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ORIGINAL ARTICLE

# Successful direct intervention for osteoporosis in patients with minimal trauma fractures

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**Abstract**
*Summary* In this study, we offered osteoporosis investigation and treatment directly to patients at out-patient fracture clinics shortly after they sustained minimal trauma fractures. We achieved long-term compliance to the recommended investigation and treatment in 80% of patients. This approach is much more successful than previous interventions.
*Introduction* Osteoporosis remains under-treated in minimal-trauma fracture subjects. The aim of this study was to determine if direct intervention at orthopaedic fracture clinics would improve post-fracture management in these subjects.
*Methods* From March 2004 to March 2006, 155 consecutive minimal-trauma fracture subjects (mean age 64.0± 17.6) attending fracture clinics at St. Vincent's Hospital, Sydney, had a specific medical assessment, following which they were recommended BMD and laboratory testing. Treatment recommendations were given after review of investigations with further follow-up at a median of 8.6 months following therapy. Comparison of outcomes was made with a similar group of patients given written information 2 years prior.
*Results* At baseline, 47% of patients had prior fractures, but only 26% had had BMD screening. Twenty-one percent were on anti-resorptive therapy, and 15% were on calcium/vitamin D. Following intervention, 83% had a BMD and of these, 68% had a T-score $< -1.0$. Of treatment naïve patients, 44% were recommended anti-resorptive therapy and 56% were recommended calcium/vitamin D. Compliance was 80% for anti-resorptive and 76% for calcium/vitamin D. Female gender and lower BMD were predictors of compliance.
*Conclusion* Compared with information-based intervention, direct intervention improved management two to fivefold, maintaining long-term treatment in 90% of osteoporotic and 73% of osteopenic subjects requiring therapy.

**Keywords** Compliance · Fracture clinic intervention · Fragility fracture · Minimal trauma · Osteoporosis · Secondary prevention

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## Introduction

Osteoporosis is a major international health problem, accentuated by increasing longevity [1, 2]. In Australia alone, 10% of the population have osteoporosis with an annual economic cost of at least Australian $5 billion. Cost of osteoporosis is even greater in many other countries with an ageing population [3–5]. Aside from the economic burden, osteoporosis is associated with an increased

morbidity and mortality in affected individuals [6–8]. Effective management for osteoporosis has been widely available for many years [9, 10], yet its uptake remains poor, with bone mineral density (BMD) tested in fewer than 8% of post menopausal women, and anti-resorptive therapy prescribed in only 20–30% of women post-low trauma fractures [11–13].

Many studies have identified factors that are barriers to osteoporosis management. In the hospital setting, osteoporosis has been considered a low priority by junior medical staff, ranking 6th out of seven common medical conditions to be addressed during a patient visit [14]. In the community, medical practitioners express concerns over cost effectiveness and side effect profiles of anti-resorptive therapies [15, 16], even though the safety and efficacy of these treatments have been amply demonstrated [17–20]. Moreover, the care of fracture patients has been fragmented, with orthopaedic surgeons, geriatricians, general practitioners, endocrinologists, and rheumatologists each providing part of the patient care. This lack of continuity of care, and perhaps more importantly, communication difficulties between health care providers, has been reported to contribute to the low rate of osteoporosis management in patients after minimal trauma fractures [21, 22]. Information-based interventions in the out-patient fracture clinic setting have not improved the situation, with minimal increases in treatment uptake [23, 24].

The aim of current study was to (1) determine if direct clinic-based intervention would improve osteoporosis management, (2) identify factors predicting compliance to investigation and therapy and (3) compare treatment outcome between direct clinic-based intervention to information-based interventions.

## Materials and methods

### Subjects

The study cohort consists of 155 consecutive minimal trauma fracture subjects attending outpatient orthopaedic fracture clinics at St. Vincent's Hospital, Sydney over 24 months, between March 2004 and March 2006. Those with fractures other than minimal trauma (defined as fall from standing height or less, or a similar degree of injury), fractures of fingers, toes and skull, any individual aged < 20 and overseas visitors were excluded.

