

The Role of Vitamin D Supplementation in Orthopedic Trauma Patients

Dr Inziamam Chughtai, Dr Muhammad Abbas, Dr summaya Asmat, Dr Muhammad Rashid khan

Corresponding author

Name: Dr Muhammad Abbas

Designation: Training registrar

Email: Mahammad abbasdr6@gmail.com

Contact: 03139744422

Abstract

This cross sectional study was evaluated for the effects of vitamin D supplementation on disease activity in trauma patients with baseline vitamin D deficiency at Hayatabad Medical Complex's Orthopedic Ward from July 2024 to March 2025. A total of 150 patients with bike trauma, firearm trauma, or history of falls were equally divided into supplemented (n=75) and control (n=75) groups. The supplemented group received 50,000 IU vitamin D3 weekly for 8 weeks followed by 2000 IU/day maintenance, while controls received standard care. Results demonstrated significantly greater reductions in disease activity scores in supplemented patients across all trauma types: bike trauma (2.4 vs 1.0, p=0.04), firearm trauma (1.6 vs 0.7, p=0.03), and history of falls (1.1 vs 0.5, p=0.05). The supplemented group also showed more stable outcomes (SD=0.7) compared to controls (SD=0.9) and achieved substantial increases in vitamin D levels (14 to 46 ng/mL) versus minimal change in controls (16 to 17 ng/mL). These findings indicate that vitamin D supplementation significantly improves disease activity and reduces clinical variability in trauma patients, supporting its potential role in orthopedic rehabilitation protocols for vitamin D-deficient individuals.

Keywords: Vitamin D supplementation, trauma patients, disease activity, orthopedic rehabilitation, randomized controlled trial

Introduction: Bone metabolism and calcium homeostasis depend on vitamin D, a fat-soluble vitamin. It affects many biological processes, including as immunological modulation, inflammatory regulation, and muscular function. Up to 77% of people worldwide suffer from vitamin D deficiency, and athletes are especially vulnerable because of their demanding physical schedules and maybe insufficient sun exposure. Muscle weakness, reduced neuromuscular function, and an increased risk of injury have all been associated with inadequate vitamin D levels, which are essential for maintaining musculoskeletal health¹⁻⁴.

Both biomolecular and clinical studies have confirmed the roles of vitamin D in calcium homeostasis, bone health, and the risk of stress fractures. Compared to people with adequate vitamin D levels, athletes and physically active people who have clinically low vitamin D levels have a much higher risk of stress fractures. Vitamin D insufficiency is linked to both high-energy and low-energy traumatic fractures. Given the significance of vitamin D for skeletal health, identifying and treating deficiencies is essential to improving patient outcomes⁵⁻⁶.

Vitamin D insufficiency can affect the healing process by causing problems with muscular function and performance. Additionally, studies have clarified vitamin D's role in pain pathway processes. Patients with orthopaedic trauma had a 66% prevalence of low vitamin D levels, whereas athletes had a 52% prevalence of the same deficit, according to a retrospective examination of orthopaedic surgery cases. Only one in six patients with elective foot and ankle surgery showed normal vitamin D levels, and one in five patients showed a severe vitamin D shortage, according to a study that included other remaining consecutive patients⁷⁻⁸.

However more research work is needed to help understand how vitamin D affects these diseases and to confirm the effectiveness of this vitamin in starvation, prevention and control of these diseases. Sufficient vitamin D levels can lower the risk of problems, increase the effectiveness of rehabilitation, and improve surgical results. We aim to provide more precise clinical practice guidelines and suggest future research areas by compiling and critically evaluating the available data. It is crucial to monitor and treat vitamin D deficiency in individuals undergoing ACL surgery because sufficient vitamin D levels may reduce muscle atrophy and improve rehabilitation.

Although vitamin D seems to affect muscle recovery, it is unclear how it affects more general functional outcomes like return to sport and quality of life. Other factors, like following rehabilitation instructions, having pre-existing muscle strength, or genetics, might be more important in determining long-term functional outcomes than vitamin D levels alone⁹⁻¹⁰.

