

Table 2: Treatment for Post-Operative Deficiencies and Suggested Supplementation<sup>43-47</sup>

Micronutrient	Post-op deficiency prevalence	Food Sources	Signs/symptoms of deficiency	Treatment for deficiency
Vitamin B3 (niacin)		Yeast, liver, cereals, legumes, seeds	4D's of Pellegra: Dermatitis: photosensitive, pigmented Diarrhea Dementia Death	
Magnesium	32%		Muscle contractions, pain, spasms, osteoporosis	Oral magnesium
Zinc	LS: 12% RYGB: 21–33% DS: 74–91%	Meat, chicken, nuts, lentils, breakfast cereals are fortified	Skin lesions, poor wound healing, dermatitis, blunting of taste sense, hair loss, altered immune function, alopecia, glossitis, infertility	Remember: Zinc:copper: 8–15 mg:1 mg as zinc supplementation can cause a deficiency in copper (e.g.: if taking zinc 50 mg/d, then add copper 4 mg/d)  If copper deficient: Mild-moderate deficiency (including low hematologic indices): 3–8 mg/d copper gluconate or sulfate Severe deficiency: 2–4 mg/d iv copper for 6 days or until serum levels return to normal and neurologic symptoms resolve.
Copper	RYGB: 2% DS: 10–24%	Everything (vegetables, grains, meat, fish, poultry)	Anemia, leukopenia, hypopigmentation of hair, skin, nails, unsteady gait, numbness and tingling in hands and feet, painful paresthesia, poor wound healing, peripheral neuropathy, myelopathy, paralysis	Toxicity level: Zinc 24-h urine >1200 ug/d Copper women >155 ug/dL Copper men >140 ug/dL
Vitamin A	RYGB: 8–11% DS: 61–69%	Preformed vitamin A (retinol): liver, kidney, egg yolk, butter  Provitamin A (beta-carotene): leafy greens, carrots, sweet potatoes	Loss of nocturnal vision, Bitot's spots (foamy white spots on sclera), itching, dry hair, xerophthalmia, decreased immunity, poor wound healing, hyperkeratinization of the skin, loss of taste (Vit A and zinc metabolism interrelated).	No corneal changes: 10000–25000 IU/day orally for 1–2 weeks  Corneal lesions present: 50000–100000 IU/day im for 3 days followed by 50000IU/day im for 2 weeks  Toxicity level: >80 ug/dL
Vitamin E		Olive oil, meat, eggs, leafy vegetables	Gait ataxia, hyporeflexia/weakness, nystagmus, ophthalmoplegia, ceroid deposition in muscle	
Vitamin K			Skin hemorrhages (petechia, purpura, ecchymosis)	For post bariatric surgery patients with hypoabsorption, the recommended dosage of vitamin K is either 1–2 mg/d orally or 1–2 mg/wk parenterally

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Folic acid	9–38%	Animal products, leafy vegetables; easily destroyed by heat of cooking	Macrocytic anemia, palpitations, fatigue, neural tube defects, changes in pigmentation or ulceration of skin, nails, or oral mucosa	1 mg/day orally for 1–3 months
Vitamin B1 (thiamine)	Up to 49%	Yeast, legumes, pork, rice, cereals; denatured at high temperature	Dry beriberi: symmetrical peripheral neuropathy; convulsions, muscle weakness +/- pain of lower and upper extremities, brisk tendon reflexes  Wet beriberi: heart failure, tachycardia or bradycardia, lactic acidosis, dyspnea, leg edema, RV dilatation  Wernicke's encephalopathy: polyneuropathy and ataxia, ocular changes (ophthalmoplegia and nystagmus), confabulation, short-term memory loss  Korsakoff psychosis: psychosis and /or hallucinations	Treat for suspected thiamine deficiency before or in the absence of lab confirmation.  Oral: 100 mg bid-tid until symptoms resolve  IV: 200 mg tid or 500 mg od-bid for 3–5 days, followed by 250 mg/d for 3–5 d or until symptoms resolve. im: 250 mg od for 3–5 days or 100–250 mg monthly  Simultaneous administration of magnesium, potassium and phosphorus should be given to patients at risk for refeeding syndrome.
Vitamin B12	2 years post RYGB/DS: 4 to 62%;  5 years post RYGB/DS 19–35%	Meat and dairy products	Pernicious anemia, tingling in fingers and toes, depression, dementia, ataxia, sore tongue, smooth and "beefy red" tongue, pale skin, slightly icteric skin and eyes.	1000 or 2000 ug/day (1–2 ampoules) orally  or  1000 ug/week im
Vitamin D	25–80%		Osteomalacia, arthralgia, depression, fasciculation, myalgia	Vit D3 is more potent than Vit D2 when comparing frequency and amount needed for repletion.  Vitamin D3 3000 to 6000 IU/d  or  Vitamin D2 50,000 IU 1–3 times weekly.  Toxicity level: >150 ng/mL
Calcium (from food and supplements)	Approx. 10%	E.g.: food=mg calcium 1 cup milk=300 mg 1 oz cheese=250 mg ¾ cup yogurt=200 mg ½ cup cooked leafy greens=50 mg	Low bone density, osteoporosis, muscle contractions, bone pain, spasms, paresthesia, muscle weakness, tetany	Adjust calcium and vitamin D intake based on normalizing lab values of calcium, 25(OH) vitamin D and PTH levels

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Iron	LS: 17%  RYGB/DS: 30% (45% after 2 years)		Fatigue, impaired work performance and productivity, microcytic anemia, decreased immune function, enteropathy, glossitis, dysphagia, spoon-shaped nails (koilonychias), vertical ridge on nails	Can increase oral non-heme iron intake in divided doses to provide 150–200 mg elemental iron daily (e.g.: ferrous sulfate 300 mg tid) <sup>48</sup> Take separately from calcium supplements, acid-reducing medications – if no response, then consider parenteral iron administration  Heme iron for treatment of post Roux-en-Y gastric bypass iron deficiency is not recommended as first line but may be considered if patient does not tolerate non-heme iron; The dosing would be 4 tablets of heme iron daily.

Source: Shiu, J.