### Intervention

Subjects fulfilling the criteria for intervention were approached and informed of their risk of osteoporosis. Each person's baseline information was collected, including circumstances and type of fractures, risk factors for osteoporosis, previous osteoporosis intervention, medical, surgical and medication history. Each person was provided with face-to-face education on osteoporosis by a medical registrar and was also advised on potential lifestyle modifications of his/her specific risk factors.

Subjects were offered investigations including BMD assessment by dual X-ray absorptiometry (DXA) and blood tests to screen for contributory illnesses. Results of these investigations were given to the patients by telephone, with advice regarding calcium and vitamin D supplementation. Those with low BMD were invited to attend the Bone and Calcium clinic to discuss anti-resorptive therapy. Recommendations of anti-resorptive therapy, given verbally to the patients at the Bone and Calcium clinic, were also sent as a letter to the patients' primary care physician to inform them of the decisions. Clinic assessment or follow-up telephone calls were made at least 6 months (10.1±4.0, median 8.6 months) after initiation of treatment to determine patient compliance with the recommendations.

### Comparison with information-based interventions

A similar group of subjects had been recruited 2 years prior (2002–2004) at the same orthopaedic fracture clinics at St. Vincent's Hospital, Sydney. This cohort included those with minimal and moderate trauma fractures. Both groups received information-based interventions [23]. Comparison of outcome was made only with the group of subjects with minimal trauma fracture.

### Analysis

All statistical analyses were conducted using statistical analysis system (SAS). Differences between men and women were compared using T tests. Univariate and multivariate logistic regression models were created to determine factors associated with uptake of investigation and compliance to recommended therapy.

## Results

Approximately 80% of identified minimal trauma fracture subjects that attended out-patient orthopaedic fracture clinics agreed to participate in the direct intervention. Those who declined participation were younger (mean age 56.0±21.8 versus 64.0±17.6, p=0.14), but had similar gender and fracture distribution compared to those that agreed (p=0.8). Over 24 months, 155 patients received direct intervention. All patients recommended anti-resorptive therapy and/or calcium and vitamin D were contacted after treatment initiation to determine compliance. Five patients recommended calcium

and vitamin D were lost to follow-up. Those not recommended therapy were not contacted (n=51).

## Baseline characteristics of study subjects

Of the 155 participants, 71% (110) were female and 29% (45) were male (Table 1). Women were older (65.6±16.9 vs. 59.9±18.6 years, p=0.07). Location of the index fracture was similar, with distal forearm fracture being the most common, followed by ankle, humerus and femur.

Almost half of all minimal trauma fracture subjects had had prior fractures during their adult life. Other risk factors for osteoporosis were also common, with 21% of all subjects aware of a family history of osteoporosis, and more than one quarter of post-menopausal women had premature menopause (≤ 45 years). Not surprisingly, despite similar risk profiles, more women than men had had previous BMD measurements (35% vs. 2%, p<0.001) and previous osteoporosis management (34% vs. 9%, p=0.001).

Compared with those who did not have prior fractures (n=82), those with prior fractures (n=73) were more likely to have had a BMD (although this was not statistically significant); anti-resorptive therapy was also higher in this group (28% vs. 13%, p=0.02), of which the majority was oral bisphosphonate. Calcium and vitamin D supplementation was uniformly low irrespective of prior fracture history.

Of the 90% (140) who agreed to have blood taken, 47% (66) were found to have a contributory abnormality. Forty-three percent (45) of women and 36% (13) of men had a 25 hydroxy vitamin D level of ≤ 50 nmol/L. Two women were diagnosed with primary hyperparathyroidism requiring surgery, while three women were hyperthyroid. One woman had pre-existing coeliac disease that remained poorly controlled, and another three women and three men were referred to a gastroenterologist for further investigation due to elevated coeliac antibody titres. Monoclonal gammopathy of unknown significance (MGUS) was diagnosed in two women.

