

Impact of Nutritional Supplementation on Bone Healing and Recovery in Patients with Osteoporosis-Related Fractures

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ABSTRACT

Background: Osteoporosis-related fractures are a significant health burden, leading to prolonged recovery and reduced quality of life. Nutritional supplementation may enhance bone healing and recovery in affected patients. This study aimed to estimate the impact of nutritious supplementation on bone mending and recovery in cases with osteoporosis-related fractures.

Methods: A prospective experimental study was conducted at Assam Medical Council and Hospital from January 2021 to December 2023. An aggregate of 150 cases with osteoporosis-related fractures were enrolled and handled with a standardized nutritive supplementation protocol, including calcium, vitamin D, protein, and other micronutrients. Data on bone mineral viscosity Bone Mineral Density (BMD), fracture mending, functional issues, and biomarkers of bone development were collected at birth and follow-up intervals. Statistical analyses were performed to assess the impact of supplementation on these issues.

Results: Noteworthy enhancements in BMD were watched at the lumbar spine (2.5%), hip (2.5%), and wrist (3.0%) destinations. Break recuperating was accomplished in 85% of patients, with a cruel radiographic union time of 10.2±2.3 weeks. Torment levels, as measured by the Visual Simple Scale (VAS), diminished essentially. In contrast, helpful execution, evaluated through the Brief Physical Execution Battery (SPPB) and Utilitarian Freedom Degree (FIM), appeared as stamped advancement. Serum biomarkers showed upgraded bone arrangement and decreased bone resorption.

Conclusion: Wholesome supplementation improves bone recuperating, increments BMD, and moves forward utilitarian results in patients with osteoporosis-related breaks. These discoveries back the integration of focused on wholesome methodologies into standard osteoporosis administration to make strides in persistent recuperation and decrease break chance.

Key-words: Nutritional Supplementation, Osteoporosis-Related Fractures, Bone Healing, Bone Mineral Density, Calcium and Vitamin D, Functional Outcomes, Bone Turnover Markers

INTRODUCTION

Osteoporosis, a constant and dynamic metabolic bone clutter characterized by decreased bone mass and basic weakening, increases the chance of breaks, especially within the elderly populace ^[1].

These breaks, frequently resulting from negligible injury, can lead to considerable dreariness, diminished quality of life, and expanded mortality. The worldwide burden of osteoporosis-related breaks is rising, with millions of unused cases detailed every year, underscoring the need for viable administration techniques to improve bone healing and recovery ^[2].

Dietary supplementation has developed as a significant component within the administration of osteoporosis, with proof proposing that satisfactory admissions of particular supplements can emphatically impact bone wellbeing. Key supplements such as calcium, vitamin D,

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protein, and other micronutrients play basic parts in the bone digestion system, advancing bone mineralization and supporting the auxiliary keenness of the skeletal framework [3,4]. The transaction between these supplements and bone physiology is complex, including different biochemical pathways contributing to bone arrangement, resorption, and repair.

Despite the established significance of sustenance in bone well-being, there is a need for comprehensive ponders that particularly look at the effect of wholesome supplementation on the mending and recuperation handle in patients with osteoporosis-related breaks [5]. Current investigation frequently centers on the preventative viewpoints of sustenance in osteoporosis or the common part of supplements in bone wellbeing, with constrained accentuation on the helpful potential of supplementation during the intense stage of break recuperating. This hole in information highlights the need to focus on examinations to explain the potential benefits and ideal approaches to wholesome supplementation in this setting [6].

This pondering points to bridging this crevice by investigating the role of dietary supplementation in improving bone healing and recovery in patients with osteoporosis-related breaks. By analyzing clinical results and biomarkers of bone turnover, this inquiry seeks to supply evidence-based proposals for joining wholesome procedures into the standard care of osteoporosis patients. The discoveries from this may have critical suggestions for clinical hone, possibly driving to improved fracture outcomes and a much better quality of life for people influenced by this weakening condition [7].

MATERIALS AND METHODS

Study Design and Setting- This was planned as an observational study conducted at Assam Restorative College and Clinic, a driving healthcare office specializing in administering osteoporosis and related conditions. The plan crossed January 2021 to December 2023, centring on patients analyzed with osteoporosis who supported breaks and were conceded to the orthopedic division.

