Retrospective Review of Distal Radius Fragility Fractures and Long-term Outcomes

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Abstract

Introduction

Distal radius fragility fractures are associated with osteoporosis and with subsequent osteoporotic fractures. This retrospective study evaluates the prevalence of osteoporosis in this group, risk factors associated with osteoporosis and subsequent long-term re-fracture rates, and whether appropriate treatment for osteoporosis has been provided.

Methods

275 adult patients admitted to a government hospital with fragility DRF but without known osteoporosis, had subsequent Dual-energy X-ray absorptiometry (DXA) scans performed. This cohort with mean age of 68.9, were mostly females at postmenopausal age range, and the average follow-up period was 3.6 years.

Results

Mean T-score was -2.18, with prevalence of osteoporosis at 42.5% (117/275). The postmenopausal group had significantly lower mean T-scores (-2.27 vs -1.59, p=0.001) and were significantly more likely to suffer from osteoporosis (46.4% vs 20.0%, p=0.002). Repeated fractures after index admission were common with 2.9% within 1 year and 9.5% by end of follow up, and occurred more frequently in those with lower T-scores (-2.90 vs -2.10, p=0.017) and older age (74.46 vs 68.38, p=0.015). Some clinicians prescribe anti-osteoporotic drug at their clinical discretion, with 34/275 (12.4%) cases in study cohort, of which 24/34 (70.6%) indeed later confirmed to have osteoporosis. In the overall cohort, excluding those lost to follow up or refuse treatment, 94.7% (89/94) received appropriate treatment in our health system.

Conclusion

Patients with distal radius fragility fractures are likely to suffer from undiagnosed osteoporosis, and are at high risk of subsequent repeat fractures, highlighting the importance of investigation and treatment for osteoporosis.

INTRODUCTION

Distal radius fractures (DRF) is the most common upper extremity fracture and the second-most common fracture in elderly patients[1,2,3]. Epidemiological characteristics of distal radius fractures have been identified by population studies done in Scandinavian countries, North America and the United Kingdom[4,5,6,7], demonstrating a bimodal age distribution with peak incidence in the youth and elderly. In the elderly population, studies have shown that distal radius fragility fractures from low-energy trauma i.e. fall at level ground are strongly related to osteoporosis[8,9].

Osteoporosis is a bone disease where the bone mineral density (BMD) or quality or microarchitectural structure of bone deteriorates leading to insufficiency or fragility fractures.[10] Osteoporosis is commonly diagnosed by the use of dual-energy X-ray absorptiometry (DXA) scan, and bone status is determined with the resulting T-score and Z-score. T-score is defined as number of standard deviations below the mean value for a healthy young adult, and the World Health Organisation (WHO) defines osteoporosis as a T-score of less than -2.5. On the other hand, the z score is the number of standard deviations below expected BMD for

the age and sex. [11] The overall prevalence of osteoporosis worldwide in those older than 50 years old is one in three for women and one in five for men. [12,13] In our locality, osteoporosis especially in postmenopausal women is significantly more common than that in Caucasian women with a 15.8% difference. [14]

Given the association of distal radius fractures with osteoporosis, it is similarly associated with subsequent osteoporotic fractures. A study in Sweden reported that following a forearm fracture in Swedish women over 39 years of age, there is a 1.5 fold increase in subsequent hip fracture.[15] Another study in Korea shows that the cumulative incidence of osteoporotic fractures increased, following distal radius fractures and especially among women.[16] Thus, early osteoporosis diagnosis and management is important in prevention of future fragility fractures[17,18] however it is often underdiagnosed and untreated globally; a local study recently suggested only 11.4% of those suffering from distal radius fractures received investigation (DXA) or treatment for osteoporosis. [19]

Despite the above, published local data on the association of distal radius fractures with osteoporosis has so far been scarce. The objective of this study is therefore to evaluate the prevalence of osteoporosis in this vulnerable patient group, risk factors associated with osteoporosis and subsequent long-term re-fracture rates. The study also aims to establish whether appropriate treatment for osteoporosis has been provided to those identified to be so.

METHODS

Ethics approval for this study was obtained from the Institutional Review Board of our unit (REF KW/EX-21-071(158-14)), and informed consent was waived due to retrospective nature of the study.

