Who Needs Vitamin D Supplementation? A Case Series Highlighting a Standard Protocol for Preoperative Bone Health Assessment

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STATEMENT OF PURPOSE:
Vitamin D plays a critical role in bone health by facilitating the absorption of calcium and phosphorus and increasing the bioavailability of these chemicals for bone metabolism. Deficiency in vitamin D has been implicated in hyperparathyroid fracture, osteoporosis, delayed fracture healing and non-union after osteotomy or osteosynthesis procedure. Optimization of bone health in patients with foot and ankle injuries as well as patients undergoing elective surgery is critical for successful early postoperative outcomes. Identifying patients with sub-optimal vitamin D levels requires a standardized protocol to ensure appropriate management. The purpose of this case series is to present a standardized protocol for preoperative optimization of vitamin D levels in patients undergoing both elective and non-elective orthopedic procedures. One must recognize that it is not necessary to delay surgical intervention if vitamin D supplementation is implemented in a timely and appropriate dosage during bone healing.

LITERATURE REVIEW:
Vitamin D in children, homeostasis and bone health has been well established. Vitamin D increases intestinal absorption of calcium and phosphorus. In the absence of vitamin D only 15-25% of dietary calcium can increase the efficiency of calcium absorption to 30-80% (1, 2). When serum calcium levels are suboptimal, parathyroid hormone is secreted by the parathyroid glands to increase bone production as well as intestinal absorption of calcium. Additionally, parathyroid hormone will activate calcium to mobilize calcium stores from bone. In conditions where both low vitamin D levels, excessive mobilization of bone calcium stores will lead to osteopenia and osteoporosis. Several studies have shown an alarming high rate of vitamin D deficiency in the general population. It is estimated that over one billion people worldwide have suboptimal levels of vitamin D (1-4). In a recent study evaluating 75 patients with low bone-ankle arthritis, fifth metatarsal fractures, stress fractures, and stress fractures, 47% had serum 25(OH)D levels below 30 ng/mL.

The Endocrine Society categorizes vitamin D status into sufficient, insufficient, and deficient levels. Sufficient levels are >30 ng/mL; insufficient levels are 21-29 ng/mL and deficient levels are <20 ng/mL. Treatment recommendations utilizing supplemental vitamin D 0.5 or D3 is based on vitamin D status (Table 1). Vitamin D insufficiency is associated with good outcomes, while patients with vitamin D deficiency are more likely to have complications. Vitamin D therapy is particularly helpful in postoperative outcomes.

Table 1. Classification and Treatment Recommendations Based on Serum 25(OH)D Levels

- Sufficient: >30 ng/mL
- Insufficient: 21-29 ng/mL
- Deficient: <20 ng/mL

Table 2. Bone Health Screening Protocol

On admission:
- Drug history
- Family history
- Review of vitamin D deficiency, if any

Preoperative:
- Bone density
- vitamin D levels
- Blood work
- Physical examination
- Patient Questionnaire
- Nutritional assessment

Preoperative bone health assessment identified age and family history of osteoporosis as risk factors with no prior vitamin D screening. 25(OH)D levels were 20 ng/mL indicating insufficient levels.

Plain radiographs of a 70-year-old female demonstrating severe degenerative joint disease of the first metatarsophalangeal joint and severe flat foot deformity. Vitamin D deficiency was confirmed with insufficient 25(OH)D levels. The patient was treated with 2000 IU D3 daily immediately following abnormal lab testing. Surgery was not delayed and osteoporosis was demonstrated by plain radiographs. Vitamin D deficiency does not necessitate delaying surgery if vitamin D supplementation is implemented in a timely and appropriate dosage during bone healing.

CASE SERIES:
A case series is presented to illustrate a standardized protocol for evaluating and managing vitamin D levels preoperatively. Bone health screening questions and assessments, with a focus on chief chief issues is a routine component of a preoperative evaluation. Preoperative orthopedic care should also include a bone density test. Preoperative orthopedic care should include a bone density test. Preoperative orthopedic care should include a bone density test. Preoperative orthopedic care should include a bone density test. Preoperative orthopedic care should include a bone density test. Preoperative orthopedic care should include a bone density test.

Table 3. Case 2 – Preoperative Flatfoot Deformity

The patient was treated with preoperative Vitamin D levels of 20.7 ng/mL indicating insufficient status. Preoperative 25(OH)D levels were 20.7 ng/mL indicating insufficient status.

