Changes in bone mass and biochemical indices in patients with Colles and femoral neck fracture

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In this study, the values of bone mineral density (BMD), bone mineral content (BMC) and bone related biochemical assays were obtained in 20 patients with femoral neck fractures and 30 patients with Colles fractures.

BMD and BMC measurements were determined by photon absorptiometry at vertebrae, mid and distal radius.

When the patients with femoral neck fractures were compared to the age-and sex-matched controls, the trabecular and cortical bone loss were significantly higher in the former group. According to the BMD values, bone loss ratios were 21% at L2L4, 20% at mid radius, 24% at distal radius in men; (p<0.01), but 35% at L2L4, 33% at mid radius and 45% distal radius in women; (p<0.001). Similar results were also obtained in patients with distal radius fractures. According to the BMD values, bone loss ratios were 23% at L2L4, 23% at mid radius, 27% at distal radius in men; p<0.001, but 23% at L2L4, 18% at mid radius and 22% at distal radius in women; (p<0.001, p<0.05 and p<0.01). The loss of bone mass was the highest in female patients with femoral neck fractures.

The body mass index (BMI) was significantly lower in all osteoporotic patients except for female patients with femoral neck fractures. In general, there was not any significant difference between the biochemical indices of healthy and osteoporotic subjects. [Turk J Med Res 1993; 11(1): 37-43]

Key Words: Femoral neck fracture, Colles fracture, Bone mineral density, Bone mineral content

Osteoporosis, the commonest bone disorder and a clinical definition, is characterized by a reduction in bone mass that compromises the biomechanical integrity of the skeleton and is complicated by fractures. Osteoporosis is categorized in two main groups; primary and secondary. While in secondary osteoporosis there is another disease or a cause responsible for osteoporosis, there is no such a cause in primary osteoporosis.

Primary osteoporosis can also be categorized in two different types having different general characteristics. Type I osteoporosis (postmenopausal) is a case observed in postmenopausal women after the age 55 and where the trabecular bone loss is dominant.

Vertebral fractures and distal radius (Colles) fractures are often observed in these atients. Type II osteoporosis (senil) is the type of osteoporosis with both trabecular and cortical bone losses, observed in old patients and manifesting itself with femoral neck fractures.

Various investigators have shown that average trabecular bone ratios were 73% in vertebrae constituting the axial skeleton system; 69-90% in lumbar vertebrae; %25 in femoral neck constituting appendicular skeleton system; 5-10% in midradius and 30-40% in distal radius (1,2).

A lot of investigators studied the relation between bone mass loss and fracture and particularly determined that the fracture risk increases when the bone mineral mass decreases more than 20% of the normal value (3,4). In femoral neck fractures, authors put forward different views. Some authors state that these persons are not osteopenic (1,5,6) and others support that bone mass loss is an important cause (7,8). But they all agree that trabecular bone mass loss is responsible for Colles fractures (9-11).

Bone turnover markers and other biochemical indices related with bone metabolism is generally found to be normal other than osteoporotic cases where turnover rates are high (12,13).
In this study, the changes occurring in the bone masses and bone related biochemical indices of the primary osteoporotic patients with femoral neck and Colles fractures were investigated.

MATERIALS AND METHODS
This study is carried out on 50 primary osteoporotic patients who admitted to the GATA internal medicine and orthopedics outpatient clinics between May 1989-May 1991 and on healthy individuals who were seen at the check-up outpatient clinic.

Osteoporotic patients consisted of 50 persons as a total of which 30 had Colles fractures (10 men, 20 women with the average ages 52, 70 and 56, 45 years) and femoral neck fractures (10 men, 20 women with the average ages 66, 70 and 64, 50 years).