Material and Methods: The study included two groups: a supplemented group, which received vitamin D supplementation in addition to standard treatment, and a control group, which received standard treatment alone (either a placebo or no additional supplementation). Eligible patients were those diagnosed with bike trauma, firearm trauma, or fall-related injuries requiring orthopedic intervention, aged between 18 and 65 years, and with baseline vitamin D levels below 20 ng/mL (indicating deficiency or insufficiency). Participants were excluded if they had chronic kidney or liver disease (which could interfere with vitamin D metabolism), malabsorption disorders such as celiac or Crohn's disease, were pregnant or lactating, had active malignancy, were on immunosuppressive therapy, or had a known hypersensitivity to vitamin D supplements. A total of 150 participants were enrolled, with 50 in each trauma category, and were randomly assigned in a 1:1 ratio (25 to the supplemented group and 25 to the control group per category) using computer-generated randomization. The supplemented group received 50,000 IU of oral vitamin D₃ (cholecalciferol) weekly for eight weeks, followed by a maintenance dose of 2000 IU daily for the remainder of the study, while the control group received a visually identical placebo following the same regimen. Baseline assessments included serum 25(OH)D levels and disease activity scores using standardized orthopedic tools, with follow-ups at three and six months to measure changes in vitamin D levels, pain scales, mobility improvement, and inflammatory markers. Statistical analysis was conducted using independent t-tests for mean differences and ANOVA for inter-group comparisons, with a p-value of less than 0.05 considered statistically significant. The study was approved by the Institutional Review Board (IRB) of Hayatabad Medical Complex, and all participants provided written informed consent, with confidentiality maintained throughout the research.

Result: Following results were analyzed.

Table 1: Participant Distribution by Accident & Trauma

TRUMA	Total Patients	Supplemented Group	Control Group
Bike trauma	50	25	25
Fire Arm Trauma	50	25	25
History of Fall	50	25	25

Table 2: Mean Disease Activity Reduction

Trauma	Mean Reduction in Activity (Supplemented)	Mean Reduction in Activity (Control)	p-value
Bike trauma	2.4	1.0	0.04
Fire Arm Trauma	1.6	0.7	0.03
History of Fall	1.1	0.5	0.05

Table 3: Standard Deviation in Disease Activity Scores

Group	Standard Deviation in Disease Activity Scores
Supplemented	0.7
Control	0.9

Table 4: Average Vitamin D Levels Pre- and Post-Supplementation

Group	Average Vitamin D Level (ng/mL)
Supplemented (Pre)	14
Supplemented (Post)	46
Control (Pre)	16
Control (Post)	17

This suggests that vitamin D supplementation may play a role in mitigating disease progression in trauma patients, aligning with findings by Rossini et al. (2011), who demonstrated that vitamin D deficiency is linked to higher disease activity in rheumatoid arthritis. The consistency in results across different trauma types strengthens the argument for vitamin D's therapeutic potential in inflammatory and autoimmune conditions (Cutolo et al., 2014).

Further supporting these findings, Table 3 reveals that the supplemented group exhibited a lower standard deviation in disease activity scores (0.7) compared to the control group (0.9), indicating more stable and predictable outcomes with supplementation. This reduced variability may suggest a modulating effect of vitamin D on immune responses, as discussed by Bozkurt et al. (2013), who found that vitamin D deficiency exacerbates autoimmune thyroid conditions. Additionally, Table 4 demonstrates a substantial increase in vitamin D levels post-supplementation (from 14 ng/mL to 46 ng/mL), whereas the control group showed minimal change (16 ng/mL to 17 ng/mL). This stark contrast underscores the efficacy of supplementation in correcting deficiency, which may contribute to improved disease management, as seen in Efraimidis et al. (2012), where vitamin D deficiency was associated with heightened thyroid autoimmunity.

The study's methodology aligns with principles of rigorous quantitative analysis, as emphasized by Campbell et al. (2018), ensuring reliable and reproducible results. The significant p-values and consistent trends across trauma categories strengthen the internal validity of the findings. However, the study could benefit from further stratification by baseline vitamin D levels to assess whether the magnitude of disease activity reduction correlates with the severity of initial deficiency, as suggested by Chiang et al. (2017) in their review on vitamin D's effects on muscle strength in athletes. Such an analysis could refine the understanding of which patient subgroups benefit most from supplementation.

Conclusion: the results suggest that vitamin D supplementation significantly reduces disease activity in trauma patients, with lower variability in outcomes compared to controls. These findings are supported by previous research linking vitamin D deficiency to worsened autoimmune and inflammatory conditions (Rossini et al., 2011; Cutolo et al., 2014). Future studies should explore long-term effects and optimal dosing strategies to maximize therapeutic benefits. The study adds to the growing body of evidence advocating for vitamin

D's role in managing trauma-related inflammation and autoimmunity, reinforcing the need for routine screening and supplementation in deficient populations.

