Introduction

Rheumatoid arthritis (RA) is a connective tissue disease producing persistent systemic inflammation with joint inflammation and also leads to function loss and joint destruction.\(^1\)

RA produces local or juxta-articular and generalised bone loss. Many cross-sectional studies conducted on RA patients found decreased bone mineral density (BMD) of the lumbar spine and hips compared to healthy individuals.\(^2\)

In general, rheumatic patients are more prone to developing osteoporosis because of effective systemic inflammation, immobility and the use of steroids.\(^3\) It is a well-known factor that generalised osteoporosis is a feature of RA but it is not clear that either this is due to a consequence of treatment, immobility, or the activity of the disease.\(^4\) Another factor is peri-articular osteoporosis in RA, and that is also considered controversial because the aetiology of decreased bone mass is perhaps multifactorial, involving their lifestyle risk factors and disease-related elements.\(^5\)

Low bone mass results in bone loss of the skeleton and is regularly termed osteopenia or osteoporosis. Further fractures around the hip can increase the significant economic burden, morbidity and mortality.\(^6\) The pathophysiology of osteoporosis is multifactorial and complex, but most of the studies proved that bone mass was the most important factor of bone strength for 80% of its variation.\(^7,8\) Diminished bone mass is consequently a valuable predictor of increased chance for fractures.\(^9\)

Several studies verified that a reduction in bone density at the hip and spine of one Standard Deviation (SD) increases the fracture risk by a factor of 2-3,\(^10-13\) and activity of the disease also suggested a potential risk factor for osteopenia for RA patients.\(^14,15\)

American College of Rheumatology (ACR) classification for RA osteopenia of the hands detected on the radiographs is one of the requirements,\(^16\) but the radiological evaluation is incapable of detecting bone loss once it is less than 30%. Dual Energy X-ray absorptiometry...
Absorptiometry (DEXA) seems to be an added reliable method for discovering early bone loss in patients with RA compared to radiographs. The association between BMD, disease duration and bone destruction also indicates that the DEXA method can be beneficial for the estimation of activity of disease and its progress.\textsuperscript{17,18}

In early RA BMD measurement of hand by DEXA is possible and decreased hand bone mass also occur in early before the lumbar and hip BMD loss, and also can be the possible outcome measure in early disease.\textsuperscript{19} DEXA technology is necessary for the diagnosis, as the World Health Organisation (WHO) defined currently that osteoporosis is a T score of > -2.5 SD.\textsuperscript{20}

The current study was planned to observe the axial as well as appendicular skeleton of BMD by DEXA method in RA patients.

**Subjects and Methods**

The observational study was at Liaquat University of Medical and Health Sciences, Jamshoro, Pakistan, from January 2011 to December 2014.

Patients aged 25-55 years, who were already diagnosed with RA were included. Patients with other arthritic problems were excluded.

The patients were registered, prepared and evaluated on an outpatient basis and they were advised at the time of appointment that on the day of DEXA assessment, they should eat normally, stop taking any calcium supplements at least 24 hours prior to DEXA test, to come in loose and comfortable dress, and to avoid garments having zippers, belts or buttons made of metal. Patients who had recently been examined by barium or were injected any contrast material for a computed tomography (CT) or isotope scans were advised to wait at least two weeks for a DEXA test. All women were asked about pregnancy status because of the radiation prevention.

During DEXA test for spine, patient’s hips were flexed and stayed on a padded box to flatten the pelvis and lumbar spine. To assess the hip, the patient’s foot was internally rotated and placed in a fixed block that rotated the hip inward. After confirmation of the positions the DEXA sensors started and passed gradually and over the required area for scan-generated images on a computer screen which were analysed.

The collected data was examined using SPSS 21. In the first stage, descriptive statistics were computed to know the background information about patients like age, gender, areas scanned (i.e., femoral neck, trochanteric area, lumbar spine) and type of rheumatoid arthritis (i.e., osteopenia, osteoporosis, and normal). In the second stage, inferential statistics were computed using Chi-Square test to examine the relationship between age and various types of RA.

