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ORIGINAL ARTICLE

Five-year refracture rates of a province-wide fracture liaison service

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Abstract

Summary We examined the 5-year refracture rate of 6543 patients and found an overall rate of 9.7%. Adjusted analysis showed that presenting with multiple fractures was an indicator of a higher refracture risk; while presenting with an ankle fracture was associated with a lower refracture risk.

Introduction To examine refractures among patients screened in a province-wide fracture liaison service (FLS).

Methods We assessed the 5-year refracture rate of fragility fracture patients aged 50+ who were screened at 37 FLS fracture clinics in Ontario, Canada. Refracture was defined as a new hip, pelvis, spine, distal radius, or proximal humerus fracture. Kaplan-Meier curves and Cox proportional hazards model adjusting for age, sex, and index fracture type were used to examine refracture rates.

Results The 5-year refracture rate of 6543 patients was 9.7%. Those presenting with multiple fractures at baseline (i.e., two or more fractures occurring simultaneously) had the highest refracture rate of 19.6%. As compared to the 50–65 age group, refracture risk increased monotonically with age group (66–70 years: HR = 1.3, CI 95%, 1.0–1.7; 71–80 years: HR = 1.7, CI 1.4–2.1; 81+ years: HR = 3.0, CI 2.4–3.7). Relative to distal radius, presenting with multiple fractures at screening was associated with a higher risk of refracture (HR = 2.3 CI 1.6–3.1), while presenting with an ankle fracture was associated with a lower risk of refracture (HR = 0.7 CI 0.6–0.9). Sex was not a statistically significant predictor of refracture risk in this cohort (HR = 1.2, CI 1.0–1.5).

Conclusions One in ten patients in our cohort refractured within 5 years after baseline. Presenting with multiple fractures was an indicator of a higher refracture risk, while presenting with an ankle fracture was associated with a lower refracture risk. A more targeted FLS approach may be appropriate for patients at a higher refracture risk.

Keywords Fragility fracture · Fracture liaison service · Refracture rates · Refracture risk

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Introduction

Fragility fractures are associated with high morbidity, mortality, and economic burden [1–3]. Patients who sustain even one fragility fracture have an increased likelihood of sustaining another fracture (refracture) [4–6]. The risk of refracture is doubled for most fragility fracture patients regardless of the index fracture site [6, 7] and is particularly high within the first 2 years [4, 8–10], persisting for up to 10 years after the initial fracture event [11, 12]. While bone sparing medications are available to reduce refractures [13–15], few fragility fracture patients receive post-fracture investigation or treatment [16, 17].

Fracture liaison services (FLS) have been advocated and increasingly implemented to improve secondary fracture prevention for fragility fracture patients [18]. One such FLS is the Fracture Screening and Prevention Program (FSPP) which began in 2007 in the province of Ontario, Canada (population 14 million, single-payer health care system). This program, formerly known as the Fracture Clinic Screening Program, has been implemented in 37 medium- and high-volume orthopedic clinics across the province with the ultimate goal of reducing the number of refractures [19].

Refracture rates reported by FLS programs vary widely and include follow-up of different durations, different settings, and different index fracture types [20–26]. Of the studies we identified, four reported outcomes after 2 years [20–22, 24], one after 3 years [23], one after 4 years [25], and one after 6 years of follow-up [21]. The refracture rates in these heterogeneous studies ranged from 4 to 18%, depending on the length of follow-up. Six of the seven studies assessed FLS programs in single hospital sites in Europe and Australia, and one study [20] evaluated FLS programs in 11 hospitals in a region of England. While two studies [23, 24] included patients with any index fragility fracture, others focused on non-vertebral fractures [25, 26], hip fractures only [20], or a few major fractures [21, 22].

It is unclear whether the refracture rates reported in previous studies are relevant to North-American or Canadian settings. It is also not yet clear from previous research whether specific index fragility fractures are associated with higher refracture rates in FLS programs. A system-wide FLS, such as the Ontario FSPP which screens patients with all types of fragility fractures seen in an outpatient fracture clinic, might also be expected to report different refracture rates. Establishing refracture rates in FLS programs is critical to future evaluations of improvement in long-term outcomes.

