

Original Research Article

Does vitamin D3 supplementation improve medial joint space narrowing in patients with osteoarthritis knee

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ABSTRACT

Background: Although vitamin D3 levels are known to improve pain and knee function in patients with knee OA, no clear evidence is available regarding relation between improvement in medial joint space with improvement in vitamin D3 levels. The aim of this study was to evaluate effectiveness of vitamin D3 supplements in improving joint space in the patients with OA knee.

Methods: 100 patients with OA Knee who fulfilled inclusion criteria and consented to participate were enrolled for study. Patients of OA Knee were blinded and randomized to receive either tablet vitamin D3 or identical placebo tablet. Vitamin D3 Tab was administered in a dose of 60000U/week for 3 months in 12 doses while placebo tablets with identical dosing schedule were used for control group. The patients who received vitamin D3 tablets were allocated to case group while those receiving identical placebo tablets were grouped as controls. The vitamin D3 levels and medial joint space were assessed at baseline, 3 mo, 6mo and 1 year in both the groups.

Results: In two groups of patients of OA knee of 50 patients each vitamin D3 supplementation increased levels of vitamin D3 in case group. While no significant improvement in joint space narrowing was noted with vitamin D3 supplementation in case group. Also no significant correlation was observed between vitamin D3 levels and medial joint space narrowing.

Conclusions: There was no improvement in medial knee joint space with vitamin D3 supplementation.

Keywords: Osteoarthritis, Knee, Vitamin D3, Medial joint space

INTRODUCTION

Osteoarthritis (OA), also known as degenerative joint disease, primary OA, wear-and-tear arthritis, or age-related arthritis, is a leading cause of disability in the US and worldwide.¹ Although the disease pathophysiology is still poorly understood and is still under investigation, it is accepted that knee OA is multifactorial in origin. Whereas both inflammatory and biomechanical whole-organ disease processes play an important role, knee OA is also influenced by a combination of factors, including family history, age, obesity, diabetes, synovitis, systemic inflammatory mediators, innate immunity, lower limb

alignment (Genu valgum and Genu varum), joint shape and dysplasia, trauma, and inflammation by metabolic syndromes. Regardless of the underlying mechanism, OA implies articular cartilage damage, bony osteophyte formation, and sclerosis of the subchondral bone, and in advanced cases, subchondral cyst formation can be seen pathologically. Several factors, such as obesity, age, ethnicity, trauma and vitamin D deficiency, have been shown to play a role in the development as well as progression of OA Knees. Meanwhile, exploring the role of vitamin D is more important because improving vitamin D deficiency may confer additional benefits in

relation to several aspects of the elderly's life, such as osteoporosis, muscle strength, and fall prevention.²

So far, the association between vitamin D3, and incidence and progression of radiographic OA knee has been investigated in many interventional and observational studies, but the results are inconsistent and do not lead to a single conclusion. Hence the present study was carried out with aim to evaluate effectiveness of vitamin D supplements in improving joint space in the patients with OA knee.

METHODS

This prospective, double-blind, randomized controlled study was conducted at outpatient department (OPD) of department of orthopaedics at a tertiary care institute over a one year (2019-20) period. The study was initiated after approval from Institutional Ethics Committee. 100 patients with OA knee who fulfilled inclusion criteria and consented to participate were enrolled for study. It was a single blinded randomized study (block randomisation) where patients of OA Knee were blinded and randomized to receive either tablet Vitamin D3 or identical placebo tablet. Vitamin D3 tablet was administered in a dose of 60000 U/week for 3 months in 12 doses while placebo tablets with identical dosing schedule were used for control group. The patients who received vitamin D3 tablets were allocated to case group while those receiving identical placebo tablets were grouped as controls.

While patients with features of OA Knee as per American College of Rheumatology (ACR) criteria, Radiological Kellgren Lawrence (KL) grades 1 and 2 and Serum Vit D3 <40ng/ml were included; patients already receiving daily supplementation of vitamin D3, calcium, drugs interacting with effects of vitamin D3, steroids, diseases like lymphoma, sarcoidosis, tuberculosis, hyperparathyroidism, malabsorption disorders, GFR<30, history of inflammatory joint disease, and pregnancy, and not willing to participate were excluded. Vitamin D3 tablet was administered to case group in a dose of 60000U/Week X3 mo. in 12 doses while identical looking placebo tablets with identical dosing schedule were used for control group.

Medial joint width of knee joints was measured on weight bearing PA Knee radiography in 30° flexion of both knees with both patellae pressed against the erect Bucky, containing imaging plate.

