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THE EFFECT OF VITAMIN D SUPPLEMENTATION ON EARLY RESULTS OF CONSERVATIVE TREATMENT OF RADIUS DISTAL FRACTURES IN ELDERLY PATIENTS*

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Abstract

Background: Radial distal fractures are common in older postmenopausal women and fractures are caused by low-energy trauma. Vitamin D deficiency is common in societies with, especially where UV exposure is reduced. This study aimed to investigate the effect of vitamin D supplementation on functional outcomes and handgrip strength in women aged 50 years and older with vitamin D deficiency.

Methods: For this purpose, 20 conservatively treated female patients aged 50 years and over who were admitted to our clinic after trauma and diagnosed as distal radius fracture were evaluated. Functional results were evaluated by DASH and Gartland Werley scores. Radiological evaluation and measurements were made on the latest radiographs. Handgrip strength was measured with the JAMAR hand dynamometer. The values obtained were evaluated according to whether or not patients received vitamin D supplementation.

Results: The mean DASH f / s scores of the patients with vitamin D supplementation were 8.36 ± 9.83; In cases without vitamin D supplementation, it was 19.50 ± 12.17. There was a statistically significant difference between DASH f / s scores ($p = 0.034$).

Conclusion: It has been shown that vitamin D supplementation positively affects functional scores after distal radius fracture in women over 50 years of age with vitamin D deficiency or insufficiency. We recommend vitamin D supplementation in these patients.

Key words: Vitamin D supplementation, distal radius fracture, older postmenopausal women, functional scores

1. INTRODUCTION

Radial distal fractures are very common. One of every six fractures admitted to the emergency department is the distal radius fracture. Especially the incidence increases between 6-10 years and 60-69 years. It usually occurs with low-energy traumas in older age and is more common in women (1). Vitamin D is a sterol-derived hormone. It has significant effects on the musculoskeletal system. It increases the type 2 fibers in the muscles and affects the fast contraction function (2). Vitamin D deficiency is a common condition. It is more common, especially in the elderly and women. In addition, due to the decrease in UV (ultraviolet) exposure, the frequency of vitamin D deficiency has increased in areas close to the poles and in some societies (3). Distal radius fractures are more common in patients with vitamin D deficiency (4,5). Functional outcomes of distal radius fractures in the elderly female population are worse than in the male population (6). It has been shown in a few studies that vitamin D supplementation positively affects grip strength in female patients (7). This study aims to investigate the effect of vitamin D supplementation on functional results and handgrip strength after distal radius fracture in elderly women with vitamin D deficiency.

2. MATERIALS AND METHODS

Conservatively treated female patients who was admitted to our clinic after trauma in the last 2 years, were screened from the hospital registry and their contact information was obtained. These patients were diagnosed with S52.5 fracture of lower end of radius, S52.6 fracture of lower end of both ulna and radius, S62.8 fracture of other and unspecified parts of wrist and hand according to ICD-10 (International Classification of Diseases 10th Revision). Patients whose Serum 25 (OH) hydroxyvitamin D levels were determined in the week following the trauma were identified. 20 patients were found to meet the study criteria and were included in the study. Female patients who were followed by closed reduction and casting, whose serum 25 (OH) hydroxyvitamin D level was below 30 μg / l measured within the week following diagnosis and fracture union detected with radiologically and clinically, were included in the study. Patients who were not followed-up regularly, who had a history of fracture on the same side, who had a disease affecting vitamin D metabolism, and who had a systemic disease affecting wrist functional scoring or handgrip were excluded from the study.

Patients were divided into two groups as vitamin D supplementation and non-vitamin supplementation. Demographic characteristics, PTH levels, grip strength, functional results, radiological results and range of motion of the patients were measured. The effect of vitamin D supplementation on the results was investigated. In addition, the relationship between radiological scores and functional outcomes was examined. Patients with 25 (OH) hydroxyvitamin D 20-30 ng / ml were supplemented with vitamin D_3 at 1500-2000 IU / day. Patients with 25 (OH) hydroxyvitamin D values below 20 ng / ml were given 50000 IU vitamin D once a week for 8 weeks as a loading dose. Subsequently, vitamin D_3 supplementation was performed at 1500-2000 IU / day (8).

