

NGN NCLEX 2026 · MUSCULOSKELETAL SYSTEM

Osteomalacia & Osteopenia

Two distinct disorders of bone health that look alike on the surface but differ in cause, lab findings, and management. Master the contrast — NCLEX loves to test it.

MUSCULOSKELETAL · ADULT HEALTH · PHARMACOLOGY

1

Definition & Overview

OSTEOMALACIA

Softening of bones in adults caused by **defective mineralization** of the bone matrix (osteoid).

- ▶ Bones are normal in **quantity** but poorly **mineralized** (soft, bendable)
- ▶ Adult equivalent of **rickets** in children
- ▶ Root cause = **Vitamin D deficiency** (most common)
- ▶ Causes **pain & weakness** — symptomatic disease

OSTEOPENIA

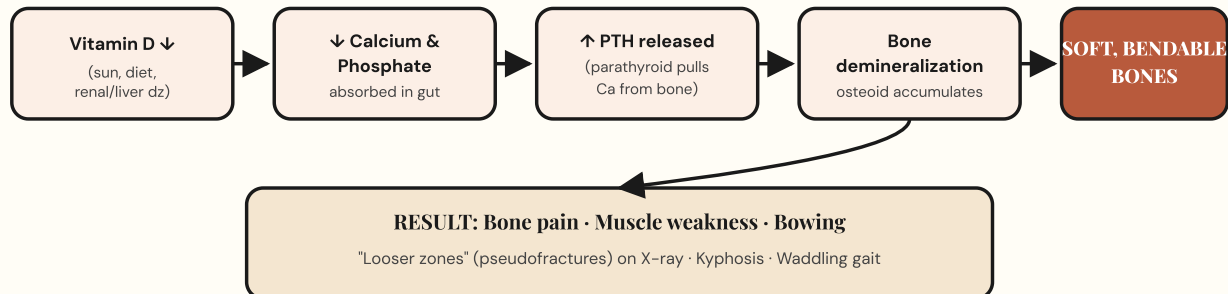
Low bone mineral density — less severe than osteoporosis. A **precursor** condition.

- ▶ Bones are normally **mineralized** but reduced in **quantity**
- ▶ **DEXA T-score**: -1.0 to -2.5
- ▶ Risk factors: aging, postmenopause, low Ca^{2+} , sedentary, steroids, smoking
- ▶ Usually **asymptomatic** — silent disease

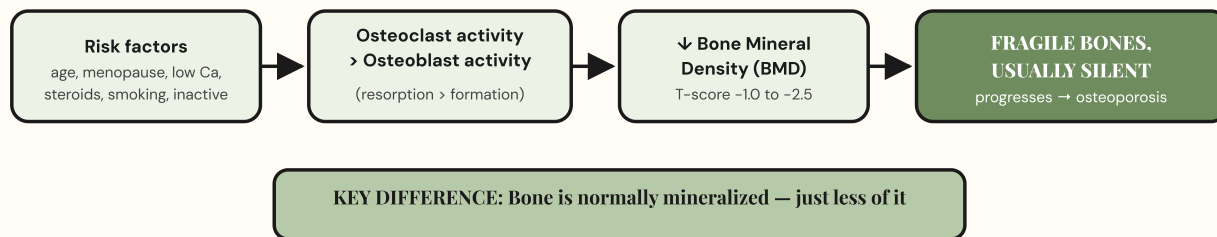
2

Pathophysiology

▼ Osteomalacia — The Mineralization Failure



▼ Osteopenia — The Quantity Loss



3

Signs & Symptoms

OSTEOMALACIA

— Symptomatic

EARLY / MILD

- Diffuse **bone pain** (pelvis, lower spine, ribs, legs)
- Bone **tenderness** to palpation
- **Proximal muscle weakness** (hips, thighs)
- Difficulty climbing stairs or rising from a chair
- Fatigue, malaise

LATE / SEVERE

- **Waddling gait** (Trendelenburg-like)
- **Bowing** of long bones (legs)
- **Kyphosis** & loss of height
- **Pseudofractures** (Looser zones) on X-ray
- Pathologic **fractures**
- Hypocalcemic **tetany** (Chvostek's / Trousseau's signs)

OSTEOPENIA

— Usually Silent

MOST COMMON PRESENTATION

- **Asymptomatic** — found on screening DEXA
- No pain, no deformity at this stage
- Patient may notice slight **loss of height** over years
- Mild postural changes (slight kyphosis)

IF PROGRESSING

- **Low-impact fractures** (wrist, hip, vertebra)
- Back pain from **vertebral compression**
- Progressive height loss (>1.5 in)
- Dowager's hump (advanced)
- Conversion to **osteoporosis** (T-score < -2.5)