The postero-anterior X-ray beam was directed parallel to the tibial plateau at a 10° caudal beam alignment. The position of the knee and foot was similar for all subjects.

The distance between the X-ray tube, the imaging plate and the knee was also kept constant in all subjects. All radiographs were obtained by the same radiographer and analysed for medial joint space width by the same person.

Outcome assessment

While Vit D3 levels were measured in both groups at baseline, 3 months, 6 months and 1 year follow up, medial joint space measurements were done on weight bearing radiographs both knee joints at base line and subsequent follow-ups.

Statistical analysis

Data were expressed as frequency, percentage, median, and interquartile range (IQR). Normality of data was assessed using Shapiro Wilk test. Categorical variables were compared using Chi square test. Skewed data were compared using Mann Whitney U test. P value <0.05 was considered significant. Statistical analysis was performed using Statistical package for social sciences (SPSS) version 21.

RESULTS

In two groups of patients of OA Knee of 50 each age of the cases was comparable to the age of the controls (49.38 (42.0, 57.25) version 47.50 (38.75, 55.00); while male /female ratio was 1:3 and 1:4 respectively (Table 1).

Table 1: General patient characteristics (n=100).

	Cases (n=50)	Controls (n=50)	P value
Age (years)	47.50 (38.75, 55.00)	49.38 (42.0, 57.25)	0.205
Sex (M:F), n	13:37	10:40	0.476
Type of knee OA			
Bilateral	20	21	0.971
Left	15	14	
Right	15	15	

Data expressed as Frequency (Percentages); #Chi Square test

Table 2: Comparison of vitamin D3 levels between case and controls.

	Cases (n=50)	Controls (n=50)	P value
Baseline	13.20 (9.90, 21.25)	15.95 (11.60, 20.75)	0.657
3 Months	79.85 (70.45, 88.97)	33.20 (27.87, 37.57)	<0.0001
6 Months	75.05 (65.80, 85.00)	28.70 (23.20, 33.60)	<0.0001
12 Months	71.40 (61.25, 80.80)	24.95 (18.95, 29.25)	<0.0001

Data expressed as median [IQR]; #Mann-Whitney U test T

41% of the patients had bilateral knee osteoarthritis while 30% of the patients had right knee osteoarthritis, type of knee osteoarthritis being comparable between cases and controls.

Table 3: Comparison of medial joint space of knee joint between case and controls (n=100).

	Cases (n=50)	Controls (n=50)	P value
Baseline	4.10 (3.80, 4.90)	4.05 (3.50, 4.90)	0.694
3 Months	4.10 (3.80, 4.90)	4.05 (3.50, 4.90)	0.694
6 Months	4.10 (3.80, 4.82)	4.05 (3.50, 4.90)	0.725
12 Months	4.10 (3.80, 4.82)	4.05 (3.50, 4.90)	0.694

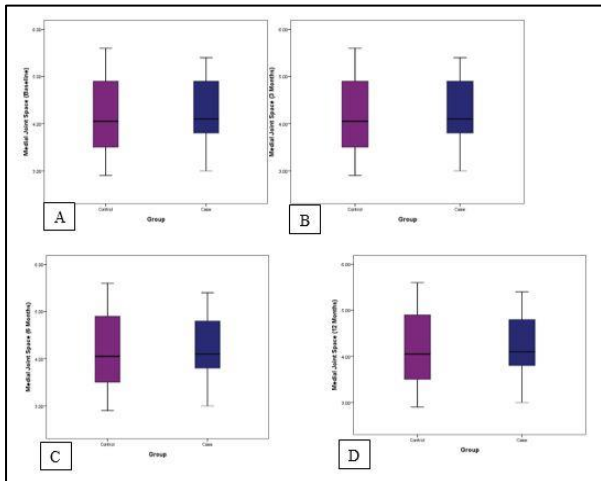


Figure 1: Comparison of median joint space between case and controls (n=100). (A) Baseline. (B) 3 Months. (C) 6 Months. (D) 12 Months.

