Peripheral bone mineral density in patients with distal radial fractures
From the University of Dundee, Scotland

Fractures of the distal forearm are widely regarded as the result of “fragility”. We have examined the extent to which patients with Colles’ fractures have osteopenia. We measured the bone mineral density (BMD) in the contralateral radius of 235 women presenting with Colles’ fractures over a period of two years. While women of all ages had low values for ultradistal BMD, the values, in age-matched terms, were particularly low among premenopausal women aged less than 45 years. This result was not due to the presence of women with an early menopause. This large survey confirms and extends the findings from earlier small studies. We consider that it is particularly important to investigate young patients with fractures of the distal forearm to identify those with osteoporosis, to seek an underlying cause and to consider treatment.

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There is good evidence from numerous sources that diminished bone mineral density (BMD) at any site predicts the overall future risk of fracture. In addition, women with fractures of the distal forearm which are sustained within ten years of the menopause have an eightfold greater risk of subsequent fractures of the hip than those in the general population. Despite this information, few patients with fractures of the distal forearm are assessed for osteoporosis. In a large population study based on insurance records in the USA only 2.8% had their bone density assessed and only 22.9% were treated with any medication approved for the treatment of osteoporosis.

Several early studies of bone density in patients with fractures of the distal forearm gave conflicting results suggesting that there may be no difference between patients with a fracture and age-matched control subjects. More recent surveys, however, have shown that patients with a fracture often have low bone density. The authors suggested that women who sustain fractures of the distal forearm should be targeted for evaluation of osteoporosis and possible treatment.

Our aim was to measure the BMD and to assess whether osteopenia was indeed a contributory factor to the fracture. Our previous pilot study suggested that the deficit was particularly low in young women and we wished to increase the numbers studied in order to confirm this. We also wished to determine which patients with fractures should be targeted for assessment of BMD and for possible treatment to prevent further fracture.

Patients and Methods

BMD is normally distributed in the population and its values are usually quoted in standard deviation units from a defined mean. When the mean value of a young adult reference group is used the measurement is called the t-score and when it is obtained from an age and gender-matched control group the values are known as the z-score.

We attempted to recruit every woman aged over 20 years who presented to a busy fracture clinic with a Colles’ fracture over a period of two years. The Tayside Committee on Medical Research Ethics gave approval for this study. Patients who were unable or unwilling to give informed consent did not have their BMD measured. In all, 235 patients, ranging in age from 21 to 92 years, gave informed consent.

Before undergoing bone densitometry, we interviewed the patient, and completed a patient-data information sheet having asked about the mechanism of injury and any relevant past medical history which may have affected the BMD, including the chronic use of steroids. We also asked the age at which they reached the menopause or had a hysterectomy, and whether they had received hormone replacement therapy.
Measurement of BMD. Using an OsteoPlan+ pDXA scanner and a 60 Kv x-ray source (NIM, Verona, Italy), with the upgraded software (version 3.x) to the Osteoscan evaluated by Mole, McMurdo and Paterson, we determined the BMD of the contralateral distal radius. The two sites used were the ultra-distal in the distal radial metaphysis and the mid-distal at the junction of the middle and distal thirds of the radius. All but one patient reported the mechanism of injury to be relatively minor, such as a fall on the outstretched hand. All tests were undertaken in the fracture clinic within six weeks of the injury. BMD and z-scores were recorded. The manufacturer of the OsteoPlan+ supplied a reference data based on 3000 subjects (NIM).

After densitometry, we excluded from analysis only those patients whose results were unreliable. This group included 23 patients who had had, in the past, a fracture of the contralateral forearm and one who had rheumatoid arthritis with involvement of the wrists. In these patients, the densitometry results were affected by the fracture callus or the rheumatoid deformities.

For statistical analysis of the data we used Microsoft Excel 97 and SPSS 10.0.5 (SPSS Inc., Chicago, Illinois).

Results

Most of the 211 women (85%) had bone density values for the radius of less than the mean value for their age. It was particularly noticeable that few young women had a positive z-score; 178 of the 211 women (89%) had ultra-distal BMD values for the radius of less than the mean value for their age. It was particularly noticeable that only three women aged less than 45 years had a positive z-score (Fig. 1). Since we wished to be sure that women who had had an early menopause, before the age of 45 years, did not compromise the results of our study, we analysed the data in four groups as follows.

Group 1. All women not subject to initial exclusion.

Group 2. Group 1 omitting women who had had the menopause before the age of 45 years.

