

Table 4: FDA-approved Bisphosphonates for the Treatment and Prevention of Osteoporosis

Bisphosphonate	Indication	Other Indications	Renal Impairment
Alendronate or alendronate; cholecalciferol	<p><i>Prophylaxis in postmenopausal women:</i> 5 mg PO daily or 35 mg PO weekly</p> <p><i>Treatment:</i> 10 mg PO daily, 35 mg PO twice weekly, or 70 mg PO weekly</p> <p><i>For glucocorticoid-induced osteoporosis:</i> 5 mg PO once daily or if postmenopausal and not on estrogen, 10 mg PO daily</p>	Malignant hypercalcemia and Paget's disease	CrCl \leq 35 ml/min: not recommended
Ibandronate	<p><i>Prophylaxis in postmenopausal women:</i> 2.5 mg PO daily or 150 mg PO once monthly Limited data for 150 mg PO once monthly or 0.5 mg, 1 mg, and 2 mg IV once every 3 months</p> <p><i>Treatment:</i> 2.5 mg PO daily or 150 mg PO once monthly Limited data for 150 mg PO once monthly or 3 mg IV bolus every 3 months</p> <p><i>For glucocorticoid-induced osteoporosis:</i> 2 mg IV once every 3 months up to 2 years</p>	Paget's disease	CrCl < 30 ml/min: not recommended
Risedronate	<p><i>Prophylaxis in postmenopausal women:</i> 5 mg PO daily, 35 mg PO weekly, 150 mg PO monthly, or 75 mg PO twice monthly on consecutive days before breakfast</p> <p><i>Prophylaxis in persons on chronic systemic glucocorticosteroids:</i> 5 mg PO daily</p> <p><i>Treatment of women:</i> 5 mg PO daily, 35 mg PO weekly, 150 mg PO monthly, or 75 mg PO twice monthly on consecutive days</p> <p><i>Treatment of men:</i> 35 mg PO once weekly before breakfast in addition to calcium and vitamin D</p>	Paget's disease	CrCl < 30 ml/min: not recommended
Zoledronic acid	<p><i>Prophylaxis in postmenopausal women:</i> 5 mg IV once every other year constantly infused over at least 15 minutes</p> <p><i>For prevention of glucocorticoid-induced osteoporosis:</i> 5 mg IV once every other year</p>	Paget's disease, hypercalcemia of malignancy, and bone metastases in multiple myeloma	CrCl < 35 ml/min or serum creatinine > 4.5 mg/dL: not recommended

Table 5: Other FDA-approved Medications for the Treatment of Osteoporosis

Medication	Mechanism of Action	Indication	Other Indications
Calcitonin	Calcium regulator hormone	<i>Treatment in postmenopausal women who are more than 5 years past menopause and not candidates for estrogen therapy:</i> 100 IU IM or SC once daily, once every other day, or 3 times weekly, or 200 IU intranasally in one nostril once daily Either regimen should be used with supplemental calcium and vitamin D	Paget's disease and hypercalcemia
Denosumab	Monoclonal antibody	<i>Treatment in postmenopausal women:</i> 60 mg SC once every 6 months with supplemental calcium and vitamin D	Prevention of skeletal events related to bone metastases
Teriparatide	PTH analogue	<i>Treatment in high-risk postmenopausal women or men:</i> 20 mcg SC once daily up to 2 years <i>Glucocorticoid-induced osteoporosis in high-risk patients:</i> 20 mcg SC once daily up to 2 years	

bone loss. Power training (fast movement with resistance weights) is more effective than strength (slower movement) training.³²

Recently investigators examined the impact of skeletal abnormalities and muscle strength on the development of osteoporosis. Exercises, particularly high-impact ones, have been shown to be beneficial during different stages of growth and development.³⁰ Further research is needed to identify the type and frequency of exercise required for osteoporosis prevention. Individualized programs based on an individual's risk factors, age, and BMD may be needed. Until there is persuasive evidence, adherence to a moderate, weight-bearing exercise program most days of the week is reasonable. The intensity of one's program should be adjusted in consultation with a person's primary care physician.

Smoking Cessation

Cigarette smoking is known to accelerate bone loss.³³ Smoking also may compromise the effectiveness of estrogen treatment in

postmenopausal women^{34,35} and is known to increase the risk of thromboembolic complications in women on HRT. Therefore, smoking cessation is highly recommended in postmenopausal women undergoing treatment with estrogen.

Calcium and Vitamin D

Sufficient daily intake of calcium is essential to maintain healthy bones. Since calcium requirements differ based on factors such as age and menopause status, the amount required to achieve this goal will vary accordingly. The National Institutes of Health (NIH) estimated optimal calcium intake based on gender and hormonal status. See Figure 2 for details.³⁶ Patients should be educated on foods with high calcium content. There does not appear to be clear benefits favoring one calcium formulation, although absorption may differ based on the fasting state, with calcium citrate preparations having a more favorable profile than calcium carbonate formulations.

Vitamin D has gained increasing interest in recent years. It plays an

important clinical role in a variety of medical conditions. The more defined role, however, is related to its impact on calcium homeostasis and bone metabolism. With minimal sun exposure, it is generally accepted that a 25-(OH) vitamin D level below 20 ng/ml is inadequate for bone health. Maintaining levels above 20 ng/ml is a reasonable treatment goal for most adults with recommendation of levels above 30 ng/ml in elderly and high-risk individuals. Calcium supplementation may prevent bone loss and changes in biochemical markers of bone turnover in susceptible populations.^{37,38}

It has been shown that mildly low levels of vitamin D, though common, may be associated with bone loss. Supplementation of vitamin D and calcium in vitamin D deficiency has been shown to decrease the risk of hip and non-spine fractures.^{39,40}

In the setting of vitamin D deficiency, treatment should aim to achieve 25-(OH) vitamin D levels of ≥ 30 -32 ng/ml to prevent a compensatory rise in the PTH level.^{41,42} The administration of 50,000