Grip strength measurements were performed with JAMAR PLUS® (JAMAR PLUS + Hand Dynamometer, Patterson Medical, Sammons Preston, Paterrson Company Remington Blvd, Bolingbrook, Illinois) recommended by the American Society of Hand Therapists (ASHT). Handgrip was measured in sitting position, shoulder adduction and neutral rotation, elbow 90-degree flexion, forearm mid rotation and wrist neutral. The measurements were made in pounds (lb) and the arithmetic means were taken 3 times with one minute intervals. The results were compared with normal values to determine how much grip strength was recovered (9).

Functional results of the patients were evaluated by DASH (Disabilities of the Arm, Shoulder and Hand) score (10) and Gartland and Werley score (11). DASH function / symptom score was calculated with the formula as [(n total score / n) -1)] x 25; (n represents the number of questions answered). DASH scores were calculated over 100 points. 0: no disability, 100 was considered as the maximum disability (10). DASH score is subjective and Gartland Werley score is based on both objective and subjective evaluations (10,11).

Radial length loss, radial inclination and volar angulation were measured to evaluate radiological results. Stewart score was calculated using these measurements. Stewart score was calculated from the last dorsal angulation degree of the patient on the last control radiography. Radial length loss and radial angulation loss were calculated from the last control radiography of the patient, compared with the contralateral radiography, and based on the mean values if the contralateral radiograph was not available. Stewart score was defined as excellent if the total result value was 0, good between 1-3, fair between 4-6, poor between 7-12 (12). The fractures were classified as type A, type B and type C according to AO / OTA (Arbeitsgemeinschaft fuer Osteosynthesfragen / Orthopedic Trauma Association) classification. The range of motion of the patients was evaluated with the help of a goniometer by measuring the degree of flexion, extension, ulnar deviation, radial deviation, pronation and supination.

The effect of radiological results on functional results was examined by correlating the Stewart score with DASH score and the Stewart score with Gartland Werley scores.

Statistical Analysis

For statistical analysis, NCSS (Number Cruncher Statistical System) 2007 & PASS (Power Analysis and Sample Size) 2008 Statistical Software (Utah, USA) program was used. The Mann Whitney U test was used for comparison of the two groups of non-normally distributed parameters in the comparison of the quantitative data as well as descriptive statistical methods (mean, standard deviation, median, frequency, ratio, minimum, maximum). Fisher's Exact Test was used to compare qualitative data. Spearman’s Correlation Analysis was used to evaluate the relationships between the parameters. Significance was evaluated at $p < 0.01$ and $p < 0.05$.

3. RESULTS

The study was conducted with 20 women between November 2012 and November 2014 who have vitamin D supplementation (n = 10) and without vitamin D supplementation (n = 10). The age of the patients ranged from 53 to 92 years with a mean of 66.70 ± 10.92 years. The follow-up period ranged from 190 to 613 days with a mean of 370.35 ± 122.73 days. The time for fracture healing ranged from 22 to 39 days, with an average of 31.30 ± 5.33 days. The dominant hand of all cases was the right side; The right side of 50% (n = 10) and the left side of 50% (n = 10) were broken. According to AO classification, 65% (n = 13) fractures are Type A (extra-articular) fractures, while 35% (n = 7) are Type B + C (intraarticular) fractures. The mean vitamin D levels of the patients with vitamin D supplementation were 15.80 ± 8.39 µg / l. In cases without vitamin D supplementation, it was 8.23 ± 3.01 µg / l. The mean age of the patients with vitamin D supplementation was 69.30 ± 12.06 years. In cases without vitamin D supplementation 64.10 ± 9.55 years. There was no statistically significant difference between the mean age of the patients according to vitamin D supplementation (p = 0.426).

