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Original Research Article

Correlation of Dual Energy X-Ray Absorptiometry with Markers of Bone Metabolism in Femur Fractures

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Abstract:

Background: Numerous functions have been made possible by notable advancements in dual-energy X-ray absorptiometry (DXA) in terms of quality, picture resolution, and acquisition time. By indirectly analyzing the micro- and macroarchitecture of the bone, DXA can assess bone quality and enhance fracture risk prediction. Additionally, without the need for additional radiologic imaging or radiation exposure, DXA can identify pre-existing fractures, such as atypical femur fractures or vertebral fractures. Furthermore, it can evaluate the metabolic state by the assessment of metrics related to body composition, such as visceral fat and muscle mass. DXA is obviously useful for more than simply bone mineral densitometry, even though additional research is needed to evaluate and apply these characteristics in a clinical setting. Aim of this study to correlate bone density DUAL ENERGY X-RAY ABSORPTIOMETRY in patient with femur fracture with markers of bone metabolism.

Methods: This cross-sectional analytic study was conducted at Department of Orthopaedics, AIIMS, Raipur from 24 months after obtaining ethical clearance approval, sample collection – 12 months (April 2021 to March 2022), follow up – 6 months and article writing – 6 months. Total 99 patients were enrolled in this study.

Results: This study by the Department of Orthopaedics, Raipur, correlated bone metabolism markers with dual energy X-ray absorptiometry in femur fracture patients (i.e. Serum calcium; Serum phosphorus; Alkaline phosphatase; Serum Vitamin D; and Serum protein - albumin). In this study of femur fractures, 99 cases met inclusion and exclusion criteria. The mean age of the population in our study was 51.44 ± 20.44 years with range (18-97 years). The majority of population the study group was male (65.7%) as compared to females (34.3%) in our study. Majority of the population had osteoporosis (47.3%) as compared to osteopenia in 31.3% of the population and normal bone mineral density in 21.2 % population. Mode of Injury reveals that Self fall (46.5%) and RTA (44.4%) were the most common mode of injury followed by fall from height (9.1%). Intertrochanteric femur fracture (42.4%) was the most common diagnosis followed by neck of femur fracture (28.3%) shaft of femur fracture (15.2%), distal femur fracture (9.1%) and subtrochanteric femur fracture (5.1%). ANOVA showed no significant association between bone mineral density and fracture groups (p value = 0.194) nor with the DXA parameters (T-score and Z-score; p value = 0.126, 0.092 respectively).

Conclusion: We found a strong correlation between advanced age and low bone mineral density, even though blood calcium, serum vitamin D, and serum phosphorus have no effect on bone density. Bone mineral density is linked to blood alkaline phosphatase, serum albumin, and fracture prediction T- and Z-scores.

Keyword: Dual-energy X-ray absorptiometry, Bone mineral density.

Introduction

In the 1950s, osteoporosis was first characterized by Fuller Albright as a lack of bone. Osteoporosis, as described by the National Institutes of Health in 1988, [1] is a disease of the skeleton in which bone strength is diminished, making the patient more susceptible to fractures. [2] Integrating bone

density and bone quality is a primary indicator of bone strength.[2] The National Institutes of Health later revised its definition of osteoporosis to describe it as a "systemic bony illness" in which less bone density and microarchitectural degeneration of bone will increase the risk of bone fracture. [3]

Among the elderly, osteoporosis is a leading cause of disability and death. The percentage of the Asian population over 65 is projected to rise from 5.3% in 1995 to 9.3% in 2025, suggesting a rise in both the number of persons at risk for osteoporosis and the number of people diagnosed with the disease. As a result, osteoporosis has reached epidemic proportions in the modern world due to variables including longer life expectancy and changes in diet and exercise habits. [4]

Because of this link to fracture due to low energy trauma, osteoporosis is a severe threat to public health. Studies have shown that osteoporosis affects approximately one-third of all women over the age of 50.[5] More over 50% of women over 50 have osteoporosis, and 1 in 5 males over 50 do as well.[6] There are currently estimated to be 26 million people with osteoporosis in India, with that figure it is expected in 2013 that it may increase up to 36 million. [7]

Bone mineral density (BMD) estimation can be done in a number of ways. Dentists' use of mandibular dental radiographs in the early 20th century gave way to with plain X-ray, used by ultrasound, dual energy absorptiometry, and through based on Computed tomography scan.[8,9] Through Dual energy X-ray absorptiometry for estimation of bone mineral density (BMD), method is the gold standard due to its high reproducibility, extensive normative data, non-invasive nature, short procedure duration, and low radiation exposure. [10]