To address these gaps in knowledge, we undertook this study whose primary objective was to examine the rates and the distribution of refractures stratified by index fracture type among the fragility fracture patients screened as part of our provincial FLS. The secondary objective was to examine whether certain index fractures were more likely to lead to refractures.

Methods

Study cohort and databases

We conducted a cohort study of ambulatory fragility fracture patients aged 50 years and over, screened at one of 37 FSPP fracture clinics in Ontario, Canada between 2007 and 2010. Fragility fracture was defined by the program as one occurring spontaneously or following minor trauma such as a trip, a slip, or a fall from standing height or less. In this first phase of the program implemented between 2007 and 2010, the fracture prevention coordinators (usually registered nurses or registered practical nurses) were in teaching and liaison roles. As part of their roles, the coordinators identified, screened, and educated fragility fracture patients, provided referrals and sent customized letters to the family physician regarding provision of guideline-based care, encouraged patients to return to their family physician for follow-up, and followed up with patients to assess their outcomes 3 to 6 months after screening. At the time of screening, the coordinators also consented patients to linking their program data to provincial healthcare administrative databases so that the program could assess long term outcomes using administrative data [27]. A more intensive version of this program (phase II) was implemented in 2011 [28].

The data used in the study included both the patients' program data collected as part of the FSPP usual care as well as the patients' administrative data. The program data included patient sociodemographics, fracture location, diagnosis, and treatment history, collected at baseline (time of screening). As described above, all patients in the study consented to linking their program data to population-based provincial administrative databases housed at the Institute for Clinical Evaluative Sciences (ICES). The ICES data are often used in health services research and are considered to be of high quality for fracture and osteoporosis care research [29].

All consenting FSPP patients aged 50 years and older with any index fragility fractures were included in our study. To qualify for the study, patients needed to be able to either provide an informed consent themselves or they needed to have a substitute decision maker who was able to consent on their behalf. All patients were ambulatory. The low trauma nature of index fractures was confirmed by an in-person survey of all patients as part of the program. Refractures (subsequent fractures) were identified from two sources of administrative data: the National Ambulatory Care Reporting System database for emergency room visits at any hospital in the province of Ontario and the discharge data housed at the Canadian Institute of Health Information for discharge summaries from inpatient hospital stays in Ontario. Both sources allowed identification of inpatient and outpatient refractures through diagnostic coding (ICD9-CM and ICD10) for humerus, distal radius, hip, spine, and pelvis fractures. Previous Canadian research showed that administrative data are generally suitable for estimating the incidence of fractures [30, 31].

To ensure that the refracture was a distinct event from the index fracture when they occurred in the same bone, we searched for the same billing code 180 days before the refracture. If a billing for the same fracture code was found in this time span, the refracture event in question was excluded (i.e., it was considered to be an index fracture). This was done to ensure that refracture billings used in the study were indeed related to a new fracture (refracture) rather than an old (index) fracture.

This project received Research Ethics Board (REB) approvals from each fracture clinic's REB for research use of patients' data; an REB approval of the principal investigator's home institution (St. Michael's Hospital REB# 08-304) and the project approval from the Sunnybrook Health Sciences Centre REB where the ICES is located.

Analysis

Univariate analyses were used to describe the cohort at the time of screening in terms of age, sex, index fracture, previous fracture, history of falls, previous diagnosis of osteoporosis, and treatment status at screening. We distinguished between patients with single and multiple index fractures. Patients with multiple fractures were those who, at the time of screening, presented with multiple, simultaneous fractures (of different sites) such as those of the distal radius and proximal humerus, distal radius and hip, and hip and proximal humerus.

The primary analysis was a descriptive time-to-event analysis. Overall unadjusted refracture rates were examined, along with the distribution of refractures stratified by the index fracture type (i.e., the fracture for which the patient was screened in the Fracture Screening and Prevention Program) at year 1, 2, and 5 post-baseline (time of screening). Kaplan-Meier curves were used to illustrate the time to refracture over a 5-year time span since screening. Censoring was done at the time of death. It was a-priori decided that sample sizes of 100 and less were not stable enough for Kaplan-Meier curves.

