

# Does Arthrodesis in the Foot Need to be Delayed Due to Low Vitamin D Level: A Retrospective Study of Concomitant Treatment of Hypovitaminosis

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## STATEMENT OF PURPOSE

The role of vitamin D has been demonstrated in osteoporosis and pathologic fractures, but there are limited studies on the impact of vitamin D regarding healing of arthrodesis procedures. Our routine is to identify and treat patients with hypovitaminosis D peri-operatively rather than waiting to order vitamin D levels after a nonunion is established. The purpose of this retrospective case control study is to assess fusion rates of the 1<sup>st</sup> metatarsal phalangeal joint (1<sup>st</sup> MTPJ), 1<sup>st</sup> tarsometatarsal joint (1<sup>st</sup> TMTJ), and subtalar joint (STJ) with stratified pre-operative vitamin D levels and concomitant peri-operative supplementation.

## LITERATURE REVIEW

In conditions of chronic low vitamin D levels, excessive mobilization of bone calcium stores will lead to osteopenia and osteoporosis (1). Several studies have identified the high rate of vitamin D deficiency in the general population (2). In 2014, Smith evaluated 75 patients presenting with low-energy ankle fractures, fifth metatarsal fractures, or stress fractures, and 47% of patients had serum 25(OH)D levels below 30 ng/dl (3). Moore in a 2017 study reviewing 29 patients who had foot and ankle arthrodesis procedures found that patients with vitamin D deficiency or insufficiency were 8.1 times more likely to experience a non-union (4).

The measurement of 25(OH)D is recommended to measure vitamin D levels (5). The Endocrine Society categorizes vitamin D status into sufficient (>30 ng/ml), insufficient (20-29 ng/ml), and deficient levels (<20 ng/ml) (Table 1) (6). Supplementation recommendations is based on vitamin D status (Table 1).

## METHODOLOGY AND PROCEDURE

**Lab Screening and Treatment Protocol:** Patients undergoing 1<sup>st</sup> MTPJ, 1<sup>st</sup> TMTJ and STJ fusion completed a bone health assessment questionnaire (Figure 1). A serum 25-hydroxyvitamin D level was drawn within three months of surgery. The serum 25(OH)D level of each case was recorded in one of three categories: sufficient (> 30 ng/dl), insufficient (20-29 ng/dl), and deficient (10-19 ng/dl). Patients with sufficient levels are not given any supplementation peri-operatively. Patients with insufficient levels are recommended over the counter supplementation of 2,000 IU D3 daily. Patients with deficient levels are prescribed 50,000 IU D2 weekly x 12 weeks plus 2,000 IU D3 daily. Surgery is only delayed with deficient levels < 10 ng/dl pending 12 weeks of 50,000 IU D2 weekly plus 2,000 IU D3 daily followed by a repeat course if levels have not improved (Figure 2).

**Operative Technique:** Joint preparation for fusion consisted of curette and bur for all three arthrodesis procedures. The 1<sup>st</sup> MTPJ was fixated with a compression screw and dorsal locking plate. The 1<sup>st</sup> TMTJ and STJ were fixated with two compression screws (Figure 3).

**Study Methodology:** A retrospective review was performed of 100 cases of foot arthrodesis from 2017-2019 including 1<sup>st</sup> MTPJ, 1 TMTJ, and STJ fusion. Cases were categorized as "insufficient" or "deficient" vitamin D levels when compared to cases with "sufficient" vitamin D levels regarding 10 week fusion rates.

Vitamin D Status	Serum 25(OH)D Value	Supplementation Recommendation
Sufficient	>30 ng/ml	No Supplementation needed
Insufficient	20-29 ng/ml	2000 IU D3 daily
Deficient	<20 ng/ml	50,000 IU D2 weekly x 12 weeks plus 1500-2000 IU D3 daily

Categories and supplementation recommendations were established by the Endocrine Society 2011 Clinical Practice Guideline

**Figure 1. Bone Health Screening Protocol**

Have you ever been diagnosed with:

Osteoporosis/Osteopenia	Yes	No
Vitamin D Deficiency	Yes	No
Celiac Disease	Yes	No
Thyroid Disease	Yes	No
Parathyroid Disease	Yes	No
Kidney Disease	Yes	No

Race (Please circle one):

American Indian or Alaskan Native
Black or African American
White
Native Hawaiian or Pacific Islander
Asian

