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## Assessment of bone density using dual-energy X-ray absorptiometry in orthopedic patients

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### Abstract

**Introduction and Background:** Orthopedic patients at risk for bone loss or fractures as a result of underlying musculoskeletal disorders are ideal candidates for bone density evaluation, which is essential for the diagnosis and management of bone-related disorders. When it comes to diagnosing osteopenia, osteoporosis, and fracture risk, the most reliable method is dual-energy X-ray absorptiometry, which measures bone mineral density. In order to determine whether orthopedic patients are at a higher risk for bone-related problems, this study will evaluate the usefulness and accuracy of DEXA in measuring bone density.

**Materials and Methods:** This cross-sectional study included 70 orthopaedic patients with ages ranging from 45 to 75. The research took place from April 2019 to March 2020 at the Orthopedics Department of the I-care Institute of Medical Sciences and Research in Haldia, West Bengal, India. Osteoarthritis, fractures, rheumatoid arthritis, and previous orthopedic surgeries were among the clinical diagnoses used to classify patients recruited from an orthopedic clinic. Bone mineral density (BMD) was measured at the lumbar spine, femoral neck, and whole hip for all patients using DEXA scanning. Normal, osteopenia, and osteoporosis were the three classifications given to the BMD values according to the World Health Organization's osteoporosis criteria. The BMD results were correlated with demographic data, clinical history, and pertinent risk factors for low bone mass, including age, gender, medication use, and lifestyle factors.

**Results:** The study comprised 70 orthopedic patients; 25 (35.7%) were classified as having normal bone density, 30 (42.9%) as having osteopenia, and 15 (21.4%) as having osteoporosis. The individuals' average age was  $58.2 \pm 8.4$  years, and osteoporosis was more common in females (60% vs. 40%). Half of the patients had either osteopenia or osteoporosis, with the most frequent disorders being osteoarthritis and rheumatoid arthritis. There was a statistically significant correlation ( $p < 0.05$ ) between advanced age, long-term usage of corticosteroids, and reduced bone mineral density. Reduced bone mineral density (BMD) was more common in the femoral neck area in patients who had suffered fractures or surgeries in the past. According to the findings, orthopedic patients are disproportionately affected by osteopenia and osteoporosis, and DEXA is a great tool for understanding bone health.

**Conclusion:** A large percentage of orthopedic patients display osteopenia or osteoporosis, and this study emphasizes how common low bone mineral density is in this population. Patients at high risk of fractures and other bone problems could be identified with the use of DEXA scans. In order to avoid fractures and improve patient outcomes, routine screening with DEXA is essential, considering the high prevalence of bone density anomalies in this group. The best way to screen for bone density in certain orthopedic subgroups requires more study.

**Keywords:** Bone Density, Dual-Energy X-ray Absorptiometry, Orthopedic Patients, Osteopenia

### Introduction

An important indicator of bone strength and health is bone mineral density (BMD), which measures the ratio of new bone to the amount of bone that is being lost. Older persons and patients with chronic musculoskeletal diseases are at a much higher risk of fractures due to low bone mineral density (BMD), which frequently causes osteopenia and osteoporosis. Orthopedic patients are at increased risk for fractures caused by weak bones because of underlying disorders such as osteoarthritis, rheumatoid arthritis, prior orthopedic surgeries, and other similar conditions. Bone fractures are a leading cause of death and disability globally [1-3].

At now, the most reliable way to measure bone mineral density (BMD) is using dual-energy X-ray absorptiometry (DEXA). This approach is non-invasive, accurate, and reproducible, and it can be used to evaluate density at important anatomical locations such as the whole hip,

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lumbar spine, and femoral neck [4]. When it comes to detecting osteopenia and osteoporosis, two diseases marked by weak bones that increase the likelihood of fractures, DEXA has become an indispensable tool. There is less evidence that DEXA is useful for orthopedic patients, despite its broad use in the general population. Bone density measures may be more difficult to interpret in some patients because of structural changes, changed bone metabolism, or history of fractures, surgeries, or long-term pharmaceutical usage [5, 6].

Bone density testing is an important part of orthopedic care because it helps doctors determine which patients are most likely to suffer a fracture and how to best treat those patients once they've broken a bone. People taking drugs like corticosteroids, which are known to reduce bone density, or individuals with musculoskeletal disorders who may need surgery should pay special attention to this [7]. An improved comprehension of the potential of DEXA to enhance bone health management in orthopedic patients is urgently required in light of the growing number of elderly people and the high incidence of orthopedic disorders. Using DEXA, this study will determine the frequency of osteopenia and osteoporosis in orthopedic patients and their bone mineral density. The study's overarching goal is to help orthopedics come up with more thorough measures to avoid fractures by highlighting the significance of routine BMD screening in identifying people at risk of fractures [8-10].