Fractures were detected in each patient through direct radiography. Patients with severe degree osteoarthrits were excluded from the study. Patients whose fractures are caused by little traumas during the post 6 months and the period 3 months ago, and who completely recovered were included in the study and the cases where the fractures occurred more than 6 months ago or not later than 3 months were excluded. There wasn’t any additional disease other than primary osteoporosis in these patients and there was no history of medicine which has an affect on the calcium metabolism. The patients in these group were divided into four subgroups;

1. Male patients with femoral neck fractures (Group I)
2. Male patients with Colles fractures (Group II)
3. Female patients with femoral neck fractures (Group III)
4. Female patients with Colles fractures (Group IV)

The Values for bone mineral density (BMD) and bone mineral content (BMC) of lumbar vertebrae and radius were measured by photon absorption technique and Norland 2600 Dichromatic Bone Densitometer device (8). BMD values were measured in all lumbar vertebrae (ALL) and L2L4 where as BMC value were measured only in L2L4. BMD and BMC values of forearm were measured in two regions; in midradius and in distal radius. Measurements were made from the dominant arm for healthy individuals. For patients with femoral neck fractures measurements were made in the same arm if the fracture was not located at the dominant arm and from the other arm if the fracture is at the dominant arm for the patients with distal radius fractures.

Measurement of serum total calcium, phosphorus and total alkaline phosphatase, and calcium, phosphorus measurements for a 24 hour urine were determined at Biochemistry Department by spectrophotometric method and Technicon RA-1000 autoanalyzer, and the urine hydroxyproline values were measured spectrophotometrically by colorimetric method developed by Kivirikko and his friends (14). Hydroxyproline values were expressed as a ratio of creatinine in the same urine.

RESULTS
The average values and the results of the statistical analysis of male patients with femoral neck fractures (Group I) and age-/sex-matched controls are indicated

Table: The average values and the results of the statistical analysis of male patients with femoral neck fractures (Group I) and healthy males
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In Table 1 and the correlation characteristics are shown in Table 5. The average values and the results of the statistical analysis of female patients with femoral neck fractures (Group III) and age-/sex-matched controls are indicated in Table 2, and the correlation characteristics are shown in Table 6. The average values and the results of the statistical analysis of male patients with Colles fractures (Group II) and healthy males are indicated in Table 3, and the correlation characteristics are shown in Table 7. The average values and the results of the statistical analysis of female patients with Colles fractures (Group IV) and healthy females are indicated in Table 4, and the correlation characteristics are shown in Table 8.

Table 2. The average values and the results of the statistical analysis of female patients with femoral neck fractures (Group III) and healthy females

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<tr>
<th>AGE (Yr)</th>
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<th>Ht (cm)</th>
<th>Ht/Sp</th>
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For the abbreviations see the footnotes shown in Table 1

Table 3. The average values and the results of the statistical analysis of male patients with Colles fractures (Group II) and healthy males

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Table 4. The average values and the results of the statistical analysis of female patients with Colles fractures (Group IV) and healthy females

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Turk J Med Res 1993; 11 (1)
DISCUSSION

Significant bone mass loss was found in the vertebrae and appendicular bones of the male and female patients with femoral neck fractures. This loss was more significant in females as compared to males (Table 1 and 2). Cummings, (1985), reported 15 studies in this field (1). Cummings asserted that the measurements of cortical and trabecular bones, taken from different places by different techniques were lower only in 6 studies as compared to the controls and these were not significant; the patients with hip fractures in fact were not significantly osteopenic because of the lack of a good correlation between BMD and BMC values in different places; and for these Jents, the factors related with age could be more important in fractures (1). Some other investigator has also reported the same view (6,15). Cummings, et al, detected 53 hip fracture cases in a study that was performed prospectively in 1990 with 9703 females older than 65 (5). They found a reverse correlation between the fracture risk and the distal, proximal radius and calcaneous BMD’s in the patients with hip fractures and though that the age related physiological loss was responsible for the bone mass loss in these places (5). On the other hand, Melton and his friends, in their study with 300 females performed in order to investigate prospectively the femoral neck and intertrochanterik fracture risk, determined a significant decrease in femoral and intertrochanteric region BMD’s of the fracture cases and asserted that the bone mass loss was important in hip fractures (16). In their prospective studies performed on 521 white females, Hui, et al, friends determined fractures out of vertebrae and asserted that mid radius BMC values are useful in determining these fractures (17).