All patients admitted to our centre, with a principal diagnosis of DRF during the 5-year period from 1 January 2018 to 31 December 2022, were identified with the Hospital Authority (HA) Clinical Data Analysis Reporting System (CDARS). Inclusion criteria include. Through subsequent record review on HA Clinical Management System (CMS), those with a Dual-energy X-ray absorptiometry (DXA) scans within 5 years after the index admission were included for further analysis; exclusion criteria include age <18, known osteoporosis, those with pathological fractures, those with prior fracture / operation at the same fracture site, non-fragility fractures (high energy trauma). Baseline parameters including demographics, details of DXA scans, and subsequent clinical outcomes (for those followed up within our health system) as of 31 May 2023 were then extracted from electronic medical records.

Primary outcomes are T-score from DXA scans and prevalence of osteoporosis, while secondary outcomes include factors associated with low T-score / osteoporosis, occurrence of repeat fractures and initiation of relevant treatment among those identified to be osteoporotic.

Statistical analysis was performed using SPSS 27.0 with significance level set at p value of <0.05. Continuous variables were compared by an independent sample t-test or Mann-Whitney U test for non-parametric data. Categorical variables were compared by χ^2 or Fisher exact test as appropriate.

RESULTS

Among a total of 1231 patients were admitted to our centre for distal radius fracture during the study period, 320 patients were found to have DXA results in CMS. After applying the exclusion criteria, a total of 275 patients were identified.

Study population (Table 1, Diagram 1)

Our study cohort consists predominantly of ethnic Chinese, most being females in the postmenopausal age range. All of the cases included were fragility fractures, with the vast majority (99.6%) being unilateral fractures, and almost half (41.8%) with surgical fixations. The vast majority of patients (91.2%) received their DXA scans within 2 years, with most (65.9%) within 1 year. After the index admission for fracture, the average total follow up period was 3.6 years.

Prevalence of osteoporosis and associated factors (Table 2)

On the DXA scans after index admissions, the prevalence of osteoporosis in our study cohort was high at 42.5%, with the remainder usually suffering from osteopenia.

Those with age ≥50 had significantly lower T-scores and were significantly more likely to suffer from osteoporosis; and there was a statistically significant (weak) correlation of declining T-score with age. The postmenopausal group also had significantly lower mean T-scores than the remainder of the cohort.

Repeated fracture (Table 3)

Repeated fractures after index admission were common,

with 2.9% within 1 year and 9.5% before end of follow up period (average 3.6 years), and occurred more frequently in those with lower T-scores. Among those who suffered from repeat fractures, the mean T-score was -2.90 (squarely in the osteoporotic range), and was significantly lower than the group who did not develop repeat fractures.

Repeated fractures also occurred significantly more frequently for those with older age, the average age those with repeated fractures being 6.08 or 9.58 years older than the group who did not.

Treatment for osteoporosis (Table 4, Diagram 2)

In our locality and patient population, there is commonly a considerable interval until DXA scan could be done due to a number of factors (mean 323.7 days in our cohort). This could potentially lead to a delay in identification and treatment of osteoporosis, and as a result some clinicians in our unit prescribe prophylactic treatment off-label at their clinical discretion, at the time of index admissions before DXA results become available.

34/275 (12.4%) such cases of prophylactic treatment were identified from our study cohort, of which 24/34 (70.6%) were indeed later confirmed to have osteoporosis (with 30/34 i.e. 88.2% having at least osteopenia). Those in the prophylactically treated group had a significantly lower mean T-score at -2.78 and were on average significantly older at average of age 78.38 years.

Among those not given prophylactic treatment, 93/275 (33.8%) were later diagnosed to have osteoporosis. After excluding those lost to follow up and those who refused treatment, a total of 70 were eligible for osteoporotic treatment and was prescribed to 65/70 (92.9%) of these.

In total, 117/275 cases (42.6%) of osteoporosis were identified in our clinical cohort, after excluding the aforementioned group, a total of 94 were eligible for osteoporotic treatment and the vast majority (89/94, 94.7%) received appropriate treatment in our health system.

DISCUSSION

To the best of our knowledge, this is one of the first local studies on the prevalence of osteoporosis and clinical outcomes for a large cohort of ethnic Chinese patients with distal radius fractures in Hong Kong, with otherwise no known history of osteoporosis.