To accurately diagnose low bone mass and foretell the likelihood of fracture, bone density measuring equipment is a crucial resource.[11] Bone density testing by dual energy x-ray absorptiometry (DEXA) is perhaps the most helpful method now available, with an accuracy of over 95% and a precision of around 1%. [11]

However, there are still barriers to these imaging methods being used in primary care settings and more widely. These include the need for a large, expensive instrument and a lack of general availability. If in early stage, osteoporosis will diagnose then it could be leads to best management and therapy, making development of alternative methods for early and proper diagnosis of osteoporosis crucial.

Researchers have been looking into bone turnover biomarkers for the past decade. Bone resorption and bone production make up the remodelling mechanism.[12] During bone remodelling phase there is production of all bone formation, bone resorption and bone turnover biomarkers. During bone remodelling phase bone metabolic indicators, enzymes, proteins and by products can be examined.[13,14] Bone formation and resorption rates may now be evaluated with greater precision and accuracy, thanks to the availability of several biomarkers.[15] For instance bone specific alkaline phosphatase, serum calcium, serum phosphorus, serum vitamin D, serum protein, etc. are all biomarkers for bone production. These biomarkers can be used for early assessment of disease activity, when there is insufficient bone mineral density (BMD) measurement obtained from DEXA scan. Therefore, there is significant advantage of using both BMD measurement by DEXA scan and bone biomarker detection in early detection of osteoporosis in high-risk group of patients.

Material and Methods

This cross-sectional analytic study was conducted at Department of Orthopaedics, AIIMS, Raipur from 24 months after obtaining ethical clearance approval, sample collection – 12 months (April 2021 to March 2022), follow up – 6 months and article writing – 6 months. 99 patients who presented in the department of orthopaedics AIIMS Raipur with femur fracture was included in this study.

Patients with traumatic femur fractures who presented at our institution during the specified time period were included in the study after taking informed consent.

Inclusion Criteria:

- Patient with femur fracture.
- Patients willing to participate in study

Exclusion criteria:

- Patient with pathological femur fracture.
- Primary malignancy, metastatic disease.
- Osteomyelitis of bone.

Investigation:

- Using plain radiographs, a diagnosis of femur fracture was made.
- The use of CT scan of the fracture was limited to certain fracture patterns.
- The patient was evaluated with (DUAL ENERGY X-RAY ABSORPTIOMETRY) to estimate Bone mineral density.
- Laboratory bio markers such as: - Serum calcium, Serum phosphorus, Alkaline Phosphatase Serum Vitamin D, Serum protein (albumin) was measured once at the time of admission

Method of data collection:

- Patient was stabilized as per ATLS Protocol and skin traction given.
- Dual Energy X-Ray Absorptiometry was performed on the patient pre-operatively
- Reports were collected
- Overall T-Score and Z-Score were calculated.
- Reports of blood investigation were collected.

Statistical analysis: Categorical variables are presented in number and percentage (%) and continuous variables is presented as mean ± SD and median. Normality of data was tested by Kolmogorov-Smirnov test.

Results

A total of 99 patients were enrolled in the study.

The mean age was 51.44 years, median age was 52.00 years and standard deviation age was noted to be 20.44 years, with a range of 16 to 97 years.

Table: 1 Age and details of population in years

Parameter Assessed	Calculated value (Years)
Mean	51.44
Median	52.00
Std. Deviation	20.443
Range	81
Minimum	16
Maximum	97

Majority of enrolled patient belonged to 71 to 80years (19 Patients) of age. Followed by 21 to 30 years (16 patients). Minimum number of patients <20 years is 5 patients.

Table 2: The frequency distribution of age of the patients enrolled in the study

Age group	Frequency
<20	5
21-30	16
31-40	12
41-50	14
51-60	15
61-70	14
71-80	19
81-90	3
91-100	1
Total	99

Table: 3 Gender Wise distribution of the population. Where number of males was 65 (65.7%) and number of females was 34 (34.3 %).