We employed multivariable Cox regression to examine whether certain index fracture types were associated with a higher risk of refracture while controlling for age and sex. Distal radius index fractures were used as a reference as they were the most common fracture type in our cohort. Other index fracture groups included in the model were ankle, hip, proximal humerus, all other single fractures, and multiple fractures. Sex was assessed as male/female; male was used as a reference. Age was assessed as a categorical variable (50–65, 66–70, 71–80, 81+), with the 50–65 age group serving as a reference group. An additional analysis using Fine and Gray competing risk model was performed to adjust for the competing risk of death.

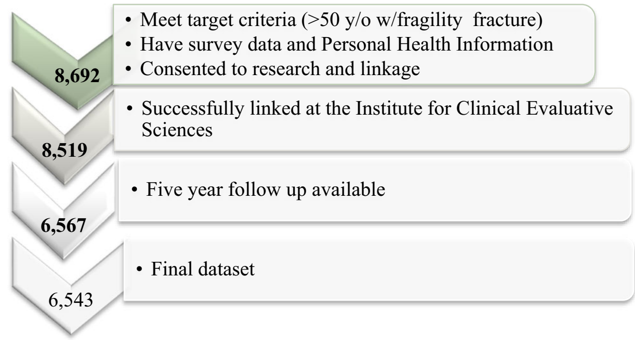

Fig. 1 Patient flow

Results

Sample description

Six thousand five hundred forty-three patients were confirmed to have sustained a fragility fracture and were included in this analysis (Fig. 1).

The majority of patients in the cohort were female (82.1%), mean age of 68 years with the most common index fracture being the distal radius fracture (Table 1). Thirty-two percent of patients reported a history of fragility fractures after the age of 40 (i.e., a fracture prior to the index fracture). Thirty-four percent of patients reported a previous diagnosis of osteoporosis and 28.7% reported a history of falls in the year prior to screening.

There were 221 cases of fragility fractures of the same site which were not considered refractures because the same billing code was found in the 180 days prior, indicating that the billing was likely related to an index fracture and not a refracture.

Table 1 Description of the cohort at baseline (time of screening) $n = 6543$

Patient characteristics	Mean ± SD or *n* (%)
Mean age (SD)	68.30 ± 11.36
Female gender	5375 (82.1)
Index fracture	
Distal radius fracture only	2372 (36.3)
Ankle fracture only	1192 (18.2)
Hip fracture only	630 (9.6)
Proximal humerus fracture only	997 (15.2)
Multiple fractures*	214 (3.3)
All other fractures	1138 (17)
Previous fracture (after age 40)	2117 (32.4)
History of falls in the past year	1881 (28.7)
Previous diagnosis of osteoporosis	2254 (34.4)
On treatment at screening	1252 (19.1)

*Multiple fractures include combinations such as distal radius/humerus, distal radius/hip, and hip/humerus

Table 2 Five-year refracture rates, stratified by index fracture type

Index fracture type	Total number of patients with index fracture	Refracture within 1 year		Refracture within 2 years		Refracture within 5 years	
		n	%	*n*	%	*n*	%
Overall	6543	128	1.96	277	4.23	637	9.74
Distal radius	2372	33	1.39	81	3.41	207	8.73
Ankle	1192	7	0.59	25	2.10	67	5.62
Hip	630	19	3.02	42	6.67	84	13.33
Proximal humerus	997	26	2.61	52	5.22	117	11.74
Multiple fractures	214	13	6.07	20	9.35	42	19.63
All other fractures*	1138	30	2.64	57	5.01	120	10.54

*Includes femur, spine, pelvis, clavicle, elbow, tibia/fibula, and other fragility fractures

Outcomes

The unadjusted refracture rate for the cohort of 6,543 patients was 2% at year 1, 4.2% at year 2, and 9.7% at year 5 after baseline. Patients presenting with an ankle fracture had the lowest refracture rate at any of the three follow-up points (0.6% at year 1, 2.1% at year 2, and 5.6% at year 5), while those with multiple (simultaneous) fractures at the time of screening had the highest refracture rates at any given follow-up point (6.1% at year 1, 9.3% at year 2, and 19.6% at year 5). Refracture rates stratified by index fracture for years 1, 2, and 5 post-baseline are shown in Table 2.