Study population

In our locality, DXA scans are not routinely arranged for post fragility fracture patients, due to availability of resources and patients lost to follow-up. A low rate of BMD measurement initiated has been previously reported for patients post hip fracture[20]; the rate for distal radius fractures was reported to be even lower.[21]

Prevalence of osteoporosis and factors

Fragility fracture has been known to be associated with osteoporosis[22], and for those in our cohort the prevalence of osteoporosis was 42.5%. This is significantly higher than that of the general population in Hong Kong[23], echoing the findings of a previous Thai study[24]. Screening patients like ours for osteoporosis gives a high diagnostic yield, and presents a golden opportunity to diagnose and treat what would otherwise go undetected.

T-scores has been known to decline with age in the general population[25]. This has been similarly shown in our cohort, notwithstanding the possibly skewed population, with age ≥50 having significantly lower T-scores.

Postmenopausal state has also long been identified as a risk factor for osteoporosis[26], with a previous study in an unselected group of postmenopausal women putting the prevalence at 25.7%[27]. In our cohort of post distal radius fracture patients, women of postmenopausal age similarly had significantly lower mean T-scores than the remainder of the cohort, with prevalence of osteoporosis being up to 46.4% for this group.

Repeated fracture

Initial low energy fracture has been known to bring high risk of subsequent fracture in the future, with an American retrospective cohort of low energy fractures showing recurrent fracture rates of 40-60% at 10 years[28]. This increased risk is similarly demonstrated in another study for wrist fractures, above those without any fractures[29].

While our cohort has a relatively short follow up period of about 3 years, almost 1 in 10 (9.5%) already presented to our health system for a recurrent fracture, presenting a significant disease burden both to our system and to the community. Those with recurrent fracture had significant lower T-scores of -2.90 (osteoporotic range) and were of significantly older age at 74.46, both being established risk factors for recurrent fractures[30].

Treatment for osteoporosis

Some clinicians in our unit prescribe prophylactic treatment off-label at the index admission, before any DXA results become available[31], and such prophylactic treatment for distal radius fracture without measured BMD has indeed been reported in some localities[32].

This prophylactically treated group has significantly higher mean age, and the mean T-score of this group was significantly lower at -2.78 when the DXA was eventually performed, again in the osteoporotic range. Overall, 70.5% of this group were identified to be osteoporotic at the DXA and treatment was continued accordingly. This possibly reflects clinical judgment among clinicians which (correctly) identified those at higher risk of osteoporosis and therefore initiated treatment early.

In those not initially given prophylactic treatment, a significant portion (93/241, 38.6%] were still later diagnosed with osteoporosis. A number of this group were lost to follow up either due to defaulting follow up or incapacitation, and several cases refused treatment despite being offered such.

After taking into account both treatment groups, a total of 94 were eligible for osteoporosis treatment and the vast majority (89/94, 94.7%) received appropriate treatment in our health system. The importance of appropriately and promptly treating osteoporosis cannot be understated, as it has been shown to prevent fractures in the long term[33].

It has been suggested overseas that orthopaedic surgeons may not be entirely comfortable in treating osteoporosis, and may prefer management by primary care physicians or specialized osteoporotic clinics[34]. Our overall performance of prescribing appropriate treatment shows our unit treats this condition actively, and multi-disciplinary nature of our health system enables clinicians of other specialities to contribute to management as well.

Limitations

In view of the retrospective nature of our study, several factors like FRAX score and hand dominance cannot be traced from records. While DXA is frequently arranged for distal radius fractures under the care of a number of clinicians in our unit, arranging DXA is not widespread routine practice for all cases. As a result, from the original sample of over 1200 cases with distal radius fractures, only 26% patients had DXA results available. No particular indications were documented for arrangement or non-arrangement of the scans, and the study cohort could therefore be skewed due to sampling.

Due to a number of factors, our cohort had an average interval of 323.7 days from index admission till DXA scan. As T-score is known to decline with age at around 1% per year,[35] this delay would possibly skew the average T-score lower, as opposed to DXA scans performed at a shorter interval.

While a repeat fracture rate of almost 10% is demonstrated in our cohort, this figure is limited by a relatively short and non-uniform follow-up period for our patients. Our study also lacks a control group for comparison, for future studies an appropriately matched control group will be helpful in demonstrating definite increase in risk of osteoporosis.