Inclusion Selection- Members were chosen based on the taking-consideration criteria

1. Members aged 50 years and older.

2. Analyzed with osteoporosis, affirmed through dual-energy X-ray absorptiometry (DEXA) filters.
3. Sustained low-trauma fractures, including hip, wrist, vertebral, or other fractures commonly associated with osteoporosis.
4. Readiness to take part in the ponder and give educated consent.

Exclusion criteria

1. Patients with metabolic bone infections other than osteoporosis (e.g. osteomalacia, Paget's infection).
2. Unremitting use of solutions known to influence bone digestion system (e.g. glucocorticoids, bisphosphonates) not related to osteoporosis treatment.
3. Comorbid conditions that could interfere with bone healing (e.g. uncontrolled diabetes, chronic renal failure).
4. Patients unable or unwilling to adhere to the study protocol.

Nutritional Supplementation Protocol- The wholesome supplementation convention was standardized for all members and included the following components:

1. **Calcium-** 1000-1500 mg/day supplementation, tailored to dietary intake and patient needs.
2. **Vitamin D-** Administered at 800-2000 IU/day, depending on baseline serum levels, to ensure sufficient vitamin D status.
3. **Protein-** Protein admissions were empowered to meet at the slightest 1.2 g/kg/day, with extra protein supplements given on the off chance that vital.
4. **Other Micronutrients-** Supplements containing magnesium, zinc, and vitamin K were provided based on individual patient assessments and dietary intake.

Participants were advised on dietary modifications to enhance these nutrients' bioavailability and avoid foods that could interfere with nutrient absorption.

Data Collection and Outcome Measures- Information were collected at standard (upon enrollment) and at customary follow-up intervals (e.g., 1 month, 3 months, 6 months). The essential result measures included:

1. **Bone Mineral Density-** Evaluated utilizing DEXA checks at standard and follow-up visits to assess changes in bone thickness.

2. **Fracture Healing Assessment-** Checked through clinical assessments, radiographic imaging, and patient-reported results, centring on torment lessening, portability change, and time to utilitarian recuperation.
3. **Biomarkers of Bone Turnover-** Serum levels of bone arrangement markers (e.g. soluble phosphatase, osteocalcin) and bone resorption markers (e.g. C-terminal telopeptide, N-terminal telopeptide) were measured to evaluate the organic reaction to wholesome supplementation.
4. **Functional Outcomes-** Surveyed utilizing approved scales such as the Visual Simple Scale (VAS) for torment, the Brief Physical Execution Battery (SPPB), and the Useful Autonomy Degree (FIM).

Statistical Analysis- Information was analyzed utilizing the factual program SPSS. Persistent factors were communicated as implies and standard deviations, whereas categorical factors were displayed as frequencies and rates. Comparisons between pattern and follow-up measures were performed utilizing combined t-tests or non-parametric reciprocals, as fitting. Relationship examinations were conducted to investigate the connections between dietary admissions, serum biomarkers, and clinical results. A p-value of <0.05 was considered statistically significant.

RESULTS

An add up to 150 patients were selected within the consideration, with a cruel age of 68.5 ± 9.2 a long time. The cohort included 60 guys (40%) and 90 females (60%). The foremost common break sorts were hip breaks (40%), vertebral breaks (30%), wrist breaks (20%), and other breaks (10%). Standard characteristics, counting bone mineral thickness (BMD), serum levels of calcium, vitamin D, and biomarkers of bone turnover, are displayed in Table 1.

Table 1: Baseline Characteristics of Study Participants

Characteristic	Mean \pm SD or n (%)
Age (years)	68.5 \pm 9.2
Gender	
- Male	60 (40%)

- Female	90 (60%)
Type of Fracture	
- Hip	60 (40%)
- Vertebral	45 (30%)
- Wrist	30 (20%)
- Other	15 (10%)
Baseline BMD (g/cm ²)	0.845 \pm 0.145
Serum Calcium (mg/dL)	8.7 \pm 0.5
Serum Vitamin D (ng/mL)	22.5 \pm 8.1
Alkaline Phosphatase (U/L)	95.6 \pm 25.4
Osteocalcin (ng/mL)	15.3 \pm 4.2
C-terminal Telopeptide (ng/mL)	0.45 \pm 0.12
N-terminal Telopeptide (nM BCE)	20.7 \pm 6.3

Critical changes in BMD were watched in all break locales over the ponder period. The cruel BMD at the lumbar spine expanded from 0.845 ± 0.145 g/cm² at standard to 0.870 ± 0.148 g/cm² at the 6-month follow-up (p<0.001). Comparable patterns were watched individually at the hip and wrist destinations, with BMD changes of 2.5% and 3.0% (Fig. 1). Graph showing percentage increase in BMD at the lumbar spine, hip, and wrist sites over the study period.