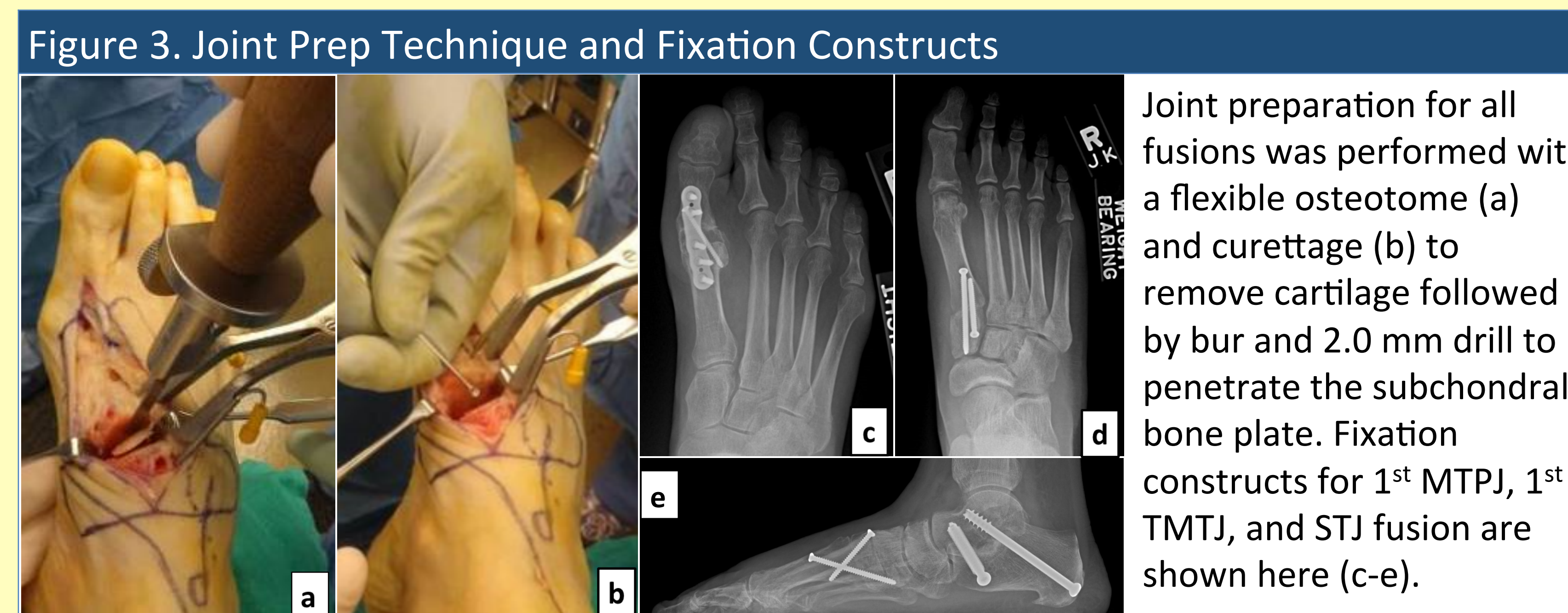
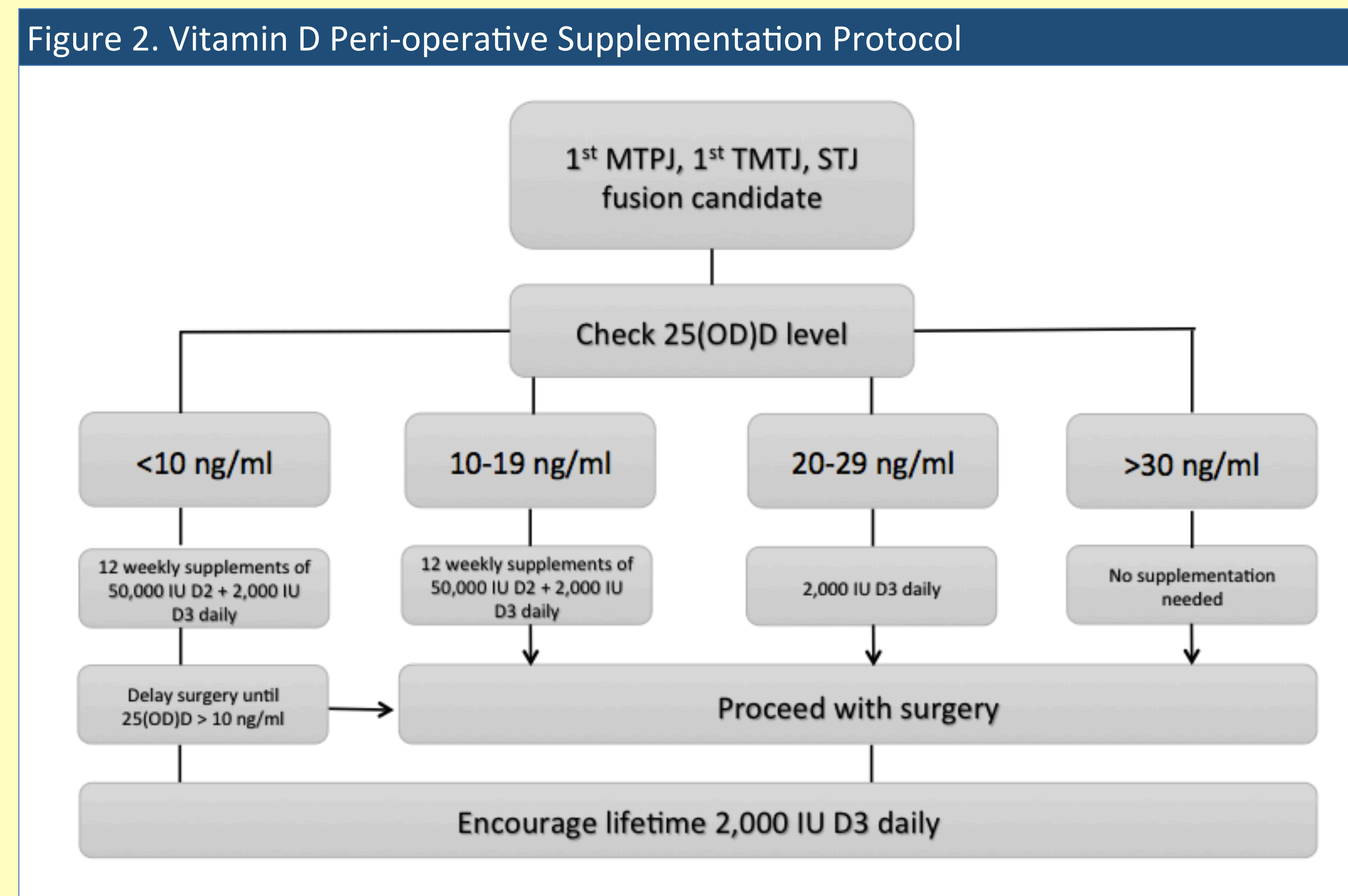
If you are a woman, are you post-menopausal?  
Yes No