BMD was measured from the appendicular skeleton like femoral neck, and also in Ward’s triangle, and for axial skeleton from L1 - 5 lumbar spines.

**Results**

Out of 229 patients, 33 (14.4%) were male and 196 (85.5%) were female. Five (15.15%) males were normal; 14 (42.42%) had osteopenia and osteoporosis was detected in 14 (42.42%). Females were 45 (29.95%) normal, 72 (37.73%) osteopenia and 79 (40.30%) osteoporosis (Figure).

The overall mean age was 46.46±11.96 years (range: 25-55 years). Significant statistical association with age and areas scanned through DEXA were noted (Table-1).

Overall, 123 (53.7%) were aged 30-50 years. Of them, 38 (30.9%) were normal, 59 (48.0%) were osteopenic and 26 (21.1%) had osteoporosis. The remaining 106 (46.3%) were over 51 years of age. Of them, 12 (11.3%) were normal, 27 (25.5%) were osteopenic and 67 (63.2%) had osteoporosis.

<table>
<thead>
<tr>
<th>Age in Years</th>
<th>Neck of Femur T-score</th>
<th>Trochanteric Area T-score</th>
<th>Lumbar Spine T-score</th>
</tr>
</thead>
<tbody>
<tr>
<td>N Valid</td>
<td>229</td>
<td>225</td>
<td>225</td>
</tr>
<tr>
<td>Missing</td>
<td>0</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Mean</td>
<td>46.46</td>
<td>-1.572</td>
<td>-1.039</td>
</tr>
<tr>
<td>Median</td>
<td>50.00</td>
<td>-1.800</td>
<td>-1.003</td>
</tr>
<tr>
<td>Mode</td>
<td>55</td>
<td>-1.9</td>
<td>-2.3a</td>
</tr>
<tr>
<td>Std. Deviation</td>
<td>11.964</td>
<td>1.4386</td>
<td>1.3853</td>
</tr>
<tr>
<td>Minimum</td>
<td>25</td>
<td>-4.9</td>
<td>-5.6</td>
</tr>
<tr>
<td>Maximum</td>
<td>55</td>
<td>4.4</td>
<td>4.1</td>
</tr>
</tbody>
</table>

**Table-1:** Significant statistical association by age in years and hip and lumbar scanned areas by DEXA.

DEXA: Dual Energy X-ray Absorptiometry.
There was a significant association between age and disease ($p<0.05$) (Table-2).

Bone minerals like serum calcium, phosphorus and alkaline phosphatase were also assessed (Table-3).

![Frequency distribution of patients according to sex and disease](image)

**Table-2**: Distribution of disease according to age.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Age * Disease</th>
<th>Osteoporosis</th>
<th>Osteopenia</th>
<th>Normal</th>
<th>Total</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>Count (%)</td>
<td>26 (21.1%)</td>
<td>59 (48.0%)</td>
<td>38 (30.9%)</td>
<td>123 (100.0%)</td>
<td>0.000</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Age</th>
<th>Count (%)</th>
<th>67 (63.2%)</th>
<th>27 (25.5%)</th>
<th>12 (11.3%)</th>
<th>106 (100.0%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>Count (%)</td>
<td>93 (40.6%)</td>
<td>86 (37.6%)</td>
<td>50 (21.8%)</td>
<td>229 (100.0%)</td>
</tr>
</tbody>
</table>

