Lower vitamin D levels in knee arthroplasty candidates as compared with lumbar spondylosis patients

Mustafa Yassin¹, Avraham Garti¹, Muhammed Khatib¹, Moshe Weisbrot¹, Nidal Issa², Dror Robinson¹,*

¹Department of Orthopaedic Surgery, Hasharon Hospital, Rabin Medical Center, affiliated with the Tel Aviv University Medical School, Tel Aviv, Petah Tikva, Israel
²Department of Surgery B, Hasharon Hospital, Rabin Medical Center, affiliated with the Tel Aviv University Medical School, Tel Aviv, Petah Tikva, Israel

1. Introduction

Vitamin D insufficiency and deficiency appear to be common in Israel.¹⁻³ Osteoarthritis has been associated with vitamin D deficiency in middle-eastern populations.⁴ While vitamin D deficiency seems to be prevalent in middle-eastern osteoarthritic individuals, the vitamin D levels are not associated with disease severity or knee function.⁵ It has been suggested that vitamin D supplementation should be included in the

Purpose: Low Vitamin D levels are common in adult Middle-Eastern populations as well as in patients with knee osteoarthritis. The current study was designed in order to assess whether vitamin D levels are different in patients with two types of osteoarthritis.

Methods: A prospective, non-randomized observational study of two groups was performed. Patients with severe knee osteoarthritis requiring knee replacement (n = 38) were compared to a control group of osteoarthritic patients suffering from lumbar spondylosis (n = 24). KOOS pain subscale scores were used to evaluate knee related pain, and imaging studies were used to define the arthritic process of the knees. Lumbar CT scans were available for most patients.

Results: The study results indicate that vitamin D insufficiency is common in both populations. However vitamin D levels were lower in the knee osteoarthritic patients than in the lumbar spondylosis patients. Low vitamin D levels correlate with worse pain in arthroplasty candidates but not in lumbar spine osteoarthritic patients.

Conclusions: The current study appears to indicate that vitamin D abnormalities are common in both types of osteoarthritis evaluated but are more severe in knee arthroplasty candidates and in this group are related to the pain severity levels.

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treatment algorithm of early knee osteoarthritis, as it might be preferable to long-term anti-inflammatory intake. Vitamin D supplementation appears to be important in improving prognosis of both osteoporosis and osteoarthritis according to some reports. The current cohort evaluation was performed in order to assess whether the evaluation of vitamin D levels is imperative in the evaluation of patients with severe knee osteoarthritis in an Israeli population.

2. Methods

This was a prospective, non-randomized observational study of two groups. Two groups of patients were evaluated: the first group of 38 consecutive patients scheduled for total knee arthroplasty was assessed for levels of knee pain using the KOOS pain subscale. A control group, consisting of 24 patients with lumbar spondylosis and spinal stenosis presenting with thigh and knee pain, was evaluated as well. Vitamin D levels were assessed in both groups as part of the routine clinical assessment.

Inclusion criteria were: 1. Age between 45 and 70 years, 2. Availability of standing knee radiographs, 3. Lack of evidence for sciatica.


Vitamin D levels were assessed in a single lab. Blood withdrawal was performed following a12-h overnight fast. Vitamin D levels were classified according to the WHO classification as normal (>30 ng/ml), inadequate (<29 ng/ml, with levels of 10–29 ng/ml classified as insufficiency) and deficient levels (<10 ng/ml).

KOOS questionnaires were routinely administered as part of the clinical assessments of arthroplasty candidate patients. Standing knee radiographs were obtained for all patients. Knee radiography was performed in a single institute according to a routine protocol with a constant (1 m) distance of the knee from the cathode. This allowed assessment in a blinded fashion of the Kelgren Lawrence grade of the radiographs. The radiographic assessment of the control group was performed as part of the routine assessment of thigh and buttock pain.

2.1. Statistical analysis

Results are expressed as mean ± standard deviation. Statistical evaluation was performed using the Student’s t-test for continuous variables and the Mann–Whitney U-test for non-parametric variables. Correlation was assessed using the Spearman correlation test. Significant difference was defined at the 0.05 level.

3. Results

Demographic data of the groups are presented in Table 1. For all patients in the control group and 19 of 38 patients of the experimental group, computerized tomography of the lumbar spine was performed up to one year prior to evaluation and was available for assessment. Findings are summarized in Table 2. Degenerative discal changes were quite common in both groups.

Radiographic findings are described in Table 2. All patients in the experimental group had K/L grade ≥3 of at least one compartment. K/L grade of the control group averaged 0.5 ± 0.5, however no patient in the control group had K/L grade higher than 2.

Vitamin D levels below the insufficiency cut-off level were common in the osteoarthritis group (18/38 patients) while levels below the deficiency cut-off level were relatively rare (5/38 patients). The mean level of vitamin D in the total knee arthroplasty candidates group was 31 ± 8 ng/ml. In the control group fewer patients had vitamin D insufficiency (8/24 patients) and no patient had vitamin D deficiency. The mean level of vitamin D in the lumbar spondylosis group was 39 ± 5 ng/ml. The intergroup difference between the percentage of individuals with levels at the insufficiency level was statistically significant (Mann–Whitney U-test, p < 0.05) as well as at the deficiency level (Mann–Whitney U-test, p < 0.05).