Do you currently take:

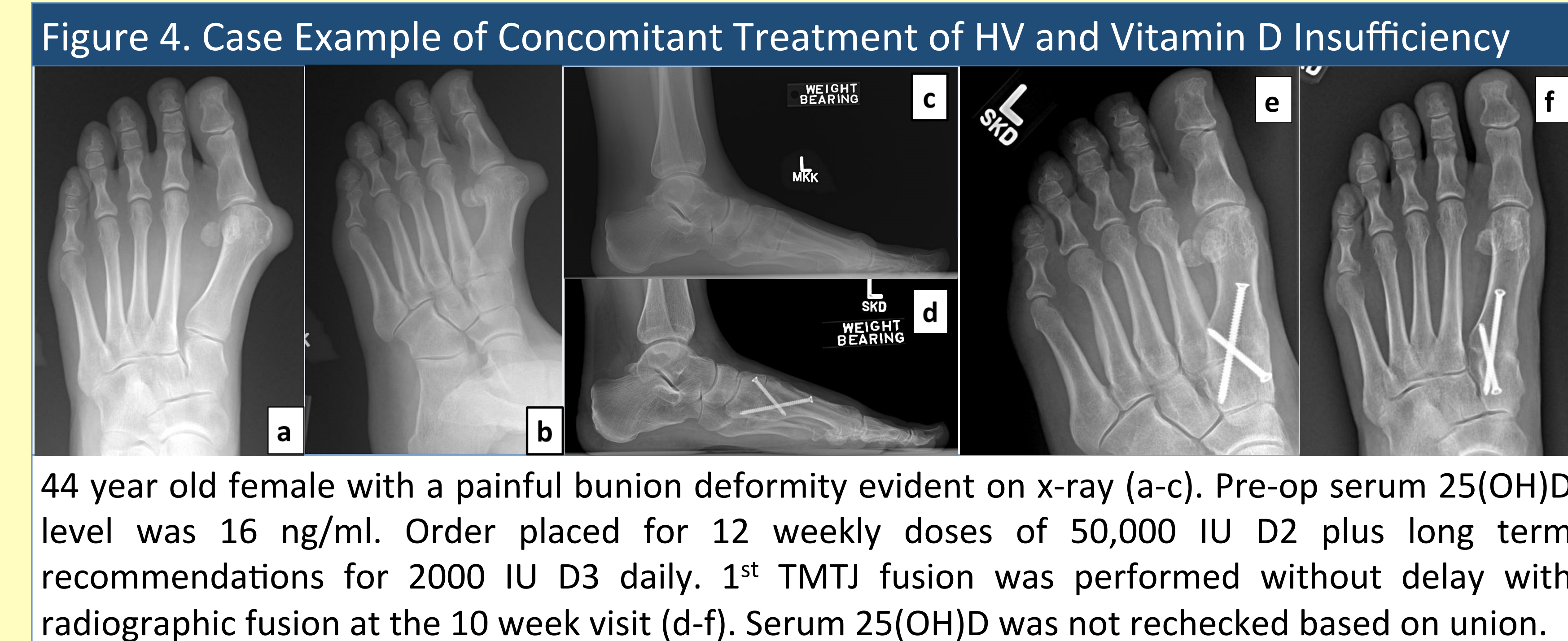
Daily multivitamin	Yes	No
Calcium supplements	Yes	No
Vitamin D supplements	Yes	No
Steroid medication	Yes	No
Anti-seizure medication	Yes	No

Have you ever had your vitamin D level checked?  
Yes No  
If yes, what were the results?

Have you ever had a DEXA scan?  
Yes No  
If yes, what were the results?



Group	Ave. age (range)	Ave. BMI (range)	Gender	Fusion Procedure
Sufficient	57.4 (19-81)	30.1 (24-35)	12 M 53 F	27 MTPJ 27 TMTJ 11 STJ
Insufficient	55.0 (28-72)	29.6 (27-38)	4 M 19 F	4 MTPJ 16 TMTJ 3 STJ
Deficient	60.8 (44-79)	29.4 (24-35)	2 M 10 F	4 MTPJ 7 TMTJ 1 STJ



## RESULTS

There were a total of 100 cases of the selected foot arthrodesis procedures. 65 cases had sufficient vitamin D levels with a 94% (61/65) 10-week fusion rate. 23 cases were vitamin D insufficient and had a 96% (22/23) 10-week fusion rate. 12 cases were vitamin D deficient >10 ng/dl with a 92% (11/12) 10-week fusion. In the vitamin D sufficient group, there were three delayed unions (beyond 10 weeks) and one nonunion that required revision. There was one delayed union in each of the insufficient and deficient groups. By 14 weeks post-operatively all 35 cases in the insufficient and deficient groups achieved radiographic fusion.

Group	n	10-week fusion rate	14-week fusion rate	P<0.05
Sufficient (>30 ng/ml)	65	94% (61/65)	98% (64/65)	Control
Insufficient (20-29 ng/ml)	23	96% (22/23)	100% (23/23)	No stat. sig. diff.
Deficient (10-19 ng/dl)	12	92% (11/12)	100% (12/12)	No stat. sig. diff.

## ANALYSIS AND DISCUSSION

In this study, 35% of cases were found to have hypovitaminosis D. Surgery was not delayed while waiting for serum vitamin D levels >10 ng/dl to normalize. There was no statistically significant difference in healing rates, and all with hypovitaminosis progressed to osseous healing, suggesting that delaying surgery is not needed to maintain high fusion rates. One case of a nonunion occurred in the sufficient group, in a patient with hypothyroidism who healed successfully after revision surgery. Post treatment vitamin D levels were not routinely obtained; however, this should be considered for patients who demonstrate delayed healing as some patients need a second course at prescription dosage. It remains unknown if no supplementation in these groups would produce poor healing rates. We also selected fusion procedures that have a high fusion rate and these results may not be applicable to ankle or talonavicular fusion.

## REFERENCES

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