Group 3. Women in group 1 who had had the menopause before the age of 45 years.

Group 4. Premenopausal women aged less than 45 years in groups 1 and 2.

This was possible because of the relatively large numbers in our study (Table I).

The negative z-scores in both the ultra-distal and mid-distal sites indicated a deficit in BMD in all four groups (Table I). This deficit was particularly noticeable in group 4 in which only one subject had an ultra-distal z-score greater than zero. A two-tailed t-test comparing mean z-scores showed that those for the ultra-distal sites differed significantly between groups 2 and 4 (p = 0.001). There were no significant differences between groups 1 and 2 for both the ultra-distal (p = 0.62) and mid-distal sites (p = 0.72), for groups 2 and 3 for both the ultra-distal (p = 0.66) and mid-distal sites (p = 0.43) and for groups 2 and 4 for the mid-distal site (p = 0.54).

Discussion

There have been several reports of BMD measurements of the radius in patients with a Colles’ fracture. The numbers, however, have been small and usually only postmenopausal women have been studied. An exception to this was a study by Ryan, in which there was a small number (< 20) under 50 years of age, but it included some men and there was no mention of the menopausal status of the women. Our study differs in that it covers a wider age range and the fact that we looked specifically at a group of premenopausal women. We have concentrated on z-scores because the WHO definition of osteoporosis based on t-scores is targeted at early postmenopausal women and care needs to be taken when considering t-score values both in older and in younger women.
Table I. The age-matched BMD in ultra-distal and mid-distal sites of the contralateral radius in women with a Colles’ fracture

<table>
<thead>
<tr>
<th>Group</th>
<th>Number of patients (%)</th>
<th>Mean age in years (± SD)</th>
<th>Ultra-distal*</th>
<th>Mid-distal*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>z-score ≤ -2</td>
<td>z-score ≤ 0</td>
</tr>
<tr>
<td>(Full)</td>
<td>211</td>
<td>59.5 ± 15.7</td>
<td>31 (14.7)</td>
<td>180 (85.3)</td>
</tr>
<tr>
<td>(No early menopause)</td>
<td>160</td>
<td>58.4 ± 16.2</td>
<td>22 (13.8)</td>
<td>138 (86.3)</td>
</tr>
<tr>
<td>(Early menopause)</td>
<td>51</td>
<td>63.0 ± 11.3</td>
<td>7 (13.7)</td>
<td>40 (78.4)</td>
</tr>
<tr>
<td>(Premenopausal age &lt; 45 years)</td>
<td>34</td>
<td>32.4 ± 6.9</td>
<td>8 (23.5)</td>
<td>33 (97.1)</td>
</tr>
</tbody>
</table>

*the z-score is the number of standard deviations by which the patient’s result differs from the mean of the age-matched reference group

Our study provides increased evidence that patients with Colles’ fracture have diminished BMD. The deficit was greater in the younger group. Those aged 45 years or less and who were premenopausal formed a distinct group in having had a fracture at this age and in having a lower BMD than their peers.

Two other studies reached similar conclusions. 7,9 These also showed that younger patients with Colles’ fractures are more distinct from age-matched peers than older patients. Earnshaw et al.,7 however, classed women under 65 years of age as ‘younger’ and all were postmenopausal. Three factors may have contributed to the conflicting results of earlier studies: the small numbers of patients, the predominance of older patients (mean age 76 years) and measurement at cortical bone sites only. 5,6 If trabecular bone is measured all patients with fractures of the distal forearm have a deficit.5,6 It is important to note that our results were not due to the presence of women with an early menopause since when we examined their results separately the effect was the same.

The immediate risk of fracture in young women with, for example, a z-score of -2 may be less than for older women with a similar z-score. Investigation for any remediable cause of osteopenia could be important in helping to decide the best treatment for each patient. While osteopenia is also a contributory factor to the risk of fracture in older patients,13 it is essential to recognise that other factors, including impaired mobility, poor sight and cognitive status, are also important.

Patients with fractures of the distal forearm, especially in younger patients, require full evaluation including densitometry. Low values indicate that these patients need clinical evaluation and further investigation for an underlying cause of osteopenia such as osteomalacia, hyperparathyroidism and coeliac disease.14 This is not routine in the fracture clinic at this hospital and many others. Even if no underlying cause is found, all patients would benefit from advice on life-style or diet and some need treatment to reduce the risk of further fractures in later life.

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References