A study of effect of Vitamin D supplementation in Osteoarthritis patients

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Abstract

Introduction: Osteoarthritis (OA) is the common cause of musculoskeletal disability and pain. Osteoarthritis (OA) is a chronic disease characterized by a loss of articular cartilage and changes of the subchondral bone [1]. Knee is one of the most commonly affected joint. Several environmental factors including obesity, malalignment, trauma or joint instability have been associated with knee OA. Other symptoms of disease include joint pain, knee muscle wasting, and decreased range of motion, all of which lead to severe pain and disability in later life [2]. There are many risk factors that lead to early structural changes of the knee among healthy individuals. Vitamin D deficiency may play a role in the pathogenesis of OA. OA coexists frequently with vitamin D deficiency in elderly people. 63% of primary knee OA patients were found to have low vitamin D status worldwide. Lower levels of vitamin D were associated with greater knee pain, poor quadriceps function with poor physical function. Several studies have documented that vitamin D supplementation increases muscle strength, improves physical performance, and decreases risk of falls among older people with low level of serum vitamin D [3].

Materials &Methods: This present study was conducted at the outpatient clinic of the Department of Orthopedics at Maheswara Medical College & Hospital, Sangareddy during a February–December 2017 study period. The inclusion criteria were that the participants had symptomatic knee OA and low vitamin D status (25(OH)D < 30 ng/mL).

Results: Data were analyzed using SPSS Statistics version 22 (SPSS, Inc., Chicago, IL, USA). Comparison of baseline vs. post-vitamin D supplementation data was performed by paired t-test. One-way repeated-measurement ANOVA was used to test the time differences in muscle strength and physical performance. A p-value less than 0.05 for differences and the values were considered to be statistically significant. Dominant grip strength (p = 0.01) and overall physical performance, such as gait speed (p < 0.001), TUGT (p < 0.001), STS (p < 0.001), and 6MWT (p < 0.001), significantly improved after vitamin.

Conclusion: Nevertheless, vitamin D supplementation is a safe and inexpensive way to improve muscle strength and physical function in this population. Based on these findings, we recommend vitamin D supplementation in knee OA patients that have poor physical function.

Key words: Osteoarthritis, Vitamin D, articular cartilage, malalignment,
osteoarthritis via reducing the proteoglycan synthesis and increasing the metalloproteinase activity [4]. Vitamin D (ergocalciferol) was used in this study for the investigation of the role of vitamin D supplementation on muscle strength and physical performance in knee OA patients with vitamin D insufficiency [5]. Given this disparity in the previous finding regarding vitamin D supplementation in Thailand, vitamin D2 (ergocalciferol) was used in this study for the investigation of the role of vitamin D supplementation on muscle strength and physical performance in knee OA patients with vitamin D insufficiency and deficiency.

Materials & Methods

Place of the study: This present study was conducted at the outpatient clinic of the Department of Orthopedics at Maheswara Medical College & Hospital, Sangareddy during a February–December 2017 study period.

Type of study: Observational study

Sampling method: Randomly selected

Sample collection: One hundred and thirty-four patients with knee OA agreed to participate in the study.

Inclusion criteria: were that the participants had symptomatic knee OA and low vitamin D status (25(OH)D < 30 ng/mL). The diagnosis of osteoarthritis is based primarily on patient history, physical examination, and radiographic findings.

Exclusion Criteria: Exclusion criteria included history of knee surgery, primary hyperparathyroidism, rheumatoid or other inflammatory arthritis

Statistical Method: Data were analyzed using SPSS Statistics version 20. Comparison of baseline vs. post-vitamin D supplementation data was performed by paired t-test. One-way repeated-measurement ANOVA was used to test the time differences in muscle strength and physical performance.

A p-value less than 0.05 for differences and the values were considered to be statistically significant.

Results

Data were analyzed using SPSS Statistics version 20. Comparison of baseline vs. post-vitamin D supplementation data was performed by paired t-test. One-way repeated-measurement ANOVA was used to test the time differences in muscle strength and physical performance. A p-value less than 0.05 for differences and the values were considered to be statistically significant. WOMAC scores did not change significantly between baseline and six months. However, VAS decreased significantly after treatment (p = 0.004) and the PCS of SF-12 improved significantly after supplementation treatment (p = 0.005).
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Table-1: Effect of Vitamin D supplementation on Muscle Strength and Physical Performance.