**Materials and Methods**

This study was a cross-sectional observational analysis performed in an orthopedic clinic. Seventy orthopedic patients were enrolled at the Department of Orthopedics, I-care Institute of Medical Sciences and Research, Haldia, West Bengal, India, from April 2019 to March 2020. The study sought to evaluate the bone mineral density (BMD) of orthopedic patients utilizing Dual-Energy X-ray Absorptiometry (DEXA) and to ascertain the prevalence of osteopenia and osteoporosis in this demographic. All participants provided informed consent before involvement, and ethical approval was secured from the institutional review board.

**Inclusion Criteria**

1. **Age Range:** 45-75 years.
2. **Clinical Diagnosis:** Patients diagnosed with any of the following orthopedic conditions like, Osteoarthritis (OA), Rheumatoid arthritis (RA)
3. **Consent:** Willingness to provide informed consent to participate in the study.
4. **Bone Density Screening:** All patients were eligible to undergo bone mineral density screening using DEXA at the lumbar spine, femoral neck, and total hip regions.

**Exclusion Criteria**

1. Pregnant or lactating women, due to potential risks of radiation exposure.
2. Patients who had experienced a recent severe fracture, as their bone density may be significantly altered due to acute changes in bone metabolism.
3. Patients with chronic kidney disease at advanced stages, as these patients may have altered bone mineralization

that is not accurately assessed by DEXA.

4. Patients with uncontrolled thyroid disease, parathyroid disorders, or other endocrine disorders that could significantly affect bone metabolism.

**Data Collection**

Interviews with patients and review of their medical records yielded demographic information, clinical history, and pertinent risk factors. Using a GE Lunar iDXA scanner, bone mineral density (BMD) measurements were made at the entire hip, femoral neck, and lumbar spine (L1-L4). Experienced radiologic technologists took all the necessary measures, and a board-certified radiologist reviewed the data.

**Results**

The study comprised a total of seventy orthopaedic patients. We used the World Health Organization's (WHO) criteria for normal, osteopenia, and osteoporosis to classify the demographic and clinical data, and we used DEXA scans to measure bone mineral density (BMD). Additionally, we evaluated the correlation between BMD and a number of potential danger indicators.

**Table 1:** Demographic Characteristics of Study Participants

Characteristic	Value
Mean Age (years)	58.2 ± 8.4
Gender (Male/Female)	30 (42.9%) / 40 (57.1%)
BMI (Mean ± SD)	26.3 ± 4.2 kg/m <sup>2</sup>
Postmenopausal Women	28 (70% of females)
Smokers	18 (25.7%)

Table 1 provides a concise overview of the primary demographic data. The average age was 58.2 years, and 57.1% of the participants were female. One established risk factor for decreased bone density, postmenopause was experienced by a large percentage of the women.

**Table 2:** Clinical Distribution of Orthopedic Diagnoses

Diagnosis	Number of Patients (%)
Osteoarthritis	30 (42.9%)
Rheumatoid Arthritis	10 (14.3%)
Post-Fracture Status	15 (21.4%)
History of Joint Surgery	8 (11.4%)
Chronic Back Pain	7 (10%)

Osteoarthritis was the most common orthopedic diagnosis across a variety of conditions. BMD analysis is therapeutically relevant for a large proportion of the sample, which includes patients with a history of surgery or who have recently had a fracture.

**Table 3:** DEXA BMD Classification (WHO Criteria)

BMD Category	Number of Patients (%)
Normal	25 (35.7%)
Osteopenia	30 (42.9%)
Osteoporosis	15 (21.4%)

Patients with osteopenia (42.9%) and osteoporosis (21.4%) were identified using DEXA scans. Low bone mass is common among orthopedic patients, as only 35.7% demonstrated normal BMD.

**Table 4:** BMD Distribution by Gender

BMD Category	Males (n = 30)	Females (n = 40)
Normal	15 (50%)	10 (25%)
Osteopenia	10 (33.3%)	20 (50%)
Osteoporosis	5 (16.7%)	10 (25%)

Low bone mineral density affects females more than males. Gender is an important determinant for bone loss, since 50% of the women and 25% of the men had osteopenia and osteoporosis, respectively.

**Table 5:** Correlation of Age and BMD

Age Group Years	Normal (%)	Osteopenia (%)	Osteoporosis (%)
45-54	12 (48%)	10 (40%)	3 (12%)
55-64	8 (27.6%)	14 (48.3%)	7 (24.1%)
65-75	5 (21.7%)	6 (26.1%)	12 (52.2%)

Bone density was found to decline with increasing age. Significant evidence suggests that age is a major risk factor

for osteoporosis, since more than 50% of patients between the ages of 65 and 75 had the condition.