Intergroup difference of mean vitamin D levels was found to be significant (Student’s t-test, p < 0.05). There was no correlation between vitamin D levels and BMI (Pearson correlation coefficient, r = 0.2). KOOS pain subscale scores of patients with vitamin D levels lower than the insufficiency cut-off level averaged 33 ± 8 (18/38 patients) compared to the normal vitamin D level group (47 ± 6, 20/38 patients, Student’s

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<td>Number of subjects</td>
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<td>Age</td>
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<td>Male/female</td>
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a Student’s t-test for continuous variables. Significant difference is defined at the 5% level.

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<th>Table 2 – Lumbar CT scans and knee radiographs.</th>
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<td>Number of subjects with available scans</td>
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a Number of positive findings/total available exams.

b Mann–Whitney U-test for non-parametric variables. Significant difference is defined at the 5% level.
KOOS pain subscale score was similar in patients with lumbar spondylosis with normal vitamin D levels (73 ± 9) or below the insufficiency cut-off level (67 ± 11, Student’s t-test, n.s.).

4. Discussion

The current study indicates that vitamin D inadequacy is common in adult patients suffering from knee osteoarthritis and was not rare in a control group of patients suffering from lumbar spondylosis without significant gonarthrosis. The prevalence of vitamin D deficiency in the current study is lower than reported in other Middle-Eastern populations.\(^4,5,8\) This difference is possibly due to less common use of long clothes,\(^3\) that limit sun-light related vitamin D synthesis or to genetic differences. The prevalence was higher in patients undergoing knee prosthetic replacement than in a group with an osteoarthritic process limited to the lumbar spine. This might indicate a possible causative role of vitamin D deficiency in the progression of osteoarthritis of the knee, but not of the spine. What might be the mechanism leading to osteoarthritis progression in vitamin D deficient individuals? Vitamin D deficiency is known to increase the risk of cancer, cardiovascular disease and autoimmune disease.\(^7\) Vitamin D (\((1,25\text{OH})_2\)D) regulates cell proliferation, differentiation and apoptosis in many normal and cancer cells, and osteoarthritis is related to abnormal cell differentiation and apoptosis.\(^10\) It is well known that bone structure is abnormal in osteoarthritis, with thickening of the subchondral bone,\(^11\) that exhibits increased turnover, decreased bone mineral content and stiffness, with decreased trabecular numbers. The low vitamin D levels might also lead to subchondral insufficiency fractures and bone edema. It has been shown that increase of bone rigidity can alleviate pain related to bone edema,\(^12\) a procedure called subchondroplasty. The authors hypothesize that the pain experienced by patients that are total knee arthroplasty candidates is partially related to insufficiency fractures of the tibial plateau, due to vitamin D deficiency. Indeed, in the current study an inverse relationship between a validated pain score (KOOS pain subscale) and the vitamin D levels was found. This is similar to a report by Jansen et al who also found a high KOOS pain subscale and the vitamin D levels was found. This is an inverse relationship between a validated pain score after arthroplasty.\(^13\) In an Egyptian population it was found that as well a worse outcome for patients with low vitamin D levels after arthroplasty.\(^15\) In an Egyptian population it was found that low vitamin D levels are associated with an increased incidence of knee osteoarthritis.\(^4\) The same authors have postulated a protective mechanism of vitamin D against knee osteoarthritis, due to increased nitric oxide synthesis.\(^8\) The possible protective effect of vitamin D on knee osteoarthritis progression has led to a recommendation for vitamin D supplementation in the treatment of early knee osteoarthritis,\(^5\) particularly in patients with low bone mineral density.\(^14\) However, while vitamin D levels are commonly low in knee osteoarthritis patients, there is not a linear correlation between these levels and osteoarthritis grade or functional incapacitation.\(^6\)

In summary, the current study appears to indicate that while vitamin D insufficiency is common in osteoarthritic patients both at the spine and the knee, the levels are lower in the knee osteoarthritic patients (most of whom had degenerative changes of the lumbar spine as well) as compared to patients with spinal degenerative process without significant knee arthritis. This finding might indicate that vitamin D per se is not a cause of the osteoarthritic process, but rather low levels might lead to bone metabolism abnormalities, that worsen the prognosis of the arthritic process in a biomechanically highly loaded skeletal area. This hypothesis is supported by the known lack of correlation between hand osteoarthritis and vitamin D levels.\(^15\) The current study indicates that vitamin D levels are inversely correlated with pain levels in knee osteoarthritic patients. This might be due to the known quadriceps weakness associated with vitamin D deficiency in these patients.\(^16\)

Further research is necessary in order to assess whether vitamin D supplementation will improve post-arthroplasty results in vitamin D deficient individuals.

## Conflicts of interest

All authors have none to declare.

## References