## Effect of direct intervention on those without prior osteoporosis management

Seventy-four percent of all subjects (71 women and 44 men) had not had a BMD scan prior to the index fracture. Of these, 83% (60 women and 35 men) took up the BMD offer (Fig. 1). Of this group, 68% had low BMD; 44% being osteopenic and 24% osteoporotic by WHO criteria. None of age, gender nor prior fracture predicted uptake of BMD assessment.

Sixty-six percent of all subjects (70 women and 33 men) had not had prior anti-resorptive therapy and had the recommended investigations after clinic review. Of these, 43% (35 women and 9 men) were advised anti-resorptive therapy based on their fracture risk and BMD results. Long-

**Table 1** Baseline characteristics of minimal trauma fracture subjects

| Number | Female | Male | p value |
|---|---|---|---|
| | 110 | 45 | |
| Age (years, mean ± SD) | 65.6±16.9 | 59.9±18.6 | 0.07 |
| BMI (kg/m$^2$, mean ± SD) | 25.8±5.6 | 26.4±4.2 | 0.55 |
| Index fracture location | | | |
| Distal forearm | 50 (45%) | 15 (33%) | |
| Ankle | 16 (15%) | 8 (18%) | |
| Humerus | 16 (15%) | 7 (16%) | |
| Femur | 10 (9%) | 5 (11%) | |
| Risk factors for osteoporosis | | | |
| Previous fractures | 53 (48%) | 20 (44%) | 0.67 |
| Family Hx of OP | 27 (25%) | 5 (11%) | 0.06 |
| Early menopause (≤ 45 years)[a] | 27 (28%) | – | |
| Low 25 OH Vitamin D (<50 mmol/L)[b] | 45 (43%) | 13 (36%) | 0.46 |
| Prior investigation/Therapy | | | |
| Prior BMD | 39 (35%) | 1 (2%) | <0.001 |
| Anti-resorptive therapy | 29 (26%) | 3 (7%) | 0.006 |
| Bisphosphonate | 19 | 3 | |
| SERM | 2 | – | |
| HRT | 8 | – | |
| Ca + Vit D alone[c] | 9 (8%) | 1 (2%) | 0.17 |

[a] 95 women were post-menopausal
[b] 104 women and 36 men had blood tests performed
[c] An additional 11 women and two men were taking Ca + Vit. D in conjunction with bisphosphonate