The mean body mass index of the patients with vitamin D supplementation was 27.57 ± 5.61 kg / m^2; In cases without vitamin D supplementation, it was 28.90 ± 3.28 kg / m^2. According to vitamin D supplementation, there was no statistically significant difference between the mean body mass index (p = 0.472). The mean follow-up period was 363 ± 135.28 days for vitamin D supplementation. In cases without vitamin D supplementation, 377.70 ± 115.67 days. There was no statistically significant difference between follow-up periods according to vitamin D supplementation (p = 0.650). The mean fracture union time of vitamin D supplementation was 30.70 ± 4.88 days. In cases without vitamin D supplementation, it was 31.90 ± 5.95 days. There was no statistically significant difference between the duration of union in terms of vitamin D supplementation (p = 0.649). The mean PTH levels of vitamin D supplementation were 58.74 ± 29.34 pg / ml; It was 84.34 ± 86.90 pg / ml in patients without vitamin D supplementation. No statistically significant difference was found between PTH levels of vitamin D supplementation (p = 0.364). The mean grip strength was 37.17 ± 10.75 lb in patients with vitamin D supplementation; In cases without vitamin D supplementation, it was 37.83 ± 6.07 lb. According to vitamin D supplementation, there was no statistically significant difference between grip strength (p = 0.545). The percent power gain was 73.17 ± 10.12 in the patients who had vitamin D supplementation; In cases without vitamin D supplementation, it was 73.25 ± 17.25. No statistically significant difference was found between the percent strength gains in vitamin D supplementation (p = 1,000). The mean DASH f / s scores of the patients with vitamin D supplementation were 8.36 ± 9.83; In cases without vitamin D supplementation, it was 19.50 ± 12.17. There was a statistically significant difference between DASH f / s scores according to vitamin D supplementation (p = 0.034). DASH f / s scores of patients who had vitamin D supplementation were significantly lower than those without vitamin D supplementation. The mean DASH score of the patients who had vitamin D supplementation was 6.25 ± 11.57; In cases where vitamin D supplementation was not performed, it was 20.35 ± 15.24. There was a statistically significant difference between DASH work scores of patients with vitamin D supplementation (p = 0.022). DASH work scores of patients who had vitamin D supplementation were significantly lower than those without vitamin D supplementation. The mean Gartland Werley scores of vitamin D supplementation were 1.50 ± 2.76; 90% (n = 9) were excellent and 10% (n = 1) were moderate. The mean Gartland Werley scores of the patients without vitamin D supplementation were 3.10 ± 3; 50% (n = 5) were excellent and 50% (n = 5) were good. No statistically significant difference was found between Gartland Werley scores according to vitamin D supplementation (p = 0.196). The mean Stewart scores of vitamin D supplementation were 0.80 ± 1.62; 70% (n = 7) were excellent, 20% (n = 2) were good and 10% (n = 1) were moderate. The mean Stewart scores of the patients without vitamin D supplementation were 0.70 ± 1.25; 60% (n = 6) were excellent, 30% (n = 3) were good and 10% (n = 1) were moderate. No statistically significant difference was found between the Stewart scores of vitamin D supplementation (p = 0.824). The mean radial inclination measurements of vitamin D supplementation were 23.4 ± 3.9; In cases without vitamin D supplementation, it was 22.6 ± 4.3. No statistically significant difference was found between the radial inclination measurements of vitamin D supplementation (p = 0.618). The mean radial length measurements of vitamin D supplementation were 11.4 ± 1; In cases without vitamin D supplementation, it was 10.4 ± 2. No statistically significant difference was found between the radial length measurements of vitamin D supplementation (p = 0.214). The mean volar angulation measurements of vitamin D supplementation were 1.3 ± 13.9; It was 2.7 ± 7.8 in patients without vitamin D supplementation. No statistically significant difference was found between volar angulation measurements of vitamin D supplementation (p = 0.820). The mean flexion degrees of the patients with vitamin D supplementation were 66 ± 7; In cases where vitamin D supplementation was not performed, it was 67 ± 9. No statistically significant difference was found between flexion degrees according to vitamin D supplementation (p = 0.969). Extension degrees of vitamin D supplementation were 68 ± 13; In cases without vitamin D supplementation, it was 61 ± 8. According to vitamin D supplementation, no statistically significant difference was found between the extension degrees of the cases (p = 0.061); Remarkably, the extension degrees of the vitamin D supplementation cases were higher. Ulnar deviation degrees were 25 ± 9 in patients with vitamin D supplementation. In cases without vitamin D supplementation, it was 23 ± 10. No statistically significant difference was found between ulnar deviation degrees of vitamin D supplementation (p = 0.511). The mean radial deviation degrees of the patients with vitamin D supplementation was 17 ± 5; In cases without vitamin D supplementation, it is 14 ± 5. No statistically significant difference was found between radial deviation degrees of vitamin D supplementation (p = 0.279). The mean pronation degrees of vitamin D supplementation was 78 ± 3; In cases without vitamin D supplementation, it is 76 ± 5. No statistically significant difference was found between the pronation degrees of vitamin D supplementation (p = 0.166). The mean values of vitamin D supplementation were 75 ± 3; In cases without vitamin D supplementation, it was 74 ± 5. No statistically significant difference was found between the supination degrees of vitamin D supplementation (p = 0.357).