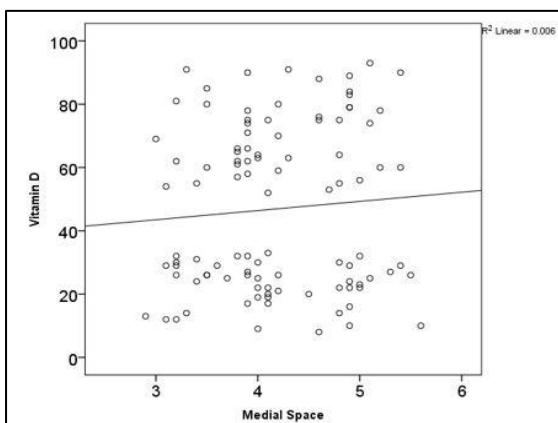


Figure 2: Relationship between Vit D3 and medial joint space showing no correlation.

At baseline vitamin D3 levels were comparable between both groups. We also observed that with time, there was

significant increase in vitamin D3 in cases in comparison with controls ($P < 0.0001$) (Table 2). Our study observed baseline vitamin D3 levels were comparable in controls in comparison to cases at baseline (15.95 (11.60, 20.75) versus 13.20 (9.90, 21.25); $P = 0.657$). With Vitamin D3 supplementation Vit D3 levels increased in cases; at 3 months (79.85 versus 33.20 ; $P < 0.0001$), 6 months (75.05 versus 28.70; $P < 0.0001$), and 12 months (71.40 versus 24.95; $P < 0.0001$). Hence Vitamin D3 levels in cases were significantly higher in comparison to controls following vitamin D3 supplementation at 3 months, 6 months and one year follow up.

Medial joint space of knee was comparable in both groups at baseline 3 months, 6 months and 12 months follow up (Figure 1, Table 3). Our study observed that there was no significant correlation between improvement in vitamin D3 levels and medial joint space (Figure 2).

DISCUSSION

Bones play central roles in the pathology of joint degeneration. Subchondral bone sclerosis, joint space narrowing, osteophyte formation, and loss of bone contours are evaluated using the Kellgren-Lawrence grading system for assessment of osteoarthritis and reflect the severity of joint changes via radiography. Literature has shown many studies analyzing influence of vitamin D on radiological OA.

Studies have shown association between decreased vitamin D levels and decreased cartilage thickness.³ Decrease in femoral cartilage thickness was noted with deficiency in vitamin D levels in females between 20 to 45 year age group while increase in osteoarthritis hip with decreased vitamin D levels was noted in another study.^{4,5} Similarly increase in hip and knee arthritis prevalence was noted on radiological analysis in patients with vitamin D deficiency in another study.⁶

Hence these studies have shown us that an association did exist between decreased vitamin D levels and hip, knee arthritis secondary to cartilage loss.

Based on these observations, our aim in the present study was to see if vitamin D supplementation decreased the radiological progression of OA, and/or restored cartilage thickness.

Studies from literature looking at increased vitamin D serum levels as a way to decrease the risk for OA have been inconclusive.⁷ Conversely some studies showed that increased vitamin D serum concentrations were associated with an increased risk of hip arthroplasty for men with OA.⁸ Similarly another study involving 413 participants with oral supplementation of vitamin D3 did not report any significant clinical or cartilage volume structural differences in patients who were previously vitamin D deficient.⁷ No significant difference has been

noted in rate of joint space narrowing in medial compartment of knee and vitamin D supplementation.⁹ Al-Jarallah et al assessed serum vitamin (25-OH) D relation with radiological grading in knee OA and reported that the level of 25(OH)D was not related to the severity of the knee X-ray grading. Similar findings have been reported by Muraki et al.^{10,11}

Observations from our study also reported that there was no significant improvement in medial joint space knee cartilage thickness with vitamin D3 supplementation. Supplementation with vitamin D3 over the period of 3 months and followed up to one year did not show an improvement (change from higher to lower grade) in radiological severity of OA.

Although some side effects of Vit D in the form of safety of vitamin D3 supplements in the form of digestive distress such as vomiting, nausea, stomach pain, diarrhea, thirst, and constipation have been reported in literature, no such events were reported in our study.

Limitations

In the present study different dose and duration effects of vitamin D3 supplements have not been analysed. Here 60,000 units of vitamin D3 were given weekly to cases for a period of 3 months. Weekly dosing effects of vitamin D3 supplements on OA were also not investigated.

CONCLUSION

Although studies have shown association between decreased vitamin D3 levels and decreased articular cartilage thickness, not much evidence is available to show decrease in radiological progression of OA Knees with vitamin D supplementation. In the present study also there was no improvement in joint space with vitamin D supplementation. Multi-centeric studies with large sample size are required to assess the association between vitamin D supplementation and improvement in articular cartilage thickness.

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Conflict of interest: None declared

Ethical approval: The study was approved by the institutional ethics committee

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