Gender	Number	Percentage
Male	65	65.7
Female	34	34.3
Total	99	100

Table 4: Correlation of variable for intertrochanteric femur fracture as per "Boyd &Griffin" Classification

Particulars	Type1	Type 2	Type 3	Type 4	Total	P Value
Age	60.5	57.74	80.67	64.33	60.44	0.14
Sex (Male)	5	15	1	2	23	0.816
Sex (Female)	3	12	2	1	18	
Sr. Calcium	8.65	8.7681	8.1333	8.4667	8.6766	0.375
Sr. PO4	4.3088	4.087	3.27	4.8	4.1227	0.166
Sr. VitD	26.3163	16.7633	16.103	13.4967	18.34	0.081
Sr. ALP	114.63	104.33	109	131.33	108.66	0.166
Sr. Albumin	3.0625	3.437	3.1333	4.1	3.3902	0.43
T score	-3.3625	-2.6519	-3.6	-2.3667	-2.839	0.221
Z score	-2.325	-1.4852	-1.4333	-1.1333	-1.6195	0.224
BMD	0.478	0.5734	0.4426	0.6073	0.5477	0.212

Table 5: Correlation of variables for Neck of Femur Fracture as per Anatomical Classification

Type	Age	Sex (Male)	Sex (Female)	Sr. Calcium	Sr. PO 4	Sr. Vit. D	Sr. ALP	Sr. Albumin	T score	Z score	BMD
Sub capital	70.14	6	1	8.4857	4.01	19.5714	108.4	3.11	-2.45	-0.98	.585
Trans cervical	49.45	7	4	9.1818	3.92	20.3073	91.2	3.67	-2.21	-1.4	.619
Basicervical	46.82	5	6	9.0818	4.34	21.4618	124.45	3.5	-2.17	-1.27	.615
Total	53.45	18	11	8.9759	4.1	20.5676	108	3.48	-2.25	-1.25	.609
P Value	0.06	0.71		0.185	0.281	0.87	0.497	0.06	0.82	0.68	0.83

Table 6: Correlation of variables for Shaft of Femur Fracture as per AO-Classification

Type	Age	Sex (Male)	Sex (Female)	Sr. Calcium	Sr. PO 4	Sr.Vit. D	Sr. ALP	Sr. Albumin	T score	Z score	BMD
32A1	57	0	1	7.2	4.2	16.3	61	3.6	- 0.50	0.40	0.86
32A2	23.3	10	0	8.5	4.1	23.5	73.7	3.4	- 0.42	-0.68	0.85
32A3	37.3	3	0	9.6	4	19.7	88.3	4.2	-1.7	-1.03	.69
Total	28.71	13	1	8.6	4.09	22.225	75.9	3.6	-0.7	-0.67	0.82

We were not able to compare the individual variables in patients with closed shaft of femur fracture, subtrochanteric femur, and distal femur fracture due to few patients in the subtypes.

Table 7: Correlation of variables for Subtrochanteric Femur Fracture as per AO-Classification

Type	Age	Sex (Male)	Sex (Female)	Sr. Calcium	Sr. PO4	Sr. Vit. D	Sr. ALP	Sr. Albumin	T score	Z score	BMD
32A1	40	1	0	7.6	3.6	22.3	120	3.2	- 0.30	-0.1	0.83
32A2	54.3	2	1	8.6	3.4	22.8	159.6	3.6	-2.0	-0.83	0.66
32A3	39	1	0	9.8	4.2	28.65	90	3.5	- 0.50	1.10	.86
Total	48.4	4	1	8.6	3.6	22.225	137.8	3.5	-1.36	-0.3	0.73

Table 8: Correlation of variables for distal Femur Fracture as per AO-Classification

Type	Age	Sex (Male)	Sex (Female)	Sr. Calcium	Sr. PO4	Sr. Vit. D	Sr. ALP	Sr. Albumin	T score	Z score	BMD
33A3	34.5	3	1	9.5	3.7	21.2	116.2	3.9	0.15	0.375	0.94
33A1	49	1	1	8.9	3.5	21.3	96	3.3	-2.4	-2.0	0.59
33C1	35	2	0	8.6	4.6	24.7	114	3.4	-0.50	-.4	0.83
33C2	50	0	1	8.6	3.3	18.3	79	2.6	-2.7	-1.4	0.55
Total	39.5	6	3	9.1	3.8	21.6	107.1	3.5	-0.88	-0.5	0.8

Table showing frequency of comorbidities of the patients with highest being hypertension – 21, Diabetes – 13, multiple co morbidities – 7, hypothyroidism – 4

Table 9: Co-morbidities of the patients

Co-morbidities	Frequency
Hypertension	21
COPD	1
Hypothyroidism	4

Epilepsy	1
Diabetes	13
K/C/Opsychiatricdisorder	3
Asthma	1
CKD	1
Sicklecelldisease	1
HIV	1
Tuberculosis	1
Multipleco-morbidities	7