4. DISCUSSION

In this study, we investigated the effect of vitamin D supplementation on functional outcomes, radiological results and grip strength in women over 50 years of age who were treated conservatively after distal radius fracture. We also evaluated the relationship between radiological and functional outcomes. In our study, we did not find any significant difference between the duration of union between vitamin D supplementation group and non-vitamin D group. In the literature, the effects of vitamin D on fracture healing have been investigated in many in vivo and in vitro studies. In a study by Doetsch et al., they found a significant increase in bone mineral density after 6 weeks in patients who underwent vitamin D and calcium supplementation after proximal humerus fracture (13). Kolb et al. examined the distal fracture in 94 postmenopausal women and found no difference between callus formations between vitamin D and calcium supplemented group and non-done group (14). In our study, we did not measure the callus formation or bone mineral density of the patients, but the duration of plaster removal can be evaluated as an indicator of their total effect. Molecular positive effects of vitamin D on fracture healing are known, but we did not see the clinical reflection of this in our study. One reason for this is that patients were not supplemented with calcium.

PTH levels of the patients were above the normal values in both groups (15). This increase in parathyroid hormone levels is due to secondary hyperparathyroidism as stated in the literature. There is a negative correlation between vitamin D and PTH. This increase in PTH levels leads to bone destruction, especially in elderly patients, leading to a weakening of the bone cortex, leading to an increased incidence of fractures (16). There was no significant difference between the rates of recovery of grip strength between vitamin D supplementation group and non-supplementation group. Lee et al. reported that vitamin D supplementation, in 70 patients treated for radius distal fractures over 50 years of age, helped patients regain their grip strength. In the same study, patients treated with surgery recovered their grip strength more quickly. Lee et al. included patients without vitamin D deficiency in the group they supplemented. There are also surgical and non-surgical patients within this group. In our study, we took only conservatively treated patients and aimed to keep the vitamin D value below 30µg / l in all of our patients. Also, Lee and colleagues have given vitamin D and bisphosphonates. We performed vitamin D supplementation only to the patients (7). On the other hand, Smedshaug et al. measured the grip strength of patients with and without vitamin D supplementation before and 1 year after supplementation and found no difference between the two groups. However, patients in this study do not have a history of distal radius fractures (17). Roh et al. in the study performed in patients aged 50 years and over who were detected with volar plaque found that the grip strength recovery was 84% at the end of 1 year (18). In a study conducted in 83 female patients aged 50-75 years, 71% of whom Brogen et al. were treated conservatively, they evaluated grip strength at the end of a 1-year follow-up. 77% of patients with the malunion and