If the results of this study and our study are taken into account one can see that vertebral and appendicular bone mass losses seen both in males and females suggest that the patients with femoral neck fractures are significantly osteopenic. BMD measurements were found to be more significant (especially in males) in showing the bone mass loss. No significant change in body mass found in female patients with fractures. However, the body mass indices of male pa-
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Table 7. The correlation of Colles fractured males' parameters that are different from the controls

For the abbreviations see the footnotes shown in Table 5.

Table 8. The correlation of Colles fractured females' parameters that are different from controls

Vertebral and appendicular bone mass loss was found in male and female patients with Colles fractures when BMD values were taken into account (Table 3 and 4). This loss was more significant in vertebrae and distal radius in females and was minimum in midradius which has the smallest amount of trabecular bone. On the other hand, the mass loss in the midradius in males was as significant as it was elsewhere. This difference in mass loss which are not in favour of males may be due to the fact that the body mass indices of males with Colles fractures is more significantly lower than that of the females.

Almost all of the investigators (9-11) hold the trabecular bone mass loss responsible for Colles fractures. In a prospective study on 1098 postmenopausal women performed by Wasnich, et al. for 4.5 years, vertebral and non-vertebral fractures were determined and the variations in proximal and distal radius BMC's and in calcaneous and lumbar vertebrae BMD's were investigated (18). The investigators determined a significant decrease in all non-vertebral fractures, including the Colles fractures, except the vertebral BMD value. They also stated that the most valuable places in this
respect were the calcaneous and proximal radius (26). In their study performed on 73 osteoporotic (28 patients with vertebral fractures and 45 patients with Codes fractures) women, Nilas, et al, detected a significant decrease in distal and proximal radius and lumbar vertebrae BMC and BMD values in female patients with Colles fractures, and showed that the bone mass losses are more significant in BMD values (19). On the other hand in their prospective study performed on 251 women, Hui and his friends found that the determination of midradius mass is valuable in determining the Colles and femoral neck fractures and that non-vertebral fracture prevalence in a period of 8 years is 80% in female patients with initial mid radius values lower than 0.6 g/cm2 and 10% in female patients with higher mid radius values (17). In another study, proximal and distal radius BMD values were found to be valuable in determining both vertebral and non-vertebral fractures in females with the age 50-69 (20).

Our findings are in conformity with the literature findings and very similar to those of the Nilas, et al, such as the significant decreases in vertebral and distal radius in female patients with fractures and more significant decreases in BMD values as compared to BMC values. However Nilas, et al. detected a significant change in the proximal radius which is very rich in terms of cortical bone (like mid radius). It seems that this difference most likely stems from the fact that the average age of their patients was 64.8 (In our study it was 56.45), because the loss in the appendicular bone especially in the cortical region increases with the age.

Insignificance of BMC: values in reflecting the bone mass loss especially in appendicular bones in females and non existence of a relation between BMD and BMC values suggest that appendicular bone BMC values must not be used instead of BMD values (Table 8). On the other hand BMC values more significantly reflect the bone mass loss in males. Furthermore, strong relations between BMD and BMC values in almost every respect indicate that BMC determinations can be used instead of BMD in males (Table 7).

There were no significant changes in the bone turnover markers of male and female patients with fractures. In males no changes were found in other biochemical indices as well. However, in females significant decreases were observed in serum PTH and urine phosphorus. It is known that in postmenopausal osteoporosis the increase in resorption especially in trabecular bone decreases the serum PTH level, depending on the decreased estrogen activity (21). Therefore we can relate this changes to this phenomenon.

As a result, it is possible to say that there is a significant mass loss in vertebral and appendicular bones, in male and female patients with Colles fractures; the loss in female patients is more dominant in vertebral and distal radius; BMD values are found to be more valuable in reflecting bone mass loss in females; BMC values can also be used in males; and there is no significant change in bone turnover markers of males and females.

**REFERENCES**