RED FLAG FINDINGS — ESCALATE IMMEDIATELY

- **Serum calcium < 8.5 mg/dL with tetany, seizures, or laryngospasm** → hypocalcemic emergency
- **New back pain + sudden height loss** → suspect vertebral compression fracture
- **Hip pain after a fall** in an osteopenic adult → assume fracture until imaging proves otherwise
- **Positive Chvostek's or Trousseau's sign** → impending tetany; notify HCP immediately

4

Priority Nursing Interventions

A

SAFETY FIRST — Fall & Fracture Prevention. Bed in lowest position, call light within reach, non-skid footwear, clear pathway, adequate lighting, no throw rugs. Use **gait belt** for ambulation; assess for orthostatic changes. Bones are fragile — falls cause fractures.

B

ASSESS pain, mobility, gait, and posture. Document height annually (loss > 1.5 in is significant). Inspect for kyphosis, bowing, deformity. Use a 0–10 pain scale and reassess after analgesia.

C

ADMINISTER vitamin D, calcium, and phosphate as prescribed. Give calcium with meals and a full glass of water (prevents GI upset, improves absorption). Separate calcium from iron, tetracyclines, and levothyroxine by > 2 hours — they bind and impair absorption.

D

MONITOR labs: serum calcium, phosphate, alkaline phosphatase, 25-hydroxyvitamin D, PTH, creatinine. *Osteomalacia profile:* ↓ Ca, ↓ phosphate, ↑ ALP, ↓ vit D, ↑ PTH. *Osteopenia:* labs often normal — diagnosis is by **DEXA T-score**.

E

ENCOURAGE weight-bearing exercise (walking, light resistance, tai chi). Stimulates osteoblasts. Avoid high-impact activities or anything risking falls until cleared.

F

PROMOTE sunlight exposure 10–15 min/day on arms/face (face/hands not covered with sunscreen during the window) — body synthesizes vitamin D. Important for osteomalacia treatment.

G

NUTRITION counseling: dairy, fortified milk, fatty fish (salmon, sardines), eggs, leafy greens, fortified cereals. Limit caffeine, soda (phosphoric acid), and excess alcohol — all leach calcium from bone.

H

MONITOR for hypercalcemia if patient is on high-dose vitamin D or calcium: constipation, anorexia, polyuria, lethargy, confusion, ECG changes. Hold supplement and notify HCP.

5

Pharmacology

DRUG / CLASS	MECHANISM	KEY SIDE EFFECTS	NURSING CONSIDERATIONS
Cholecalciferol (Vit D₃) Ergocalciferol (Vit D ₂)	Promotes intestinal Ca ²⁺ & phosphate absorption; restores mineralization	Hypercalcemia, N/V, weakness, polyuria, kidney stones (toxic doses)	Monitor serum Ca ²⁺ & 25-OH-vit D; take with meals; teach signs of toxicity
Calcium carbonate Calcium citrate	Replaces calcium for bone formation & nerve/muscle function	Constipation, gas, bloating, kidney stones, hypercalcemia	Give with meals (carbonate); citrate can be given without food; ↑ fluids/fiber; separate from iron & tetracycline > 2 hr
Calcitriol (active vit D)	Active form of vit D for patients with renal disease (cannot activate D themselves)	Hypercalcemia (high risk), N/V, soft tissue calcification	Used in CKD/dialysis patients; check calcium frequently; monitor for symptoms of hypercalcemia
Bisphosphonates Alendronate, risedronate, ibandronate	Inhibit osteoclast bone resorption → preserves BMD	Esophagitis, esophageal ulcer, jaw osteonecrosis, atypical femoral fracture, GI upset	Take in AM with 8 oz plain water, empty stomach, remain UPRIGHT 30–60 min, no other meds/food for 30 min. Dental exam before starting. Used for osteopenia/osteoporosis.
Denosumab (Prolia)	Monoclonal antibody — inhibits osteoclast formation	Hypocalcemia, infection risk, jaw osteonecrosis, skin reactions	SubQ every 6 months; check Ca ²⁺ before each dose; ensure adequate Ca/vit D intake
Raloxifene (SERM)	Estrogen-like effect on bone (postmenopausal women)	Hot flashes, leg cramps, VTE/DVT risk , stroke risk	Hold > 72 hr before prolonged immobility/surgery; teach DVT signs; not for premenopausal women
Phosphate supplements	Replaces phosphate in deficiency-related osteomalacia (e.g., renal phosphate wasting)	Diarrhea, hyperphosphatemia, hypocalcemia	Monitor phosphate & calcium; dilute well; report tetany

6 NCLEX Test Traps ⚠️

✗ WRONG CHOICE

"Osteomalacia and osteoporosis are the same disease."