88% of patients who did not detect problems showed that patients regain their grip strength (19). In our study, this rate was 73% in patients with and without vitamin D supplementation. Unlike Roh's study, we treated our patients conservatively. It is known that grip strength is recovered faster after surgical treatment (20-22). Unlike Brogen's study, we did not evaluate the grip strength of our patients by taking into account their false union. Egol et al. evaluated the results of surgical and conservative treatment in patients aged 65 years and over. At the end of the 1-year follow-up, grip strength was 39 ± 16.1 lb in the surgical group and 27.9 ± 14.3 lb in the conservative treatment group (21). We found that 37,17 ± 10,75 lb in the supplementation group and 37,83 ± 6,07 lb in the non-supplemented group. We could not detect a significant improvement in the grip strength of the vitamin D supplemented group compared to the non-supplemented group, but this may be since the grip strength of the non-supplemented group reached very good values. We found a significant difference in DASH f / s and DASH work scores of the vitamin D supplemented group. Patients with vitamin D supplementation had better DASH f / s and DASH work scores. However, the DASH f / s score was 8.36 in the supplemented group, while it was 19.5 in the untreated group and the difference was 11.2 points, which left us in doubt about making a definite conclusion. In some publications, the minimum clinical significance of the DASH f / s score was reported as 15 points (23), while in some publications it was reported as 10.8 points (24). Although the minimum clinical significance value is controversial, it is one of the results of our study that vitamin D supplementation has a statistically significant positive effect on the DASH score. In the literature, many publications are reporting functional and radiological outcomes after distal radius fracture treatments. Stewart et al. compared various conservative fixation methods in 243 patients and found a significant improvement in radiological and functional results in patients who had excellent anatomic reduction after 3 months. However, the functional and radiological results of elderly patients could not be fully evaluated since the patient population in this study was between 18-86 years of age and randomization was not performed according to age. Since we selected our study population from patients with radius distal end fractures over the age of 50, no significant correlation was found between the radiological and anatomical results based on the DASH f / s, DASH work, Stewart and Gartland Werley scores. For this reason, we think that anatomic reduction does not correlate with the functional outcomes of patients with distal radius fractures over the age of 50 (12,25).

Gartland and colleagues Colles fracture patients in their study over the age of 53, divided the patients into three groups according to the type of fracture. (group 1: joint-related fractures, group 2: joint-related but nondisplaced, group 3: joint-related displacement). The functional and radiological results of these patients at 18 months were evaluated. However, functional results were found to be good in patients with low radiological scores due to inadequate immobilization and reduction. They explained this with the ability of the wrist joint to compensate for bone deformities (26).

The most important limitation of this study is that the patients who were included in the vitamin D supplementation group and those who were not included in the group did not show a homogenous distribution in terms of fracture types. In the supplemented group, 8 patients were typed A, 2 patients were type B + C, whereas 5 patients were typed A and 5 patients were type B + C in the non-supplemented group. This limited our assessment of the effects of vitamin D supplementation. Another limitation of the study is that patient follow-up times are not equal. Although the mean follow-up period was close between the groups, it ranged from 190 days to 613 days. This may cause us to misjudge the grip gain in particular. In addition, patients were separated according to vitamin D values and only the lower limit of 30µg / l and below were included in the study. For better standardization between groups, vitamin D deficiency (20 µg / l - 30µg / l), vitamin D deficiency (10 µg / l - 20 µg / l), and severe vitamin D deficiency (≤ 10 µg / l) self-assessment of patients may give more guiding results. This study showed that vitamin D supplementation positively affected functional scores after distal radius fracture in women over 50 years of age with vitamin D deficiency or insufficiency. In addition, there was no relationship between radiological and functional results.

In conclusion, it has been shown that vitamin D supplementation positively affects functional scores after distal radius fracture in women over 50 years of age with vitamin D deficiency or insufficiency. Also, according to AO / OTA classification, type A fractures, functional results and wrist joint range of motion were better than type B + C fractures after a mean follow-up of 370 days. We recommend vitamin D supplementation in women over 50 years of age who have vitamin D deficiency or insufficiency after distal radius fracture.

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