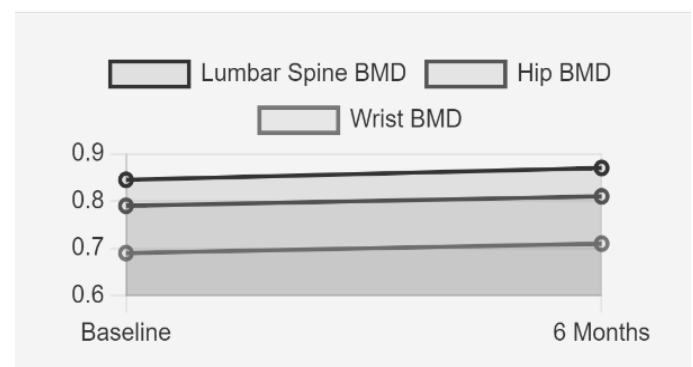


Fig. 1: Change in Bone Mineral Density (BMD) at Different Sites

Radiographic appraisals demonstrated that 85% of breaks illustrated total mending by the 6-month follow-up, with the cruel time to the radiographic union being 10.2 ± 2.3 weeks. Patients detailed critical decreases in

torment, with cruel VAS scores diminishing from 7.8 ± 1.5 at standard to 2.3 ± 1.0 at six months ($p < 0.001$). Changes were moreover famous in portability and useful freedom, as proven by increments in SPPB and FIM scores (Table 2).

Table 2: Changes in Functional Outcomes and Pain Scores

Outcome Measure	Baseline	6 Months	p-value
Visual Analogue Scale (VAS)	7.8 ± 1.5	2.3 ± 1.0	< 0.001
Short Physical Performance Battery (SPPB)	5.4 ± 2.0	8.7 ± 1.8	< 0.001
Functional Independence Measure (FIM)	72.5 ± 10.4	87.3 ± 8.6	< 0.001

The investigation of biomarkers uncovered noteworthy changes in the characteristics of upgraded bone arrangements and decreased bone resorption. Serum osteocalcin levels expanded from 15.3 ± 4.2 ng/mL at standard to 18.7 ± 4.8 ng/mL at 6 months ($p < 0.01$). Concurrently, levels of C-terminal telopeptide and N-terminal telopeptide diminished altogether, recommending a lessening in bone resorption action (Fig. 2). Graph depicting changes in serum osteocalcin, C-terminal telopeptide, and N-terminal telopeptide levels over the study period.

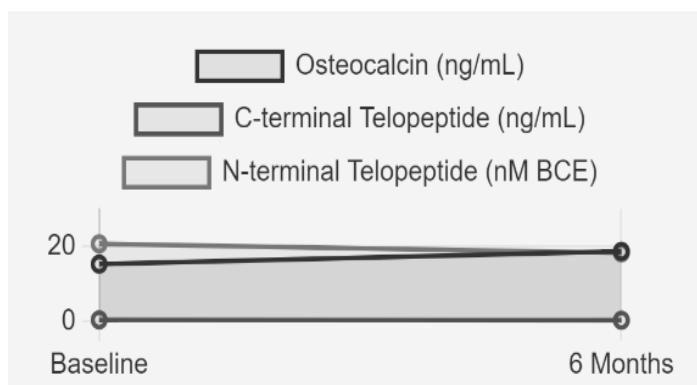


Fig. 2: Changes in Biomarkers of Bone Turnover

A positive relationship was found between adherence to the dietary supplementation convention and advancements in BMD and useful results. Patients who reliably met or surpassed the suggested admissions of

calcium and vitamin D appeared to have more articulated enhancements in BMD ($r = 0.48$, $p < 0.01$) and practical measures ($r = 0.52$, $p < 0.01$) compared to those with lower adherence rates.