Kaplan-Meier curve showed that those patients who presented with multiple fractures were most likely to refracture and also refractured after a shorter interval than those presenting with a single fracture at the time of screening (Fig. 2). Those with an index ankle fracture were least likely to refracture and also refractured after a longer interval than patients with other index fracture types.

In the multivariable Cox regression model, older age and index fracture type were found to be associated with a higher risk of refracture within 5 years of baseline. As compared to the 50–65 age group, refracture risk increased monotonically with age group (66–70 years: HR = 1.3, CI 95%, 1.0–1.7; 71–80 years: HR = 1.7, CI 1.4–2.1; 81+ years: HR = 3.0, CI 2.4–3.7). Relative to distal radius, presenting with multiple fractures at screening was associated with a higher risk of refracture (HR = 2.3 CI 1.6–3.1), while presenting with an ankle fracture was associated with a lower risk of refracture (HR = 0.7 CI 0.6–0.9). Presenting with a proximal humerus fracture was statistically significant; however, the confidence interval (HR = 1.4 CI 1.1–1.7) was similar to that of the index hip fracture (HR = 1.3, CI 1.0–1.7) which was of borderline statistical significance ($p = 0.06$) in this cohort of ambulatory fracture patients. Sex was not a statistically significant predictor of refracture in this cohort of fracture patients (HR = 1.2 CI 1.0–1.5 $p = 0.07$) (Table 3).

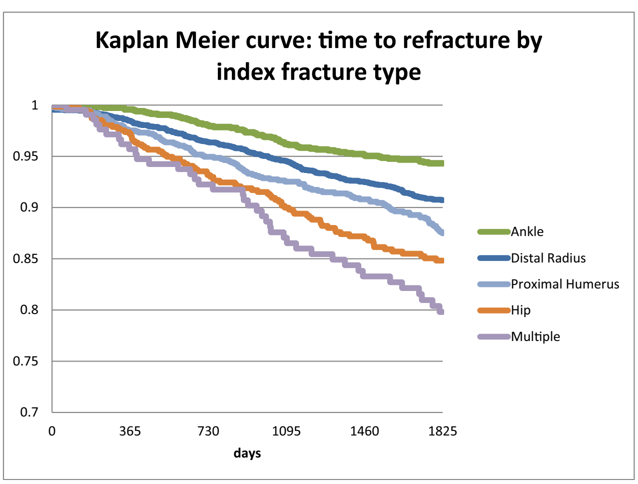

Fig. 2 Kaplan-Meier curve: time to refracture stratified by the index fracture type

Table 3 Multivariable Cox regression analysis on 5-year refracture outcome

	Hazard ratio (95% CI)	*p* value
Age		
50–65	Ref	Ref
66–70	1.3 (1.0–1.7)	0.05
71–80	1.7 (1.4–2.1)	< 0.01
v81+	3.0 (2.4–3.7)	< 0.01
Sex		
Male	Ref	Ref
Female	1.2 (1.0–1.5)	0.07
Index fracture		
Distal radius only	Ref	Ref
Ankle only	0.7 (0.6–0.9)	0.02
Hip only	1.3 (1.0–1.7)	0.06
Proximal humerus only	1.4 (1.1–1.7)	< 0.01
Multiple fractures	2.3 (1.6–3.1)	< 0.01
All other fractures	1.3 (1.1–1.7)	0.02