Table 10: Correlation of Pattern of fracture with various parameters

Fracture Pattern	N	Age (years)		Sex M	Sex F	T Score	Z Score	Bone Density
Intertrochanteric Femur Fracture	42	59.79	15.9	24	18	-.8357	-.6381	.5481
Neck Of Femur Fracture	28	54.18	21.4	17	11	-.2429	-.2143	.6113
Shaft of Femur Fracture	15	31.13	17.9	14	1	-.5800	-.5200	.8297
Subtrochanteric Femur Fracture	5	48.40	17.5	4	1	-.3600	-.3000	.7394
Distal Femur Fracture	9	39.56	14.4	6	3	-.8889	-.5222	.8017
Total	99			65	34			

Table 11: Comparison of Bone Mineral Density with Different fractures groups using ANOVA test

Fracture pattern		N	Mean	Std. Deviation	P Value
T-score	Intertrochanteric Femur Fracture	42	-2.3548	1.52655	0.126
	Neck Of Femur Fracture	28	-1.9429	1.43073	
	Shaft of Femur Fracture	15	-1.2667	1.51076	
	Subtrochanteric Femur Fracture	5	-2.1000	1.20623	
	Distal Femur Fracture	9	-2.5111	.84327	
	Total	99	-2.0747	1.46234	
Z–score	Intertrochanteric Femur Fracture	42	-1.4595	1.29616	0.094
	Neck Of Femur Fracture	28	-1.0536	1.17992	
	Shaft of Femur Fracture	15	-.4733	1.25952	
	Subtrochanteric Femur Fracture	5	-1.4600	.52726	
	Distal Femur Fracture	9	-1.2889	.77531	
	Total	99	-1.1798	1.22191	
Bone mineral density	Intertrochanteric Femur Fracture	42	.6057	.19607	0.194
	Neck Of Femur Fracture	28	.6633	.19453	
	Shaft of Femur Fracture	15	.7325	.18642	
	Subtrochanteric Femur Fracture	5	.6412	.16579	
	Distal Femur Fracture	9	.5878	.10899	
	Total	99	.6414	.18917	

Table 12: ANOVA results of the age, biochemical, and DEXA scan findings of the group

Variable	Normal (N=21)		Osteopenia		Osteoporosis		P Value
	Mean	SD	Mean	SD	Mean	SD	
Age	27.67	9.068	55.65	19.976	59.30	16.166	0.001
Serum calcium(mg/dl)	8.9952	.80155	8.8206	.72490	8.7085	.70459	0.329
Serum Vit. D(ng/ml)	22.5971	5.79380	17.4748	5.84248	20.7183	10.03896	0.069
Serum phosphorus(mg/ dl)	4.1738	.73376	4.0916	.81217	3.9945	.76600	0.658
Alkaline phosphate(u/l)	85.95	32.779	99.06	28.152	117.21	56.098	0.022
Serum protein Albumin(gm/dl)	3.7238	.43117	3.6065	.58931	3.2787	.44621	0.001
T-score	-.1619	.47590	-1.5677	1.04861	-3.2638	.67225	0.001
Z–score	-.1286	.80755	-.5000	.99599	-2.0979	.75714	0.003
Bone mineral density	.8985	.07165	.6969	.13432	.4899	.08074	0.0003

Table 13: Tukey's HSD (post-hoc) test findings comparison between the groups

Variable	Group	Std. Error	P value	95% Confidence Interval	
				Lower Bound	Upper Bound
Age	I vs II	4.619	.000	-38.97	-16.98
	I vs III	4.289	.000	-41.84	-21.42
	II vs III	3.781	.600	-12.65	5.35
Serum calcium(mg/dl)	I vs II	.20690	.677	-.3180	.6672
	I vs III	.19216	.299	-.1707	.7442
	II vs III	.16939	.786	-.2911	.5154
Serum Vit. D. (ng/ml)	I vs II	2.29521	.071	-.3417	10.5863
	I vs III	2.13161	.653	-3.1957	6.9534
	II vs III	1.87901	.201	-7.7166	1.2297
Serum phosphorus (mg/dl)	I vs II	.21882	.925	-.4387	.6031
	I vs III	.20322	.653	-.3045	.6631
	II vs III	.17914	.851	-.3293	.5236
Alkaline phosphate (u/l)	I vs II	12.574	.552	-43.05	16.82
	I vs III	11.678	.024	-59.06	-3.46
	II vs III	10.294	.188	-42.65	6.36
Serum protein Albumin (gm/dl)	I vs II	.13922	.677	-.2141	.4488
	I vs III	.12930	.002	.1373	.7529
	II vs III	.11398	.014	.0564	.5991
T-score	I vs II	.22026	.000	.8815	1.9302
	I vs III	.20456	.000	2.6150	3.5889
	II vs III	.18032	.000	1.2668	2.1254
Z–score	I vs II	.23991	.273	-.1997	.9426
	I vs III	.22281	.000	1.4389	2.4997
	II vs III	.19640	.000	1.1303	2.0654
Bone mineral density	I vs II	.02802	.000	.1349	.2684
	I vs III	.02603	.000	.3467	.4706
	II vs III	.02294	.000	.1524	.2616