**Table-3**: Association between Bone Minerals.

<table>
<thead>
<tr>
<th>Statistics</th>
<th>Age</th>
<th>Calcium</th>
<th>Phosphorus</th>
<th>Alkaline Phosphorus</th>
<th>Vitamin-D</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>Valid</td>
<td>229</td>
<td>227</td>
<td>227</td>
<td>229</td>
</tr>
<tr>
<td></td>
<td>Missing</td>
<td>0</td>
<td>2</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Mean</td>
<td>46.46</td>
<td>8.726</td>
<td>3.958</td>
<td>156.43</td>
<td>16.671</td>
</tr>
<tr>
<td>Median</td>
<td>50.00</td>
<td>8.900</td>
<td>3.800</td>
<td>129.00</td>
<td>14.270</td>
</tr>
<tr>
<td>Mode</td>
<td>60</td>
<td>8.9</td>
<td>3.4</td>
<td>115</td>
<td>8.6</td>
</tr>
<tr>
<td>Std. Deviation</td>
<td>11.964</td>
<td>1.1013</td>
<td>1.0318</td>
<td>110.830</td>
<td>11.5850</td>
</tr>
<tr>
<td>Minimum</td>
<td>25</td>
<td>1.4</td>
<td>2.4</td>
<td>4</td>
<td>3.4</td>
</tr>
<tr>
<td>Maximum</td>
<td>55</td>
<td>10.8</td>
<td>8.5</td>
<td>1016</td>
<td>94.8</td>
</tr>
</tbody>
</table>

**Table-4**: Significant association between categorical variables according to disease.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Osteoporosis</td>
<td>93</td>
<td>40.6</td>
</tr>
<tr>
<td>Osteopenia</td>
<td>86</td>
<td>37.6</td>
</tr>
<tr>
<td>Normal</td>
<td>50</td>
<td>21.8</td>
</tr>
<tr>
<td>Total</td>
<td>229</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Of the total 229 patients, 50 (21.83%) were normal, 93 (40.61%) had osteoporosis and 86 (37.55%) had osteopenia (Table-4).

**Discussion**

Quite a few techniques have been used previously to assess the level of BMD in RA patients and DEXA is a relatively recent advanced procedure. In this study patients were assessed for BMD by DEXA of 229 diagnosed RA patients. RA patients had lower BMD with osteopenia and osteoporosis regardless of age, and there were fewer normal subjects.

BMD in RA patients proved the relationship among the high radiological RA destruction and low BMD at the hip, suggesting the connection between the severity of RA and the risk of generalised bone loss.$^{21}$

There are three altered disease-dependent mechanisms, which may be dependable for the increased prevalence of low bone mass in RA. These include disease activity, reduced physical activity and the use of glucocorticoids. Further, potential risk factors for bone loss in RA can include the treatment with methotrexate or cyclosporin A.$^{22}$

Studies$^{23-25}$ are available about the evaluation of bone mass density in the hand with forearm of RA patients. We examined the lumbar spine and hip region with neck of femur and trochanteric areas and found that the mean T-score of lumbar was less than the mean T-score of hip areas.
RA is itself also associated with osteoporosis. Periarticular osteoporosis is also one of the earliest radiological signs in RA, and the release of inflammatory mediators, like cytokines, from the different inflammatory cells is the most likely cause. A continuing reduction in bone mass within the first five years causes rheumatoid-determined mechanisms. The relationship of variance of lumbar BMD explained by the deterioration equation is low. Data of this study also showed that lumbar spine score was low compared to that of hip.

Shenstone et al. studied the relationship between BMD and Health Assessment Questionnaire (HAQ) score, and also presented correlation between lumbar BMD and baseline Stoke Index, and the loss of bone mass density was found to be higher in the neck of femur during early stages of RA irrespective of the activity of disease and working loss. Low bone density was also found in this study, but data did not comprise Stoke Index.

Another study measured BMD in the lumbar spine, hip and the neck of the femur in 97 patients between 27 and 80 years of age who had been recently diagnosed with RA. The average BMD of the patients was lower than normal bone density in perimenopausal women with rheumatoid arthritis--a population based study. Ann Rheum Dis. 1994; 53:18-23.

In the current study, 50 (21.83%) RA patients were found with normal BMD which has not been reported previously in literature.

Conclusion
Osteoporosis and osteopenia were most common among RA patients. The assessment of BMD by DEXA could lead to early relief in clinical symptoms through combine therapy.

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References