Case #2: A 56-year-old Asian female presented to clinic with progressive pain associated with flatfoot deformity and posterior talon fibular tendon dysfunction. Conservative care had been exhausted without any relief of symptomatology. A radiographic examination demonstrated severe deformity deformity with apex of medial column collapse located at the naviculo-cuneiform joint (Case 3). Operative plan included subtotal fusion and naviculo-cuneiform joint fusion. Preoperative bone health screening identified no prior vitamin D assessment. Family history was significant for osteoporosis. Age was an additional risk factor for vitamin D deficiency. Preoperative 25(OH)D levels were 17.3 ng/mL indicating deficient status. Preoperative bone density screening identified severe bone density. Vitamin D deficiency was confirmed with deficient 25(OH)D levels. The patient was treated with 2000 IU D3 daily immediately following abnormal lab testing. Surgery was not delayed and osteoporosis was demonstrated by plain radiographs. Prophylactic vitamin D supplements were started and continued for 12 weeks. Preoperative bone health screening identified no prior vitamin D assessment. Identified vitamin D deficiency factors including low vitamin D intakes, which increases risk of vitamin D deficiency due to absorption of UVB radiation by melanin. 25(OH)D levels were deficient at 17.3 ng/mL. The patient was treated with 5000 IU D3 weekly for 12 weeks and an additional vitamin D3 treatment plan was developed at follow-up visit. The patient was treated with D3 weekly for 12 weeks and an additional vitamin D3 treatment plan was developed at follow-up visit. The patient was treated with D3 weekly for 12 weeks and an additional vitamin D3 treatment plan was developed at follow-up visit. The patient was treated with D3 weekly for 12 weeks and an additional vitamin D3 treatment plan was developed at follow-up visit.

RESULTS:
Risk factors for vitamin D deficiency were identified in each of the presented cases. Suboptimal vitamin D levels were treated immediately using a standard treatment protocol. D therapy was not delayed while waiting for serum vitamin D levels to normalize and all patients progressed to osseous healing. Preoperative vitamin D levels were not routinely obtained however this should be considered for patients who demonstrate delayed healing or patients receiving weekly injections of 50,000 IU D2 for deficiency as some patients present delayed healing for up to 12 weeks. We would recommend a long-term daily supplementation and to discuss overall bone health with their primary provider.

DISCUSSION:
Optimization of bone health before osseous procedures or when treating fractures is critical. Prior to elective surgery orthopedic surgeons are recommended to consider vitamin D levels. Chronic vitamin D deficiency can lead to osteopenia and osteoporosis, a heightened awareness is needed for those undergoing elective orthopedic procedures. Vitamin D deficiency is associated with patients for recent fractures or those undergoing elective osteostomy or fusion. A standard screening protocol for identifying risk factors, testing serum vitamin D levels when indicated, and treating deficient levels appropriately would be valuable tool for the surgeon. Not all patients need serum levels checked or supplementation to determine vitamin D status. All patients need serum levels checked or supplementation to determine vitamin D status. All patients need serum levels checked or supplementation to determine vitamin D status. All patients need serum levels checked or supplementation to determine vitamin D status. All patients need serum levels checked or supplementation to determine vitamin D status. All patients need serum levels checked or supplementation to determine vitamin D status.

Preoperative patients need to be carefully screened for suboptimal bone health. Patient questionnaires should focus on risk factors for vitamin D deficiency, osteomalacia, and vitamin D status. Vitamin D deficiency is associated with patients for recent fractures or those undergoing elective osteostomy or fusion. We recommend a long-term daily vitamin D3 treatment plan. Our routine is to screen for bone health risk factors in all new patients using a standardized intake history form. The shared medical record is also helpful from this regard. Annual screening is indicated at the point of the consultation rather than when surgery is being scheduled, as part of our fracture care process and at preoperative visits. One population that needs extra attention involves those who enter the system on an emergency basis and undergo surgery without the usual preoperative work up afforded to elective surgery patients. These patients need special attention to their bone health assessment during hospital admission or an early postoperative visit. We have noted that preoperative testing patients with risk factors, if osseous procedures and fracture care planned.

Patients with suboptimal vitamin D levels are treated based on recommended supplementation. The goal of postoperative treatment is to optimize bone health in patients with suboptimal levels undergoing elective foot and ankle procedure or fracture care. Our routine is to proceed with surgical intervention rather than delaying surgery while waiting for serum levels to normalize. Interestingly, we have encountered a high rate of union with concomitant surgery and treatment of vitamin D deficiency. This case series is intended to highlight our current practices yet further research is needed to evaluate the consequences of D deficiency and preoperative supplementation on osseous procedures and fracture healing of the foot and ankle.

REFERENCES: