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ORIGINAL ARTICLE

Adherence to osteoporosis therapy after an upper extremity fracture: a pre-specified substudy of the C-STOP randomized controlled trial

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Abstract

Summary Despite their proven efficacy for secondary fracture prevention, long-term adherence with oral bisphosphonates is poor.

Introduction To compare the effectiveness of two interventions on long-term oral bisphosphonate adherence after an upper extremity fragility fracture.

Methods Community-dwelling participants 50 years or older with upper extremity fragility fractures not previously treated with bisphosphonates were randomized to either a multi-faceted patient and physician educational intervention (the active control arm) vs. a nurse-led case manager (the study arm). Primary outcome was adherence (taking > 80% of prescribed doses) with prescribed oral bisphosphonates at 12 months postfracture between groups; secondary outcomes included rates of primary non-adherence and 24-month adherence. We also compared quality of life between adherent and non-adherent patients.

Results By 12 months, adherence with the initially prescribed bisphosphonate was similar ($p = 0.96$) in both groups: 38/48 (79.2%) in the educational intervention group vs. 66/83 (79.5%) in the case manager arm. By 24 months, adherence rates were 67% (32/48) in the educational intervention group vs. 53% (43/81) in case managed patients ($p = 0.13$). Primary non-adherence was 6% (11 patients) in the educational intervention group and 12% (21 patients) in the case managed group ($p = 0.07$). Prior family history of osteoporosis (aOR 2.1, 95% CI 1.0 to 4.4) and being satisfied with current medical care (aOR 2.3, 95% CI 1.1 to 4.8) were associated with better adherence while lower income (aOR 0.2, 95% CI 0.1 to 0.6, for patients with income < $30,000 per annum) was associated with poorer rates of adherence. There were no differences in health-related quality of life scores at baseline or during follow-up between patients who were adherent and those who were not.

Conclusion While both interventions achieved higher oral bisphosphonate adherence compared to previously reported adherence rates in the general population, primary non-adherence and long-term adherence to bisphosphonates were similar in both arms. Adherence was influenced by family history of osteoporosis, satisfaction with current medical care, and income.

Trial registration ClinicalTrials.gov: NCT01401556

Keywords Adherence · C-STOP · Osteoporosis

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Introduction

Osteoporosis is common but often clinically silent until a fracture occurs [1, 2]. Fragility fractures of the upper extremity (i.e., fractures of the distal radius and ulna or proximal humerus) are a harbinger of future risk for more serious osteoporotic fractures such as those in the hip or vertebrae that are associated with substantial morbidity and mortality [3–5]. However, even if therapies proven efficacious to reduce future fracture risk (such as bisphosphonates) are initiated, long-term adherence is frequently poor [6, 7]. Predictably, patients who demonstrate poor adherence to proven efficacious chronic disease therapies have poorer outcomes and generate higher health care costs [8].

In the C-STOP Trial [9], we demonstrated that both a high intensity nurse case manager approach (hereafter "case manager," which identified at risk patients, ordered appropriate investigations, including BMD study, and prescribed appropriate treatment when indicated by test results) and a low intensity patient and physician educational intervention (hereafter "educational intervention," which only identified at risk patients and provided their primary care provider a one page opinion-leader endorsed general recommendations at the time of notification) improved the quality of care for patients after an upper extremity fragility fracture. Within 6 months of the fracture, bisphosphonate treatment was started in 48% case-managed vs. 28% educational intervention patients. In this pre-specified substudy of the C-STOP Trial, we compared primary adherence (long term and primary) with bisphosphonate therapy and explored what factors were associated with adherence.

Methods

Setting and subjects

We recruited community-dwelling patients 50 years or older with an upper extremity (distal radius and/or ulna, or proximal humerus) fracture from the Emergency Department and Fracture Cast Clinic of a tertiary care university hospital in Edmonton, Canada. We excluded patients already receiving bisphosphonate therapy, or those with pathological or multiple (e.g., major trauma) fractures, on long-term glucocorticoids, unable to understand or converse in English, living outside of Edmonton, or unable to provide written informed consent. In Alberta, all seniors have their medication costs covered by government subsidy through Alberta Blue Cross; patients younger than 65 years may have private insurance to cover medication costs but we did not collect information on how much our younger patients had to co-pay for medications.

Study design

The full study design and primary study results (appropriateness of care at 6 months postfracture) for C-STOP have been reported elsewhere [9]. In brief, we conducted a patient-level randomized trial comparing an educational intervention arm (active control) to a case manager (study arm). We chose to use an active control group (the educational intervention arm) as we felt it unethical to randomize patients to usual care since we had previously demonstrated [10] that a multifaceted patient and physician educational intervention improved treatment relative to usual care. However, the educational intervention still left approximately 70% of patients untreated for osteoporosis at 1 year after fracture.

The educational intervention arm [10] included patient education on osteoporosis with encouragement to follow-up with their primary care physician. It also included a fax to each patient's primary care physician notifying them that their patient had recently sustained an upper extremity fracture and providing an actionable summary of osteoporosis treatment guidelines endorsed and signed by five peer-nominated local opinion leaders. Receipt of this educational package by the primary care physician was verified by the study coordinator via telephone.

The study case manager was an experienced registered nurse who met with patients face to face to educate and counsel about the association between fractures and osteoporosis, the need for BMD tests, and the efficacy of bisphosphonates to prevent recurrent fractures. She then arranged BMD tests and standardized laboratory tests and discussed the results with the patients in person in the first 3 months. For those with normal bone mass, no further investigations or treatments were advised. For those who had low bone mass (defined as T-score less than − 1.0), no severe esophagitis, no risk factors for osteonecrosis of the jaw (recent dental work or implants), and normal renal function, she counseled patients about potential benefits and side effects of osteoporosis therapy and for those who accepted treatment, she provided a 1-year prescription for 70 mg of generic alendronate or 35 mg of generic risedronate weekly. For those with a history of intolerance to bisphosphonate therapy, she referred them to an osteoporosis specialist for management. All test results and treatment plans were communicated to the family physician via fax. The case manager communicated with patients a minimum of four times in the first 24 months after the baseline visit (once in person within the first 3 months, and then by telephone at 3, 12, and 24 months, although patients could initiate further contacts if they had questions or concerns), during which bisphosphonate initiation or patient refusal, as well as adherence and quality of life measures were documented.

Main outcome

The primary outcome for this pre-specified substudy of the C-STOP Trial was adherence with bisphosphonate therapy (in those who were taking bisphosphonates within 6 months of fragility fracture) at 12 months after study enrollment. Secondary outcomes included primary non-adherence and 24 month adherence. We used standard literature-based definition to define patient adherence (> 80% of pills consumed) [7, 10] and primary non-adherence (not following recommendations for testing or therapy even after receiving education about osteoporosis and the importance of fragility fractures as a marker of future risk) [11]. These outcomes were determined by patient self-report and confirmed through pharmacy dispensing records.

Additional outcomes

We evaluated health-related quality of life measures at study entry, and 6, 12, and 24 months later, using the generic SF-12 [12], the Osteoporosis Quality of Life (OptQoL) tool [13], and upper extremity specific functional outcomes (Disabilities of the Arm, Shoulder, and Hand [DASH]) [14]. The 6-month results by randomized arm were reported in the C-STOP primary results manuscript [9]. This report focuses on the results by adherence group.

Data analysis

Continuous variables are reported as means and standard deviations (SD) or medians and inter-quartile ranges (IQR), as appropriate. Continuous variables were compared using Student's *t* test or Wilcoxon signed-rank test, as appropriate. Categorical variables are reported as percentages and compared between groups using chi-square statistics. Logistic regression modeling was completed with result reported as adjusted odds ratio (aOR) with associated 95% confidence interval (CI). We adjusted for randomization arm and any covariates that differed ($p < 0.20$) between groups, and used backward stepwise selection. We considered p values < 0.05 in the final model to be statistically significant. The data were analyzed using Statistical Analysis Software (SAS) version 9.4 (SAS Institute Inc., Cary, NC, USA).

Ethics

This study received ethics approval from the University of Alberta (PRO00018520) and was registered at ClinicalTrials.gov (NCT01401556). Study personnel collected outcomes without knowledge of allocation status, and investigators were blinded to both allocation status and outcomes.

Results

As reported elsewhere [9], 181 participants were randomized to the educational intervention and 180 to case manager; both groups were similar at baseline. Most participants were female, had good self-reported health literacy, sustained the fracture as a result of a fall, and over 86% had previously had their bone density measured, although less than half knew their results (Table 1). At 6 months after fracture, only 11 (3%; 7 in the active control group and 4 in the case manager) were lost to follow-up or had died; 108 (62%) of the active controls had their BMD measured vs. 128 (73%) of the case managed patients, and 51 (28%) participants in the active control arm vs. 86 (48%) in the case manager arm started bisphosphonate treatment (Fig. 1). Of participants eligible (due to low BMD) and offered bisphosphonate prescriptions, 11 (6%) active controls and 21 (12%) case managed patients refused treatment (primary non-adherence), which did not achieve statistical significance ($p = 0.07$). Although the 19 case-managed patients who did not undergo their ordered BMD are also primary non-adherent patients, we could not determine how many active control patients similarly did not undergo an ordered BMD test; thus, we could not compare these proportions between treatment arms.

Adherence with the initially prescribed bisphosphonate was similar in both arms: 44/51 (86%) in the educational group vs. 74/86 (86%) in the case manager group at 6 months ($p = 0.98$) and 38/48 (79%) vs. 66/83 (79%) at 12 months ($p = 0.96$) (Fig. 2). By 24 months, adherence rates were 67% (32/48) in the education arm vs. 53% (43/81) in case managed patients ($p = 0.13$). The most commonly reported reasons for stopping bisphosphonate therapy were side effects (59%), with most of these associated with gastrointestinal upset.