A Cox model accounting for a competing risk of death confirmed that older age and index fracture type were associated with higher refracture risk. As compared to the 50–65 age group, those 71 years of age and older had a higher risk of refracture (71–80 years: HR = 1.6, CI 95%, 1.3–2.0; 81+ years: HR = 2.5 CI 2.0–3.1), while the risk for those aged 66–70 was not statistically different (HR = 1.3, CI 1.0–1.7, $p = 0.08$). Relative to distal radius, presenting with multiple fractures was associated with a higher risk of refracture (HR = 2.1, CI 1.5–3.0), while presenting with an ankle fracture was associated with a lower risk of refracture (HR = 0.7, CI 0.6–0.9). Relative to distal radius, presenting with a proximal humerus fracture was statistically significant; however, the confidence interval (HR = 1.3, CI 1.0–1.6) was similar to that of the index hip fracture (HR = 1.2, CI 0.9–1.6) which was not statistically significant when accounting for a competing risk of death ($p = 0.15$). Sex was a statistically significant predictor of refracture when accounting for a competing risk of death (HR = 1.3, CI 1.1–1.7 $p < 0.05$); however, the effect was not very large.

Discussion

We identified refracture rates of ambulatory fragility fracture patients screened through a provincial, multisite FLS and found an overall refracture rate of 2% at year 1, 4.2% at year 2, and 9.7% at year 5. Of interest was the finding that patients who presented with multiple fractures at the time of screening had the highest refracture rate at any given follow-up point. Their refracture rate was 6.1% at year 1, 9.3% at year 2, and 19.6% at year 5. Even after controlling for age, sex, and index fracture type, presenting with multiple fractures was an indicator of higher refracture risk. Presenting with a proximal humerus fracture was a statistically significant indicator of refracture; however, the confidence interval was similar to that of the index hip fracture which was of borderline significance. In addition to having a higher refracture rate, patients with multiple fractures refractured earlier than other patients. These findings have not been previously described in the literature, and they suggest a need for a more targeted approach within FLS programs, targeting those patients who are at a higher risk of refracture.

Refracture rate was lowest for patients with ankle fractures and they refractured later than others. The analysis showed that patients with ankle index fractures were also least likely to refracture at any given follow-up point. Ankle fractures have been considered fragility fractures in some jurisdictions, and FLS initiatives such as ours, but other jurisdictions, including the Public Health Agency of Canada (PHAC), do not include ankle fractures in the category of typical fragility fractures [32]. Our findings confirm that ankle fractures as a group tend to have lower refracture rates than other index fractures which are considered more typical fragility fractures. We did not assess the attributable proportion of refractures from index ankle fractures or compare the outcomes of patients with an index ankle fracture to outcomes of patients with no fragility fracture. Based on these findings and constraints, FLS programs may wish to re-evaluate the value of continued screening of ankle fractures.

Although no other study has been exactly the same as ours, nor in the Canadian population, these results build upon existing knowledge of refracture occurrence in FLS-screened fragility fracture patients. While our 5-year refracture rate of 9.7% (637/6543) was much lower than the 6-year rate of 18% (39/219) found in Astrand et al. [21], it was also higher than Lih et al.'s [25] 4-year refracture rate of 4.1% (10/246). However, direct comparisons to other studies are difficult because of variations in sample sizes, setting, patient age, and the type of index fractures included in the study. For example, the sample size of ten patients with refractures (of 246 patients) in Lih's 2011 study was quite different from 637 patients with refractures (of 6543 patients) in our study, making the comparison uneven. In terms of settings, our study, along with that of Hawley et al. [20], is the only report which included multicenter FLS program data. Hawley et al. examined data from 11 hospital sites in the UK with 33,152 patients in the cohort. However, the focus of Hawley's study was on index hip fractures and a 2-year hip refracture rate. Patient age ranges were also different depending on the study, with some studies including patients as young as 45 [25] and others limiting the upper age at 75 [21]. In terms of the fragility fractures assessed, two studies [23, 24] included patients with any index fragility fracture while others focused on non-vertebral fractures [25, 26], hip fractures only [20], or a few major fractures [21, 22].