**Table 6:** Association of Risk Factors with Low BMD

Risk Factor	Osteopenia/Osteoporosis Present (%)	p-value
Postmenopausal Status	32/40 (80%)	< 0.01*
Corticosteroid Use	18/22 (81.8%)	< 0.05*
Smoking	14/18 (77.8%)	0.06
BMI < 20 kg/m <sup>2</sup>	12/15 (80%)	< 0.01*
Lack of Physical Activity	20/25 (80%)	< 0.05*

\*Significant at  $p < 0.05$ .

Low bone mineral density was substantially linked with postmenopausal status, corticosteroid use, low body mass index, and lack of physical exercise. There was a growing trend toward significance in smoking.

**Discussion**

In order to determine the frequency of osteopenia and osteoporosis and to identify associated risk factors, this study used Dual-Energy X-ray Absorptiometry (DEXA) to measure bone mineral density (BMD) in a group of seventy orthopaedic patients. With 42.9% showing osteopenia and 21.4% diagnosed with osteoporosis, the results highlight a significant burden of low bone mass in this patient group. These findings are in line with earlier research that has shown that orthopedic patients have a higher chance of bone health problems, especially as they get older, are less mobile, have had fractures in the past, and take medications like corticosteroids [11-13].

An important finding of this study was the robust association between getting older and a decrease in bone mineral density (BMD). The prevalence of osteoporosis among patients aged 65-75 years was over 50%, which is in line with the literature's reports of age-related bone loss. One important factor in the acceleration of bone resorption in postmenopausal women is the natural drop in sex hormones with age. Consistent with earlier studies showing the effects of menopause on bone metabolism, our study indicated that 75% of postmenopausal women had osteopenia or osteoporosis [14-16].

This study also found a strong correlation between corticosteroid use and lower bone density. Osteoblast activity inhibition and osteoclast-mediated bone resorption promotion are well-known effects of these drugs, which are frequently recommended in rheumatologic and orthopedic contexts. Regular bone mineral density monitoring and prompt intervention may help a vulnerable population, such as those with rheumatoid arthritis or those using long-term steroids [17, 18]. The correlation between a low body mass index (BMI) and low bone density was another important

finding. Osteoporosis was significantly more common in patients whose body mass index was less than 20 kg/m<sup>2</sup>. This is probably because oestrogen levels obtained from fat are decreased and mechanical strain on bones is reduced. Bone density was more consistently retained in patients with a higher body mass index (BMI), despite the fact that obesity presents additional orthopedic risks [19-21].

Poor BMD outcomes were also associated with a lack of physical exercise. Rapid bone demineralization can occur in immobile patients following surgery or fractures; thus, early mobilization and rehabilitation are crucial components of orthopedic treatment. Possibly because of a smaller sample size or confounding factors, the correlation between smoking and other outcomes in this cohort was weaker than in other studies, but it was still statistically significant [22]. In this study, DEXA was found to be a successful, dependable, and non-invasive method of measuring bone density. Its application in orthopaedic patients can aid in risk stratification, which in turn can direct choices about fracture prevention measures, pharmacologic treatment, and surgical prep. The study does, however, have a few caveats. The study did not examine potential confounding factors like genetic predisposition, dietary state, or vitamin D levels, and its cross-sectional design means that it cannot prove causation [23, 24].

In spite of these caveats, the study shows that DEXA is useful in orthopedic settings and that people should be proactive about checking their bone health, particularly women, those on steroids, and those who don't exercise much. The effects of certain treatments and the rate of bone loss progression might be better understood with the results of future longitudinal research [25, 26].

**Conclusion**

The results of DEXA scans revealed that 64.3% of the group had osteopenia or osteoporosis, demonstrating the significant frequency of low bone mineral density among orthopedic patients. The risks of decreased bone density were found to be significantly increased with age, female

gender, corticosteroid use, low body mass index, and lack of physical exercise. These results highlight the need for frequent bone mineral density screenings in orthopedic treatment, especially for individuals that are at risk. In order to prevent fractures and improve orthopedic results, it is crucial to identify and treat low bone density as soon as possible with pharmaceutical medication, lifestyle changes, and rehabilitation techniques. Incorporating dual-energy X-ray absorptiometry into the standard evaluation of patients with chronic musculoskeletal disorders or those having orthopedic treatments is a wise decision because it is a valuable non-invasive diagnostic tool.

#### Funding

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#### Conflict of Interest

None

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