I =Normal, II= Osteopenia, III=Osteoporosis

Discussion

In the 1950s, Fuller Albright defined osteoporosis as a lack of bone mass. The Institutes of Health (NIH) defined osteoporosis as a skeletal disease with decreased bone strength and increased fracture risk in 1988. Bone strength depends on bone density and quality. In 2001 NIH redefined osteoporosis as a Systemic increases fracture risk due to low bone mass and microstructural bone tissue damage.

The WHO defined osteoporosis operationally in 1994: BMD above 1 SD below the young adult mean is normal. Osteopenia, also known as low bone mass, is characterised by a BMD that is 1 to 2.5 SD below the mean of young adults. Having one or more fragility fractures, a BMD that is more than 2.5 SDs below the mean for young adults, or a BMD that is less than or equal to 2.5 SDs below the mean for young people are all signs of established (or severe) osteoporosis. Due to reduced bone mass and microarchitectural degeneration, osteoporosis causes bone fragility and fractures. Osteoclast activity increases and osteoblast activation decreases, causing a remodelling deficit and bone loss. Osteoporosis kills many elderly people and is debilitating. Osteoporosis risk will increase as the Asian population ages from 5.3% in 1995 to 9.3% in 2025. Due to life expectancy and lifestyle changes, osteoporosis is now a pandemic. Low-energy trauma or fragility fractures cause osteoporosis, a public health issue. 30% of women over 50 have osteoporosis.

According to various expert groups, 26 million Indians have osteoporosis (as of 2003), but that number is expected to rise to 36 million by 2013.

Osteoporosis affects a disproportionately high percentage of senior citizens worldwide, including Indians. Osteoporosis increases bone breakage. Fragility fractures are deadly. Osteoporosis treatment is costly.

BMD testing has several methods. In the early 20th century, dentists used mandibular dental radiographs. Quantitative morphometry radiographs, USG, DEXA (dual energy absorptiometry), and Computed Tomography scan-based modalities like peripheral quantitative computed tomography (QCT) and high resolution QCT replaced them. Peripheral X-ray absorptiometry (DXA) systems are portable and cheaper than traditional DXA systems, but they are best used for screening and risk assessment. Dual-

energy X-ray absorptiometry is the best way to diagnose osteoporosis (DXA).

The Fracture Risk Assessment (FRAX) tool doesn't consider total risk variables or bone turnover marker when predicting the likelihood of a severe fracture in the next decade (BTMs).

Dual-energy X-ray absorptiometry is the gold standard for osteoporosis diagnosis (DXA). The Fracture Risk Assessment (FRAX) tool does not consider all risk variables or bone turnover markers when predicting the likelihood of a serious fracture in the next decade or more (BTMs). Osteoclast and osteoblast caloric expenditure. Serial assessments can detect increased bone turnover and fracture risk (particularly resorption indicators).

Antiresorptive treatment helps fast bone-losers faster. Numerous studies have shown that high resorption indicators predict fractures independently of BMD. BTMs also monitored patients' anti-osteoporotic medication compliance sensitivity and specificity for postmenopausal osteoporosis are unknown.

BTM assessments have pros and cons. All bone resorption indicators except TRAP-5b are breakdown products of bone collagen.

Macrophages, dendritic cells, and osteoclasts produce TRAP-5a and TRAP-5b, respectively. Serum TRAP-5b levels reflect osteoclast quantity and activity. Serum concentration is unaffected by diet and liver/kidney diseases. It's sensitive and specific and matches other resorption indicators.

Biochemical bone indicators can identify high-risk fracture patients and evaluate anti-re-absorptive or anabolic medication.

Biochemical markers of bone metabolism allow real-time assessment of bone resorption, production, and turnover. Biochemical bone markers have only recently been detected in clinics, despite decades of bone biochemistry research.