One factor that did not appear in our data is the finding that the risk of refractures is particularly high within the first year of the index fracture [10]. This, however, could be because the studies with these findings included general population rather than FLS patients. It is possible that, due to improvements in moving patients through the steps involved in fracture risk assessment and treatment initiation when indicated, FLS corrects for this vulnerable period.

Strengths and limitations

Our study offers 1-, 2-, and 5-year refracture outcomes for a real-world application of a multi-site FLS in the province of Ontario (population 14 million, single-payer health care system). To our knowledge, no other study has described index fracture-stratified refracture rates in either a system-wide FLS or in the North-American context. The strength of our study is access to a large, provincial database that included data from 37 hospital sites and 6543 patients. The low trauma nature of the index fracture in our study was confirmed through both an in-person patient survey and administrative data.

This study focused on the patients screened in phase I of our provincial FLS (implemented between 2007 and 2010) in which coordinators were in a teaching and a liaison role. In this initial phase, coordinators had targeted discussions with patients, communicating results, and recommendations to the patients' primary care providers and following up with patients who, at the time of screening, were not diagnosed with osteoporosis nor on treatment. A more intensive version of this program (phase II) was designed and implemented in 2011 [28]. In this ongoing phase II, the coordinators also facilitate BMD testing through medical directives or requisitions and communicate the BMD testing results along with a fracture risk assessment to the primary care provider. These program improvements may result in a different refracture rate for phase II of the program, as the treatment rates of the phase II are higher [28].

There are limitations to our study. Our cohort consisted of outpatients screened in ambulatory fracture clinic settings. Therefore, the results of our study may not be generalizable to very frail patients who are unable to attend outpatient clinics, and the refracture rate in our program may be specific to ambulatory patients only. We also did not control for baseline treatment status. Osteoporosis treatment rates in the community are generally low and those treated may already have severe osteoporosis and refracture risk. We therefore hypothesized that the treatment status was likely going to reflect confounding by indication as it would indicate people with a higher refracture risk who were identified and treated in the community because of this risk. We also did not assess treatment rates at follow-up. A constraint associated with using administrative data in the province of Ontario is that prescription billing data can only be tracked for those 66 and older. We were therefore unable to assess the prescription billing data for the entire cohort. We were unable to ensure the refracture was due to low trauma as we used the PHAC definition and diagnostic codes which do not differentiate between the low versus high trauma nature of the force. We opted for this approach because administrative data are valid indicators of fracture occurrence, suitable for estimating the fracture incidence [30, 31]. The other option of using self-reported fractures is associated with 11% false positives and 7% false negatives [33] and can be misestimated due to attrition and loss of follow-up.

Another potential source of underestimation of our refracture rate could have come from the methods we used to ensure that the index fracture and the refracture were two different events. Since we excluded refractures that had the same billing code as fractures that occurred within 180 days prior, we could have excluded some very early refractures of the same bone and potentially lowered our refracture rate estimation.

Conclusion

The results of this study have implications for clinicians as well as policy and program decision makers. Refracture rate was lowest for patient with index ankle fractures and highest for those who presented with simultaneous multiple fractures at baseline.

As well as providing a real-world estimation of refracture rates in ambulatory fragility fracture patients identified in an FLS, our results provide evidence of importance for amendments to our FLS. Ankle fractures have long held an ambiguous position in the fragility fracture definitions. Our results could help policy makers and program decision makers weigh the risk/benefit of including ankle fractures given their relatively lower risk of refracture. The results of our study also indicate increased attention should be directed to patients presenting with multiple fractures due to their higher refracture risk, a finding not previously described in the literature. Within the context of an FLS, a more targeted FLS approach may be appropriate for patients presenting with these index fractures.

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Compliance with ethical standards

Conflicts of interest Rebeka Sujic: no disclosures. Dorcas E Beaton: no disclosures. Muhammad Mamdani: received Honoraria and served as a consultant/advisory board of Novo Nordisk, Allergan, and Amgen. Suzanne M Cadarette: no disclosures. Jin Luo: no disclosures. Susan Jaglal: no disclosures. Joanna EM Sale: no disclosures. Ravi Jain: no disclosures.

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