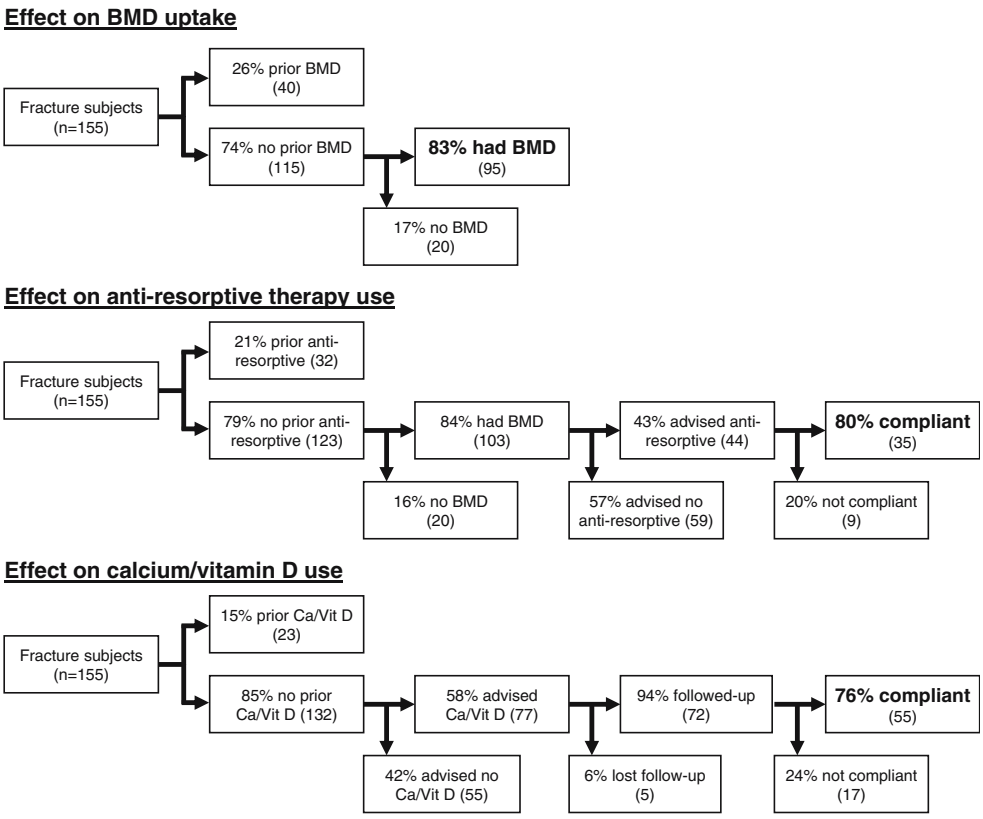


**Fig. 1** Effect of direct intervention in out-patient fracture clinics on those with minimal trauma fractures

term compliance was seen in 80% of subjects (31 women and 4 men) recommended anti-resorptive therapy (Fig. 1). Female gender and lower BMD were univariate predictors of treatment compliance but in multivariate analysis, only female gender remained significant (Table 2).

Eighty-five percent of all subjects (90 women and 42 men) were not taking either calcium or vitamin D supplementation. After review of their dietary calcium intake and serum 25 hydroxy vitamin D level, 58% (57 women and 20 men) were advised calcium and/or vitamin D. There were five subjects lost to follow-up. Of those contacted, 76% (46 women and nine men) remained compliant (Fig. 1). Female gender, low BMD and concurrent anti-resorptive therapy were associated with increased compliance in univariate analysis, but only low BMD remained significant in a multivariate model (Table 2).

## Effect of age

To determine the effectiveness of direct intervention on the younger population, patients were considered in the < 50 and ≥ 50 year old age groups (Table 3). There was lesser female predominance (p=0.03) and more ankle and fewer humerus fractures in the younger group. Despite similar osteoporosis risk factors, more subjects in the older age group had had a prior BMD (p=0.003) and had been prescribed anti-resorptive therapy (p=0.013) and calcium/vitamin D supplement (0.06). After direct intervention,

**Table 2** Univariate and multivariate analysis of compliance to therapy

| Variables | Anti-resorptive therapy | |
|---|---|---|
| | Univariate (95% CI) | Multivariate (95% CI) |
| Female gender | 9.7 (1.8–51.8) | 6.5 (1.1–38.9) |
| Femoral BMD[a] | 3.7 (1.1–12.4) | 2.5 (0.7–8.7) |
| | Calcium/Vitamin D supplement | |
| | Univariate (95% CI) | Multivariate (95%CI) |
| Female gender | 4.5 (1.4–14.9) | 3.3 (0.8–13.1) |
| Femoral BMD[a] | 4.4 (1.8–10.6) | 3.8 (1.3–11.3) |
| Concurrent anti-resorptive | 7.3 (2.2–24.2) | 1.3 (0.3–6.1) |