CONCLUSION

Our study shows that distal radius fractures may be the first clinical sign in diagnosing patients with osteoporosis – these patients are likely to suffer from undiagnosed osteoporosis, and are at high risk of subsequent repeat fractures, which highlights the importance of subsequent investigation and treatment.

Awareness of the above risks can prompt medical professionals to take the appropriate course of action and investigate for and treat osteoporosis accordingly[36]. As long as it has been diagnosed, our health system is indeed able to treat these cases of osteoporosis.

In our aging society, undetected osteoporosis is a major public health burden, and patients like that of our cohort present a unique opportunity to diagnose this condition, intervene early and break the cycle[37] – prevent subsequent fractures and the increased mortality risk[38].

Table 1

Demographics of study population

Number recruited	275	
Mean age (range)	68.9	(38-95)
Total mean follow up	1315	(170-1981)
Sex [%]		
- Male	30	[10.9%]
- Female	245	[89.1%]
Ethnicity [%]		
- Chinese	271	[98.5%]
- Other Asian	2	[0.7%]
- Others	2	[0.7%]
Fracture laterality [%]		
- Unilateral	274	[99.6%]
- Bilateral	1	[0.4%]
Surgical fixation	115/275	[41.8%]
Mean days till DXA (range)	323.7	(4-1581)
- Done within 1 year [%]	181	[65.9%]
- Done within 2 years [%]	251	[91.2%]

Table 2

Prevalence of osteoporosis

		(95% CI) [%]	P value
Mean T-score	-2.18		
- Male	-1.91	0.29	0.195
- Female	-2.22	(-0.15 to +0.75)	
- Age ≥50	-2.25	-1.72	<0.001*
- Age <50	-0.53	(-2.38 to -1.07)	
- Postmenopausal (a)	-2.27	-0.68	0.001*
- Non-postmenopausal	-1.59	(-1.07 to -0.29)	
- Age R^2 (Cox & Snell)	0.288		<0.001*
Osteoporotic	117/275	[42.5%]	
- Male	8/30	[26.7%]	0.062
- Female	109/245	[44.5%]	
- Age ≥50	117/263	[44.5%]	0.002*
- Age <50	0/12	[0.0%]	
- Postmenopausal †	109/235	[46.4%]	0.002*
- Non-postmenopausal	8/40	[20.0%]	
- Age R^2 (Cox & Snell)	0.160		<0.001*
Osteopenia	119/275	[43.3%]	
At least osteopenia	236/275	[85.8%]	
† Female age ≥50 at fracture admission			

Table 3

Repeat fractures

Repeated fracture <1y	8/275	[2.9%]	
- Mean T-score with	-2.86	-0.70	0.095
- Mean T-score without	-2.15	(-1.54 to +0.12)	
- Mean age with	78.25	+9.58	0.028*
- Mean age without	68.67	(+1.02 to +18.13)	
Repeated fracture within study	26/275	[9.5%]	
- Mean T-score with	-2.90	-0.80	0.017*
- Mean T-score without	-2.10	(-1.45 to -0.16)	
- Mean age with	74.46	+6.08	0.015*
- Mean age without	68.38	(+1.18 to +10.99)	

Table 4

treatment for osteoporosis

Prophylactic treatment ‡	34/275	[12.4%]	
- Mean age treated	78.38	11.47	<0.001*
- Mean age untreated	66.91	(7.26 to 15.68)	
- Mean T-score treated §	-2.78	-0.82	<0.001*
- Mean T-score untreated	-1.96	(-1.22 to -0.42)	
- Treated and later diagnosed ‖	24/34	[70.6%]	
No prophylactic treatment	241/275	[87.6%]	
Later diagnosed osteoporosis	93/241	[38.6%]	
> Ineligible for treatment ¶	23/93	[24.7%]	
> Given treatment	65/70	[92.9%]	
Total identified osteoporosis	117/275	[42.5%]	
Total treated	89/117	[76.1%]	
Total treated excluding ineligible	89/94	[94.7%]	
‡ 34/275 started treatment immediately on index admission			
§ T-score on subsequent DXA scan after index admission			
‖ 24/34 later confirmed to have osteoporosis on			
¶ Refused treatment or lost to follow up			

