 6 months	200 mg
Infants 7–12 months	260 mg
Children 1–3 years	700 mg
Children 4–8 years	1,000 mg
Children 9–13 years	1,300 mg
Teens 14–18 years	1,300 mg
Adults 19–50 years	1,000 mg
Adult men 51–70 years	1,000 mg
Adult women 51–70 years	1,200 mg
Adults 71 years and older	1,200 mg
Pregnant and breastfeeding teens	1,300 mg
Pregnant and breastfeeding adults	1,000 mg

<https://ods.od.nih.gov/pdf/factsheets/Calcium-Consumer.pdf>

CALCIUM RICH FOODS

Apart from milk and its products, some good source are

- **Less than 100 mg of calcium**

- 1 orange
- 1 cup of sweet potatoes or green beans
- 1 cup of cooked lentils, chick peas, navy beans, or pinto beans
- 3 ounces of shrimp,

- **100 - 199 mg of calcium**

- 1 cup of cottage cheese
- 1 cup of cooked spinach
- 1 cup soya beans

- **200 - 299 mg of calcium**

- 1 cup of cooked cabbage, turnip (shalgum)
- 10 dried figs (anjeer)

- **300 + mg of calcium**

- 8 oz of yoghurt plain
- 1 cup almonds



READING FOOD LABELS

- ✗ To determine how much calcium is in a particular food, check the nutrition facts panel of the food label for the daily value (DV) of calcium. Food labels list calcium as a percentage of the DV. This amount is based on 1,000 mg of calcium per day. For example:
- ✗ 30% DV of calcium equals 300 mg.
- ✗ 20% DV of calcium equals 200 mg of calcium.
- ✗ 15% DV of calcium equals 150 mg of calcium.

<https://www.nof.org/patients/treatment/calciumvitamin-d/>

TYPES OF CALCIUM COMPOUNDS

- ✗ Several different kinds of calcium compounds are used in calcium supplements. Each compound contains varying amounts of the mineral calcium — referred to as elemental calcium. Common calcium supplements may be labeled as:
- ✗ Calcium carbonate (40 percent elemental calcium)
- ✗ Calcium citrate (21 percent elemental calcium)
- ✗ Calcium lactate (13 percent elemental calcium)
- ✗ Calcium gluconate (9 percent elemental calcium)

CALCIUM SUPPLEMENTS

- ✗ Aim to get the recommended daily amount of calcium from food first and supplements should be taken only in case of short fall. If breakfast has good calcium in oral foods , take it at lunch or dinner
- ✗ In fact, there is no added benefit to taking more calcium than required .

When choosing the best supplement to meet your needs, keep the following in mind,

Choose brand-name supplements with proven reliability. Look for labels that state “purified” or have the USP (United States Pharmacopeia) symbol. The “USP Verified Mark” on the supplement label means that the USP has tested and found the calcium supplement to meet certain standards for purity and quality.

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- ✗ **Read the product label carefully to determine the amount of *elemental calcium***, which is the actual amount of calcium in the supplement.
 - ✗ **Calcium is absorbed best when taken in amounts of 500 – 600 mg or less.**
Try to get your calcium-rich foods and/or supplements in smaller amounts throughout the day.
 - ✗ **Take most calcium supplements with food.** Eating food produces stomach acid that helps your body absorb most calcium supplements. The one exception to the rule is calcium citrate, which can absorb well when taken with or without food.
 - ✗ **When starting a new calcium supplement, start with a smaller amount to better tolerate it.** When switching supplements, try starting with 200-300 mg every day for a week, and drink an extra 6-8 ounces of water with it. Then gradually add more calcium each week.

CALCIUM SUPPLEMENTS IN MARKET FOR ORAL MAINTENANCE

Name	Type of calcium	Elemental calcium	Vitamin D	Other nutrients
Calcite 600	Carbonate	600mg	400IU	Magnesium -40mg Zinc 7.5mg Copper -1mg Manganese -1.8mg Boron -250mcg
Chewcal	Carbonate	400mg	2.5mcg (100IU)	
CAC1000plus	Lactate Gluconate Carbonate		400IU	Lactate Gluconate-1000mg Carbonate-327mg Vitamin C-500mg Vitamin B2-10mg
Qalsan D	Carbonate	500mg	125IU	Sugar free – aspartame

DRUG INTERACTIONS WITH CALCIUM

- ✗ Calcium dietary supplements can interact or interfere with certain medicines and some medicines can lower or raise calcium levels in the body. So calcium absorption is reduced with,
- ✗ Bisphosphonates (to treat osteoporosis)
- ✗ Antibiotics of the fluoroquinolone and tetracycline families
- ✗ Levothyroxine (to treat low thyroid activity)
- ✗ Phenytoin (an anticonvulsant)
- ✗ Loop diuretics (Lasix) increase calcium excretion and thereby lower blood calcium levels.
- ✗ Antacids containing aluminum or magnesium increase calcium loss in the urine.
- ✗ Mineral oil and stimulant laxatives reduce calcium absorption.
- ✗ Glucocorticoids (such as prednisone)

POTENTIAL RISK OF EXCESSIVE CALCIUM

- ✗ Urinary tract or renal stones in susceptible individuals
- ✗ Deficiency of iron and other mineral divalent cations resulting from decreased absorption.
- ✗ Constipation

USEFULL RESOURCES

- ✗ <https://medlineplus.gov/calcium.html>
- ✗ Health Professional Fact Sheet on Calcium
- ✗ U.S. Department of Agriculture's (USDA) National Nutrient Database
- ✗ Nutrient List for calcium listed by food or by calcium content, USDA