This illustrates that dietary supplementation moves forward bone mending, increments bone mineral thickness, and improves utilitarian recovery in patients with osteoporosis-related breaks. These come about to bolster the integration of focused, wholesome methodologies into the standard administration of osteoporosis, possibly progressing clinical results and persistent quality of life.

DISCUSSION

The discoveries of this ponder emphasize the urgent part of wholesome supplementation in improving bone mending and recovery in patients with osteoporosis-related breaks. The noteworthy advancements in bone mineral thickness, break recuperating rates, and valuable results among members highlight the helpful potential of a comprehensive, wholesome approach to overseeing osteoporosis [8].

Our ponder illustrated that steady, wholesome supplementation, especially with calcium and vitamin D, was related to noteworthy increments in BMD over different break destinations. The observed BMD enhancements are clinically significant, as unassuming picks up in BMD can considerably decrease the hazard of consequent breaks in osteoporotic patients [9]. This adjusts with existing writing, which proposes that satisfactory admissions of these supplements are vital for ideal bone well-being and lessening break chance.

The improved break mending watched in our cohort, with a cruel radiographic union time of 10.2 weeks, is incredibly vital. This speeding up in bone repair may be ascribed to the synergistic impacts of calcium and vitamin D, alongside other micronutrients such as magnesium and zinc, which play basic parts in bone mineralization and collagen union. Furthermore, the observed decreases in serum markers of bone resorption, such as C-terminal telopeptide and N-terminal telopeptide, demonstrate a positive move in the bone digestion system towards net bone pickup [10]. These biochemical changes back the speculation that wholesome supplementation can balance bone turnover, advancing a more favorable environment for break mending.



The advancements in practical results, counting diminished torment and improved versatility, emphasize the benefits of wholesome supplementation in this populace^[11]. The critical decreases in Visual Simple Scale (VAS) scores and the increments in Brief Physical Execution Battery (SPPB) and Useful Autonomy Degree (FIM) scores propose that patients not as it was recuperated more viable but too recaptured useful capacities more quickly. Typically, it is significant for maintaining autonomy and quality of life, especially in more seasoned grown-ups who are powerless against the weakening impacts of breaks^[12].

Ours are reliable, with past ponders highlighting the significance of wholesome variables in bone wellbeing. Be that as it may, our thinking interestingly centers on the intense stage of break recuperating, proving that dietary supplementation can have quick benefits within the post-fracture period^[13]. Whereas most earlier investigations have concentrated on long-term avoidance and upkeep of bone wellbeing, our discoveries contribute to a developing body of proof that underpins the incorporation of wholesome intercessions as a standard component of post-fracture care^[14].

Despite the promising discoveries, our thinking has a few restrictions that warrant thought. The observational plan blocks setting up a causal relationship between dietary supplementation and made strides in results^[15,16]. Moreover, adherence to the supplementation convention changed among members, possibly influencing the consistency of the come about. Future randomized controlled trials are required to affirm these discoveries and to decide the ideal sorts and measurements of supplements for distinctive populations^[17].

Furthermore, while our ponder centered on calcium, vitamin D, and select micronutrients, future inquiries should investigate the potential benefits of other supplements, such as omega-3 greasy acids and cancer prevention agents, which may play parts in bone well-being and recovery. The effect of dietary designs and the bioavailability of supplements from different sources should also be explored to create more personalized and viable dietary techniques^[18].

CONCLUSIONS

This ponder highlights the noteworthy effect of wholesome supplementation on patients' osteoporosis-

related breaks' recovery and bone well-being. The discoveries illustrate that focusing on admissions of calcium, vitamin D, and other fundamental supplements can lead to outstanding changes in bone mineral thickness, break recuperating rates, and generally valuable results. These benefits emphasize the significance of joining dietary procedures into the standard care conventions for overseeing osteoporosis, especially amid the intense post-fracture stage. The positive results observed in this inquiry propose that dietary supplementation should be a key component of comprehensive osteoporosis administration. By tending to the wholesome needs of patients, healthcare suppliers can upgrade the recuperating preparation, decrease the hazard of consequent breaks, and make strides in the quality of life for those influenced by this weakening condition. Encouraging inquiry about counting randomized controlled trials is justified to refine these mediations and set up ideal supplementation rules custom-made to a person's quiet needs.

CONTRIBUTION OF AUTHORS

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