Diagram 1

Cohort Follow-up

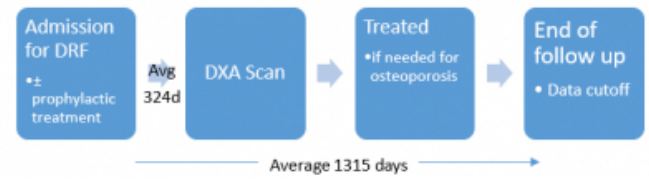


Diagram 2

prophylactic treatment for osteoporosis

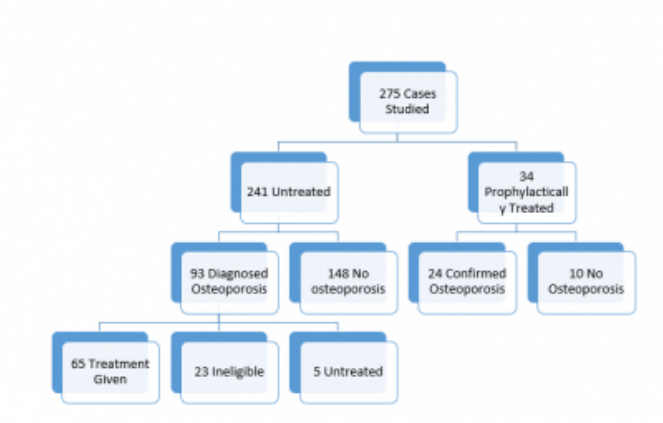


Diagram 3

Patient recruitment

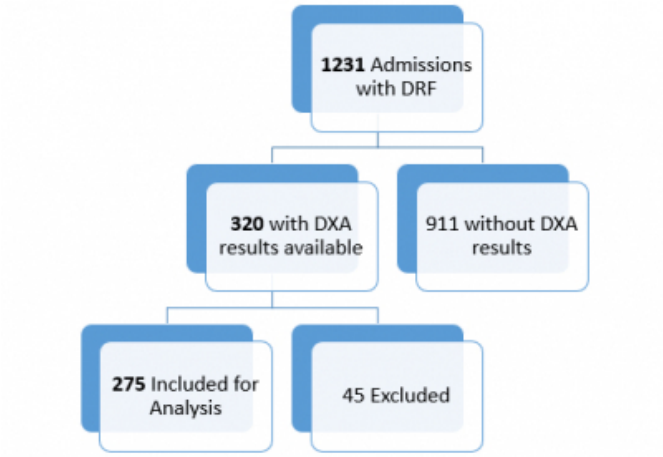


Diagram 4

scatter plot of T-score vs Age

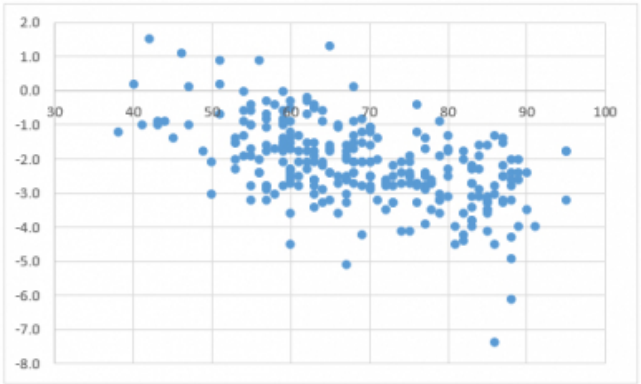
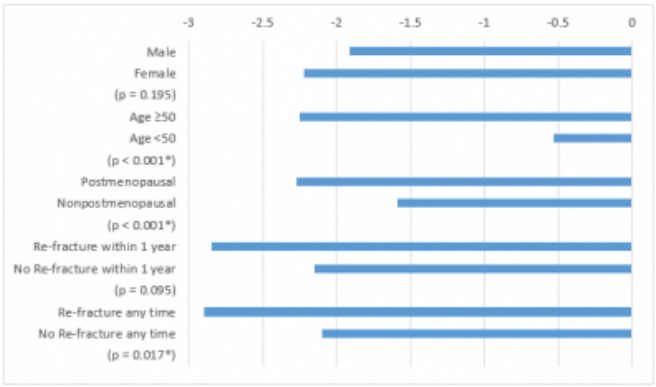


Diagram 5

Average T-scores



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