Serum bone-specific alkaline phosphatase is a common indicator of new bone growth (BSAP). Bone formation velocity increases with BSAP synthesis in osteoblasts.

Thus, the current study sought to link DUAL ENERGY X-RAY ABSORPTIOMETRY bone density and bone metabolism markers in femur fracture patients (i.e. Serum calcium; Serum phosphorus; Alkaline phosphatase; Serum Vitamin D; and Serum protein - albumin).Our study was conducted in AIIMS Raipur Orthopaedics department. The study included 99 femur fracture cases that met all inclusion criteria.

In this study, bone mineral density was affected by age, serum calcium, vitamin D, phosphorus, alkaline phosphatase, albumin, t-score, and z-score.

As mentioned above, old age is strongly associated with poor bone mineral density, while serum calcium, vitamin D, and phosphorus levels had no significant correlation. Serum alkaline phosphatase, serum albumin, T-score, and Z-score predict fracture risk with bone mineral density. In femur fracture patients, DXA is inversely related to blood alkaline phosphatase and serum albumin levels. Due to structural degradation and microarchitectural degeneration, OP increases bone fracture risk. It's called a "silent epidemic" because many don't show symptoms.

Published studies show that it cannot predict fracture risk. DXA detects osteoporosis best. When bone microarchitecture changes, fracture risk rises even without low BMD (affecting bone quality). BTM assesses bone mechanics. Many people with bone mineral density above the diagnostic threshold (T-score > 2.5 SD) had osteoporotic fractures. Thus, BMD alone may identify fracture risk.

No other study had the same objectives. Researchers wonder if DXA can accurately predict fracture risk. We'll handle your studies.

BMD values are inversely related to BTMs. Pre-treatment BTM levels accelerated bone loss. Although we all have the same bone resorption for a given BTM, these levels may vary greatly. BTMs cannot predict patient-specific rapid bone loss. BTMs can help select patients who will benefit most from anti-osteoporotic medication.

BTMs and BMD have an inverse relationship, especially in older patients (notably resorption markers).

Elderly BTMs are still elevated, but usually due to another process (vitamin D deficiency, intestinal malabsorption for calcium, and secondary hyperparathyroidism).

Several meta-analyses show that bone mineral density and BSAP are moderately unfavourable. Estrogen deprivation for more than 15 years decreased bone sialoprotein A levels in osteoporosis patients (BSAP). BSAP levels decrease with E2 deprivation length, indicating that bone production slows.

V.E. Gómez-Islas et al. found that DXA-assessed BMD can predict fracture risk in CKD women. As in the general population, DXA-measured BMD is sensitive and specific enough to predict fracture risk in women with CKD. Renal failure patients are diagnosed, treated, and monitored.

In their study, Fidan N et al. evaluate serum bone turnover markers (BTM) and DEXA-measured BMD in before dialysis patients with chronic renal disease CKD. However, serum alkaline phosphatase (AP) and BSAP were negatively

correlated, and BMD of FN T-Z scores and serum HCO3 were positively correlated (r=0.270, p=0.029; r=0.306, p=0.012; r:0.250, p=0.043). No site's BMD correlated with Egfr statistically. Women over 65 and after menopause had the greatest BMD decline. In late renal failure, elevated BSAP and AP blood levels indicate femur fracture risk but not spinal fracture risk. DEXA bone mineral density (BMD) measurements show bone loss, but they cannot distinguish between chronic kidney disease phases (CKD). DXA-measured BMD can predict fractures because it correlates well with bone metabolism markers like serum alkaline phosphatase.

Conclusion

At the end of the study, we come to the conclusion that:

- Due to decreased bone mass and microarchitectural degradation, osteoporosis causes bone fragility and fractures.
- Bone mineral density measurements are crucial for diagnosing osteoporosis and prescribing fracture-prevention medication. Dual-energy X-ray absorptiometry accurately diagnoses osteoporosis, calculates fracture risk, and monitors treatment.
- However, biochemical bone markers can identify high-risk fracture patients and monitor anti-re-absorptive or anabolic medication.
- This study examined whether DXA bone density and bone metabolism indicators were linked in people who had broken their femur (i.e. Serum calcium; Serum phosphorus; Alkaline phosphatase; Serum Vitamin D; and Serum protein - albumin).
- We conclude from these findings that DXA-measured BMD is a valuable tool for predicting fractures and has a strong correlation with markers of bone metabolism such serum alkaline phosphatase.

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