| S No | Parameters                      | Baseline       | 6months        | p-value |
|------|--------------------------------|----------------|----------------|---------|
| 1    | Grip strength (kg)              |                |                |         |
|      | Dominant (kg)                   | 21.15±0.10     | 22.30±0.21     | 0.01    |
|      | Non dominant (Kg)               | 19.17±0.21     | 19.39±0.40     | 0.13    |
| 2    | Knee extension force            |                |                |         |
|      | Symptomatic leg (N)             | 351.02±5.02    | 353.43±5.32    | 0.30    |
|      | Non- symptomatic leg (N)        | 367.12±5.34    | 369.51±5.45    | 0.04    |
| 3    | Physical Performance            |                |                |         |
|      | Gait speed (m/s)                | 0.87±0.12      | 1.10±0.03      | <0.001  |
|      | TUGT (S)                        | 8.82±0.12      | 7.65±0.19      | <0.001  |
|      | STS (S)                         | 14.24±0.89     | 13.21±0.76     | <0.001  |
|      | 6 MWT (m)                       | 369±12         | 412±30         | <0.001  |

Effects on Muscle Strength and Physical Performance Dominant grip strength (p = 0.01) and overall physical performance, such as gait speed (p < 0.001), TUGT (p < 0.001), STS (p < 0.001), and 6 MWT (p < 0.001), significantly improved after vitamin D supplementation, but there were no significant difference observed for non-dominant grip strength and knee extension force between baseline and post-treatment (p > 0.05) are presented (Table 1).

Discussion

In the above study, regarding muscle strength and physical performance, we found that knee OA patients significantly improved grip strength and physical performance, but did not improve knee extension force. In this aspect, our results are consistent with the findings of several previous studies. Zhu et al. reported that hip muscle strength and TUGT improved significantly after 1000 IU/day vitamin D2 supplementation for one year in older women with vitamin D insufficiency [6]. Lagari et al. reported that vitamin D supplementation might be most beneficial in older populations with poor physical function [7].

Sato et al. found that the mean of type II muscle fiber diameter and percentage of type II fibers increased significantly after 1000 IU/day vitamin D2 treatment over two years in elderly patients with post-stroke hemiplegia [8]. Ceglia et al. reported that intra myonuclear VDR concentration increased 30% and total (type I and II) muscle fiber size increased 10% after vitamin D supplementation in mobility-limited elderly women [9]. However, some studies have reported that vitamin D supplementation did not improve muscle strength or physical function. Kenny et al. found that vitamin D supplementation did not improve muscle strength or physical performance in a group of healthy community-dwelling older men [10]. These conflicting findings may be attributed to differences in populations, disease advancement, or measurements applied, or to incomplete control of confounding variables. Nonetheless, conclusions should be drawn with caution on whether the characteristics of studied participants or the dose of vitamin D used are of significance, as these studies were heterogeneous with regards to most aspects. Various outcome measures have been documented by different investigators and even in the case of measurements of similar characteristics, different methods have been applied, making it difficult to compare studies directly. A strength of this study is the finding that a high dose and a long-term intervention of vitamin D2 supplementation was effective in raising 25(OH) D concentrations. It is possible that achieved serum 25(OH)D levels may improve muscle function by increasing muscle strength and physical performance in knee OA patients. Higher serum 25(OH)D concentrations may be essential in skeletal muscle, particularly for the elderly with limited mobility. On the other hand, increasing 25(OH)D levels in healthy populations do not relate to any improvement of muscle function.

Therefore, patients with impaired mobility may be more sensitive to the improvement in physical functioning by vitamin D supplementation. Previous studies indicated that vitamin D supplementation in the elderly with vitamin D insufficiency reduced an atrophy of type II muscle fiber and increased the size of type I and II muscle fiber, as well as VDR concentration. Actually, knee OA patients with poor muscle function and vitamin D deficiency may be the most likely to benefit from vitamin D supplementation. This study has several mentionable limitations. First, the controlled before–after design of this study did not include a control group. The lack of randomization, and our decision not to evaluate the sensitivity of drug effect, potentially weaken our findings relative to the therapeutic effect of vitamin D supplementation. Second, the sample size...
was small and the proportion of men was low, both of which prevented us from establishing the clinical relevance, particularly regarding changes in muscle strength. Third, we assayed markers of oxidative damage using plasma protein carbonyls that were not directly measured in skeletal muscle. Finally, 8.37% of patients were lost to follow-up. While this rate is higher than can be considered ideal, the loss to follow-up rate in the present study was lower than loss to follow-up rates reported from other studies.

Conclusions

In conclusion, our results suggest that 40,000 IU of vitamin D supplementation reduced oxidative protein damage, improved quality of life, and improved grip strength and physical performance. Accordingly, vitamin D treatment decreases current pain using VAS, but does not reduce pain during physical activity, as determined by WOMAC score. Vitamin D supplementation is a safe and inexpensive way to improve muscle strength and physical function in our population. Based on these findings, we can strongly recommend vitamin D supplementation in knee OA patients that have poor physical function.

Contribution by different authors during the study process - The principal author involved in conception or design of the work, data collection, data analysis and interpretation and co-author involved in drafting the article critical revision of the article.

Study adds to the existing knowledge - Vitamin D supplementation leads to reduced pain, stiffness or functional loss over a 3-year period. On the basis of these findings we consider that vitamin D supplementation has no role in the management of knee OA.

Conflict of interest: None declared.

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