[a] Per standard deviation reduction in BMD

**Table 3** Characteristics of minimal trauma fracture subjects with respect to age cut-off at 50 years

| Number | < 50 years | ≥ 50 years | p value |
|---|---|---|---|
| | 28 (18%) | 127 (82%) | |
| Female gender | 15 (54%) | 95 (75%) | 0.03 |
| Age (years, mean±SD) | 37.5±9.0 | 69.8±13.0 | |
| BMI (kg/m$^2$, mean±SD) | 27.3±5.7 | 25.7±5.2 | 0.21 |
| Risk factors for osteoporosis | | | |
| Previous fractures | 12 (43%) | 61 (48%) | 0.62 |
| Family history of osteoporosis | 10 (36%) | 22 (17%) | 0.03 |
| Post-menopausal | 3 (11%) | 92 (72%) | <0.001 |
| Early menopause (≤ 45 years) | 2 (67%) | 25 (27%) | 0.14 |
| Low 25 OH Vitamin D (<50 nmol/L)[a] | 10 (40%) | 48 (42%) | 0.87 |
| Index fracture location | | | |
| Distal forearm | 12 (43%) | 53 (42%) | 0.91 |
| Ankle | 10 (36%) | 14 (11%) | 0.001 |
| Humerus | 0 (0%) | 23 (18%) | 0.02 |
| Femur | 0 (0%) | 15 (12%) | 0.06 |
| Prior osteoporosis management | | | |
| Prior BMD | 1 (4%) | 39 (31%) | 0.003 |
| Prior anti-resorptive | 1 (4%) | 31 (24%) | 0.01 |
| Prior Ca/Vit D | 1 (4%) | 22 (17%) | 0.06 |
| Treatment recommendations in those without prior osteoporosis management | | | |
| Recommended BMD | 27 | 88 | |
| Compliant to BMD measurement | 19 (70%) | 76 (86%) | 0.06 |
| Recommended anti-resorptive/Ca/Vit D | 8 | 76 | |
| Compliant to anti-resorptive/Ca/Vit D[b] | 3 (43%) | 55 (76%) | 0.06 |

[a] 25 subjects < 50 year old and 115 subjects ≥ 50 year old had 25 hydroxy vitamin D measured
[b] 1 subjects < 50 years old and 4 subjects ≥ 50 years old were lost to follow-up

compliance to recommended investigation and therapy was slightly higher, but not significantly so, in the older age groups (p=0.06).

### Comparison to a previous information-based intervention

Considering minimal trauma fracture subjects who received information-based intervention in the previous study, letter alone resulted in 10% BMD uptake and 12% osteoporosis therapy (including anti-resorptive therapy and calcium/vitamin D supplement). Intervention with letter and offer of free BMD resulted in 42% BMD uptake, but only 16% osteoporosis therapy. During a similar period of time, direct intervention improved BMD assessment twofold, resulted in 83% uptake of BMD, and improved long-term osteoporosis management fivefold, maintaining therapy to 80% of all those requiring treatment.

### Overall osteoporosis management

Considering both prior BMD and BMD post direct intervention, 87% of all minimal trauma fracture subjects were investigated (n=135). Overall, 27% (36) had normal BMD, while 29% (40) were osteoporotic, and 44% (59) were osteopenic by WHO criteria. All osteoporotic and 76% (45/59) osteopenic subjects were assessed as requiring treatment based on clinical criteria. With the addition of direct intervention over prior management, appropriate long term (10.1±4.0 months) therapy was maintained in 90% (36/40) of osteoporotic and 73% (33/45) of osteopenic minimal trauma fracture subjects assessed as requiring treatment.

## Discussion

The inadequacy of osteoporosis care has been reported globally [13, 25, 26]. Previous information-based interventions demonstrated low rates of post-fracture osteoporosis therapy despite higher uptake of BMD assessment [23, 24]. This study was designed to improve on the post-fracture osteoporosis care achieved by the information-based intervention. With a “one stop” approach to osteoporosis management offered to subjects attending out-patient fracture clinics, and alerting them of osteoporosis risk relating to the current fracture, this intervention resulted in very high compliance to recommended investigations and osteoporosis therapy.

In this study, patients were offered individualised doctor-patient assessment that allowed them to discuss their concerns and receive full responses from a physician. This could be expected to improve patient understanding of osteoporosis and increase their perception of osteoporosis risk. In previous studies, this knowledge and understanding have been identified as independent predictors of BMD assessment, osteoporosis therapy and physician follow-up [23, 24]. As demonstrated in this study, > 80% of patients agreed to have a BMD assessment irrespective of their age, gender or prior fracture history, aspects of all of which have previously been identified as barriers to osteoporosis care [11, 23, 24, 27, 28].