✓ CORRECT THINKING

Osteomalacia = poor mineralization (soft bone). Osteoporosis/osteopenia = decreased bone mass (less bone). Different cause, different labs, different treatment.

✗ WRONG CHOICE

"Patient just took alendronate — help them back to bed to rest."

✓ CORRECT THINKING

Keep the patient UPRIGHT for at least 30–60 minutes after a bisphosphonate to prevent esophagitis/ulceration. Reclining is contraindicated.

✗ WRONG CHOICE

"Give the calcium supplement with the morning iron tablet."

✓ CORRECT THINKING

Separate calcium from iron, tetracycline, levothyroxine, and bisphosphonates by > 2 hours. Calcium binds to these drugs and blocks absorption.

✗ WRONG CHOICE

"Osteopenia has obvious symptoms like back pain and deformity."

✓ CORRECT THINKING

Osteopenia is usually SILENT — it's diagnosed by DEXA scan, not symptoms. Symptomatic bone disease in an adult is more likely osteomalacia, advanced osteoporosis, or a fracture.

✗ WRONG CHOICE

"The patient has osteomalacia and a positive Chvostek's sign — give vitamin D and continue monitoring."

✓ CORRECT THINKING

Chvostek's = hypocalcemia, which can progress to **tetany, laryngospasm, and seizures**. This is a **priority airway/safety concern** — notify the HCP, prepare IV calcium gluconate, institute seizure precautions.

✗ WRONG CHOICE

"Push high-dose vitamin D — more is always better for bone health."

✓ CORRECT THINKING

Vitamin D is fat-soluble and accumulates. **Excess causes hypercalcemia** (constipation, kidney stones, confusion, polyuria, weakness). Dose to lab values, not to "more."

7

Patient & Family Education



NUTRITION

- ✓ Aim for **1,000–1,200 mg calcium/day** (food first)
- ✓ **600–800 IU vitamin D/day** (more if deficient)
- ✓ Dairy, fortified milk/cereal, salmon, sardines, leafy greens, almonds, tofu
- ✓ Limit caffeine, soda, alcohol & high-sodium foods
- ✓ Stop smoking — it accelerates bone loss



VITAMIN D & SUN

- ✓ 10–15 min sun exposure on arms/face several times/week
- ✓ Darker skin and older adults need more sun or supplements
- ✓ Don't rely on sun alone in winter / northern latitudes
- ✓ Take vit D **with a fatty meal** — fat-soluble



EXERCISE

- ✓ **Weight-bearing activity** 30 min most days (walking, dancing, tai chi)
- ✓ Add light resistance training 2×/week
- ✓ Balance training reduces falls (yoga, tai chi)
- ✓ Avoid high-impact or risky activity until cleared



HOME SAFETY

- ✓ Remove throw rugs; secure cords
- ✓ Install grab bars in bathroom; non-slip mats
- ✓ Adequate lighting, night lights
- ✓ Wear supportive non-skid shoes (no slippers/socks)
- ✓ Get vision and hearing checked yearly



MEDICATION TEACHING

- ✓ Bisphosphonate: AM, empty stomach, 8 oz **plain water**, stay **upright 30–60 min**
- ✓ Calcium with meals; separate from iron & thyroid meds
- ✓ Report new **jaw pain** or **thigh/groin pain** (rare bisphosphonate effects)
- ✓ Dental exam **before** starting bisphosphonates or denosumab



SCREENING & FOLLOW-UP

- ✓ DEXA: women ≥ 65 , men ≥ 70 , or earlier if risk factors
- ✓ Re-DEXA every 1–2 years (or as ordered)
- ✓ Measure height yearly; report > 1.5 in loss
- ✓ Report new back pain, falls, or fractures promptly

8

Complications

OSTEOMALACIA

Complications

- ▶ **Pathologic fractures** (femur, ribs, vertebrae)
- ▶ **Pseudofractures** (Looser zones) — partial fractures in soft bone
- ▶ **Bone deformities:** bowed legs, pigeon chest, kyphosis
- ▶ **Hypocalcemic tetany, seizures, laryngospasm**
- ▶ Chronic bone pain & disability
- ▶ Secondary **hyperparathyroidism**
- ▶ Falls from gait disturbance & weakness
- ▶ Vitamin D toxicity if over-treated (hypercalcemia)

OSTEOPENIA

Complications

- ▶ **Progression to osteoporosis** (T-score < -2.5)
- ▶ **Low-impact / fragility fractures:** wrist (Colles'), hip, vertebra
- ▶ **Vertebral compression fractures** → back pain, height loss
- ▶ Kyphosis ("dowager's hump") with disease progression
- ▶ Loss of independence after fracture (especially hip)
- ▶ Increased mortality after hip fracture in older adults
- ▶ Bisphosphonate complications: esophagitis, jaw osteonecrosis, atypical femur fracture
- ▶ Chronic pain & reduced quality of life