Conflict of interest: None

Funds: None

References:

- 1: Agoncillo M, Yu J, Gunton JE. The role of vitamin D in skeletal muscle repair and regeneration in animal models and humans: a systematic review. *Nutrients*. 2023; **15**(20): 4377.
- 2: Albright JA, Chang K, Byrne RA, Quinn MS, Meghani O, Daniels AH, et al. A diagnosis of vitamin D deficiency is associated with increased rates of anterior cruciate ligament tears and reconstruction failure. *Arthroscopy*. 2023; **39**(12): 2477–2486.
- 3: Aujla RS, Allen PE, Ribbans WJ. Vitamin D levels in 577 consecutive elective foot & ankle surgery patients. *Foot Ankle Surg*. 2019; **25**(3): 310–315.
- 4: Barker T, Henriksen V, Martins T, Hill H, Kjeldsberg C, Schneider E, et al. Higher serum 25-hydroxyvitamin D concentrations associate with a faster recovery of skeletal muscle strength after muscular injury. *Nutrients*. 2013; **5**(4): 1253–1275.
- 5: Boyan BD, Hyzy SL, Pan Q, Scott KM, Coutts RD, Healey R, et al. 24R,25-Dihydroxyvitamin D3 protects against articular cartilage damage following anterior cruciate ligament transection in male rats. *Plos One*. 2016; **11**(8):e0161782.
- 6: Song GG, Bae SC, Lee YH. Association between vitamin D intake and the risk of rheumatoid arthritis: a meta-analysis. *Clin Rheumatol*. 2012;**31**(12):1733-1739.
- 7: Amital, H., Szekanecz, Z., Szucs, G., Danko, K., Nagy, E., Csépany, T., et al. (2010). Serum vitamin D levels in patients with systemic lupus erythematosus: association with disease activity and damage accrual. *Arthritis Care & Research*, 62(8), 1160-1165.
- 8: Hong, Q., Xu, J., Xu, S., Lian, L., Zhang, M., Ding, Z., et al. (2014). Association of vitamin D supplementation with respiratory infection and disease activity in rheumatoid arthritis patients. *International Journal of Rheumatic Diseases*, 17(5), 488-495.
- 9: Craig, S. M., Yu, F., Curtis, J. R., Alarcón, G. S., Conn, D. L., Jonas, B. L., et al. (2010). Vitamin D deficiency and disease activity in rheumatoid arthritis patients compared with controls. *Journal of Rheumatology*, 37(11), 2148-2152.
- 10: Rossini, M., Maddali Bongi, S., La Montagna, G., Minisola, G., Malavolta, N., Bernini, L., et al. (2011). Vitamin D deficiency in rheumatoid arthritis: prevalence, determinants and associations with disease activity and disability. *Arthritis Research & Therapy*, 12(6), 1-9.

11: Bozkurt, N. C., Karbek, B., Ucan, B., Sahin, M., Cakal, E., Ozbek, M., & Delibasi, T. (2013). The association between severity of vitamin D deficiency and Hashimoto's thyroiditis. *Endocrine Practice*, 19(3), 479-484.

12: Effraimidis, G., Badenhoop, K., Tijssen, J. G., & Wiersinga, W. M. (2012). Vitamin D deficiency is associated with thyroid autoimmunity and hyperthyroid Graves' disease. *Thyroid*, 22(5), 484-489.

13: Cutolo, M., Plebani, M., Shoenfeld, Y., & Adorini, L. (2014). Vitamin D endocrine system and the immune response in rheumatic diseases. *Vitamins and Hormones*, 86, 327-351.

14: Campbell M, Katikireddi SV, Sowden A, McKenzie JE, Thomson H. Improving Conduct and Reporting of Narrative Synthesis of Quantitative Data (ICONS-Quant): protocol for a mixed methods study to develop a reporting guideline. *BMJ Open*. 2018; **8**(2):e020064.

15:Chiang C, Ismaeel A, Griffis RB, Weems S. Effects of vitamin D supplementation on muscle strength in athletes: a systematic review. *J Strength Cond Res*. 2017; **31**(2): 566–5.