In the present study, a significantly lower rate of osteoporosis intervention at baseline was found in men compare to women, despite a similar incidence of prior fractures and osteoporosis risk factors. Although men were equally likely to adhere to the recommendation for BMD assessment, they were still less likely to remain compliant to long-term therapy. This may reflect the general perception in the community that osteoporosis is a disease of post-menopausal women.

Fragmented osteoporosis management has also been identified as a barrier [21, 22, 29]. Often, orthopaedic surgeons are the only medical professionals that fracture patients encounter and, although surgeons provide good acute fracture care, most leave the long-term management of osteoporosis to the patient's primary care provider [15, 16, 30]. Even when patients are referred for osteoporosis care, few follow-up with their primary care physicians [25, 29, 31]. In a recent study of hip fracture patients, despite education and encouragement to follow-up with their primary care physician regarding osteoporosis, less than half of patients received subsequent osteoporosis assessment [32]. Low rate of follow-up with primary care physicians after fracture has also been demonstrated in a previous study at the same institute as the current study [11]. In another study using electronic reminders, alerting primary care physicians of fractures in their patients only leads to 50% of fracture subjects receiving assessment [33]. By providing "one-stop" osteoporosis care at the out-patient fracture clinics in the current study, the care fragmentation barrier was bypassed by providing direct assessment to at-risk patients at the orthopaedic fracture clinic. Although personalised intervention is probably more costly then the above interventions, a demonstrably higher uptake and adherence to therapy was achieved.

The strength of this study consists of a high participation rate (80%) of consecutive fracture subjects and good follow-up. Subjects < 50 years of age who suffered minimal trauma fractures has not previously been assessed. Inclusion of these younger, premenopausal subjects reduced specific osteoporosis treatment recommendations, as expected. However, this study had demonstrated a similarly high incidence of osteoporosis risk factors and achievement of similarly high adherence to investigation and treatment recommendation in the younger group.

There are several limitations to the current study. Firstly, there was no parallel control group. Nevertheless, recent historical cohorts were available for comparison based on studies in the same fracture population at out-patient fracture clinics conducted between 2002 and 2004. Without intervention after fracture, only 11% had BMD and only 12% were commenced on therapy [11]. Information-based intervention, with letter alone did not improve BMD uptake or osteoporosis therapy. Although letter and BMD offer together improved BMD assessment, it still did not impact on final therapy [23]. With direct intervention, BMD assessment and long-term osteoporosis treatment has been clearly improved. Secondly, compliance to treatment was determined at 10.1±4.0 months in the current study. Whilst recent studies demonstrated lower compliance to bisphosphonates at > 12 month compared to 6 months, the majority of non-compliant subjects had already stopped their therapy by the 6-month review [34]; thus, we consider 10.1±4.0 months compliance to be a reasonable estimate. Lastly, throughout the period of this study, three medical registrars provided intervention to minimal trauma fracture subjects. While each medical registrar provided similar osteoporosis education and recommended a standard intervention, we are not able to account for differences in personality between these registrars. It is possible that interpersonal relationship between the medical registrar and the fracture subjects may affect patient's attitude in complying with the recommendations. But despite this, the high uptake of BMD and treatment recommendation is proof of the effectiveness of direct intervention even when intervention is delivered by different people.

In summary, this study has demonstrated a high rate of uptake and maintenance of osteoporosis preventive therapy post-fracture when the intervention is delivered directly at orthopaedic out-patient fracture clinics, with 80% compliance to recommended investigation and long-term therapy. This direct approach overcame several barriers to osteoporosis care and provided a convenient service to minimal trauma fracture subjects that was more effective than information-based interventions previously studied. This study, therefore, demonstrates the potential for significant improvement in secondary osteoporosis fracture prevention.

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