9

Memory Boosters

"SOFT"

Osteomalacia = bones are **SOFT**

- S** — Sunlight needed (Vit D)
- O** — Osteoid accumulates (unmineralized)
- F** — Fractures & pseudofractures
- T** — Tetany risk (low calcium)

"LESS"

Osteopenia = **LESS** bone (but normally mineralized)

- L** — Low BMD (T-score -1.0 to -2.5)
- E** — Estrogen drop ↑ risk (postmenopausal)
- S** — Silent — no symptoms
- S** — Screen with DEXA

"D for D"

Deficient vitamin **D** = **D**emineralized bones (osteomalacia)

"AM-UP"

Bisphosphonate teaching:

- A** — AM only
- M** — Empty stomach (no Meals)
- U** — Upright 30–60 min
- P** — Plain water (8 oz)

Lab Signature

Osteomalacia: ↓ Ca · ↓ Phos · ↑ ALP · ↓ Vit D · ↑ PTH

Osteopenia: Labs usually normal — DEXA tells the story

T-Score Cheat

Normal: ≥ -1.0

Osteopenia: -1.0 to -2.5

Osteoporosis: < -2.5

"Below -2.5 is the diagnosis line."

★ NCJMM Clinical Judgment — Six-Step Application

Scenario: A 68-year-old postmenopausal woman is admitted with a 6-month history of diffuse low back and hip pain, increasing difficulty rising from a chair, and a "waddling" gait. She lives in a northern climate, rarely goes outside, and has chronic kidney disease (stage 3). Vital signs: BP 132/78, HR 84, RR 18, T 98.4 °F. Labs: serum calcium 7.9 mg/dL, phosphate 2.3 mg/dL, alkaline phosphatase 220 U/L, 25-OH vitamin D 12 ng/mL, PTH elevated. A faint twitch is noted at the corner of her mouth when the facial nerve is tapped.

STEP
1

Recognize Cues: Postmenopausal woman + CKD + limited sun exposure + diffuse bone pain + proximal muscle weakness + waddling gait + hypocalcemia (7.9) + hypophosphatemia + elevated ALP + low vit D + elevated PTH + positive Chvostek's sign. Pattern points to **osteomalacia with secondary hyperparathyroidism and impending tetany.**

STEP
2

Analyze Cues: CKD impairs activation of vitamin D → ↓ Ca/Phos absorption → ↑ PTH pulls Ca from bone → demineralization (high ALP from osteoblast activity) → soft bones, pain, weakness. Hypocalcemia is the most immediate threat (Chvostek's positive = pre-tetany). Falls are a secondary safety priority due to muscle weakness and gait change.

STEP
3

Prioritize Hypotheses:

1. **Hypocalcemia with risk for tetany/laryngospasm** — airway/safety
2. **Osteomalacia secondary to vit D deficiency & CKD** — underlying problem
3. **Risk for falls and pathologic fracture** — mobility-related safety
4. Chronic pain — comfort priority once acute risks addressed

STEP
4

Generate Solutions: Initiate seizure & airway precautions; place IV calcium gluconate at bedside; obtain ECG; notify HCP of Chvostek's and Ca 7.9; administer prescribed **calcitriol** (activated vitamin D — patient cannot activate D in CKD); supplement calcium and phosphate as ordered; institute fall precautions (bed low, call light, gait belt, non-skid shoes); pain management; nutrition consult; teach sun exposure and dietary calcium sources; arrange DEXA & X-rays.

STEP
5

Take Action:

1. Notify HCP — report Ca 7.9 & positive Chvostek's
2. Implement **seizure precautions** (suction, O₂, padded rails)
3. Establish IV access; prepare **IV calcium gluconate**
4. Continuous cardiac monitoring (hypocalcemia → prolonged QT, dysrhythmias)
5. Administer prescribed **calcitriol** + oral calcium + phosphate
6. Fall precautions & gait-belt-assisted ambulation
7. Pain assessment & analgesia per orders
8. Patient teaching on vit D, calcium, sunlight, exercise

STEP
6

Evaluate Outcomes: Goal — serum calcium returns to 8.5–10.5 mg/dL within 24–48 hr; Chvostek's resolves; no tetany, seizures, or laryngospasm; no falls or fractures; pain $\leq$ 3/10; patient verbalizes understanding of nutrition, supplements, sunlight exposure, and home safety; follow-up labs & DEXA scheduled; PTH trending toward normal; gait improves over weeks of therapy.