Prior family history of osteoporosis (adjusted odds ratio [aOR] 2.1, 95% CI 1.0 to 4.4) and being satisfied with current medical care (aOR 2.3, 95% CI 1.1 to 4.8) were associated with better adherence while lower income (aOR 0.2, 95% CI 0.1 to 0.6, for patients with income < $30,000 per annum) was associated with poorer rates of adherence. Age, sex, and randomized treatment arm were not associated with adherence (Table 2). Of note, neither comorbidity burden nor number of medications were associated with primary non-adherence or long-term adherence to bisphosphonate therapy. Although patients were allowed to contact the case manager between scheduled follow-ups, there was no difference in the frequency of communication with the case manager between the adherent and non-adherent groups.

Health-related quality of life scores were similar at baseline, 12 months, and 24 months in patients who were adherent compared to those who were not (Table 3).

Discussion

Although the case manager intervention resulted in significantly higher rates of bisphosphonate prescribing in the first 6 months after a fragility fracture relative to our educational control intervention, long-term adherence was not significantly different between groups at 6 months (86%), 12 months (79%), or 24 months (58%). Both groups had substantially higher adherence than reports from usual clinical practice [15–17]. This is perhaps not surprising since trial participants often exhibit better adherence than patients in clinical practice. It is worth noting that the adherence rates we observed were very similar to those reported from both arms of a trial evaluating an Australian fracture liaison service (79% at 1 year and 62% at 2 years) [18].

There are, however, several interesting observations from our data. For one, despite concerns sometimes raised by

Table 1 Baseline characteristics of participants by adherence status

Characteristics	Adherent at 12 months ($n = 104$)	Non-adherent at 12 months ($n = 27$)	p value comparing adherent vs. non-adherent	Primary non-adherence ($n = 32$)	p value comparing adherent vs. primary non-adherent	Total ($n = 163$)
Socio-demographic						
Age, mean (SD)	65.2 (8.9)	65.2 (7.4)	0.97	64.5 (9.1)	0.72	65.0 (8.67)
Female (%)	101 (97.1)	24 (88.9)	0.10	30 (93.8)	0.34	155 (95.1)
Rural residence (%)						
Good health literacy (%)	76 (73.1)	20 (74.1)	0.92	22 (68.8)	0.63	118 (72.4)
Income (%)						
< $30,000	6 (5.9)	9 (33.3)	< 0.01	3 (9.7)	< 0.01	18 (11.3)
$30,000 to $49,999	14 (13.9)	6 (22.2)		6 (19.4)		26 (16.4)
$50,000 to $69,999	13 (12.9)	1 (3.7)		6 (19.4)		20 (12.6)
$70,000 and above	36 (35.7)	7 (25.9)		9 (29.0)		52 (32.7)
Do not know	6 (5.9)	1 (3.7)		0 (0.0)		7 (4.4)
Chose not to answer	26 (25.7)	3 (11.1)		7 (22.6)		36 (22.6)
Education (high school or less)	20 (19.3)	4 (14.8)	0.78	6 (18.8)	0.95	30 (25.7)
FoOQ Score; median (IQR)	0.7 (0.6–0.8)	0.8 (0.6–0.8)	0.27	0.68 (0.6–0.8)	0.45	0.72 (0.6–0.8)
Current employment						
Employed full-time	31 (29.8)	8 (29.6)	0.81	16 (50.0)	0.11	55 (33.7)
Retired	48 (46.2)	14 (51.9)		11 (34.4)		73 (44.8)
Other	25 (24.0)	5 (18.5)		5 (15.6)		35 (21.47)
Married	63 (60.6)	13 (48.2)	0.24	17 (53.1)	0.45	93 (57.1)
Injury characteristics and fall/fracture history						
Distal radius and/or ulna (Colles + Smith + other) (%)	77 (74.0)	21 (77.8)	0.69	24 (75.0)	0.91	122 (74.8)
Family history of osteoporosis (%)	45 (43.3)	4 (14.8)	0.01	12 (37.5)	0.56	61 (37.4)
Admission to hospital for current fracture (%)	43 (41.4)	12 (44.4)	0.77	14 (43.8)	0.81	69 (42.3)
Satisfaction with medical care						
Satisfied (%)	78 (75.0)	21 (77.8)	0.76	14 (43.8)	0.01	113 (69.3)
Not satisfied (%)	26 (25.0)	6 (22.2)		18 (56.3)		50 (30.7)
Comorbidities and health status						
Body mass index, mean (SD)	26.3 (5.9)	26.0 (4.8)	0.78	25.7 (4.7)	0.58	26.1 (5.46)
Weight (kg), mean (SD)	69.4 (16.0)	68.7 (14.0)	0.81	69.6 (14.6)	0.96	69.3 (15.34)
Two or more health problems (%)	80 (76.9)	22 (81.5)	0.61	24 (75.0)	0.82	126 (77.3)
Diabetes mellitus (%)	8 (7.7)	2 (7.41)	0.99	0 (0.0)	0.20	10 (6.1)
Rheumatoid arthritis (%)	4 (3.9)	0 (0.0)	0.58	2 (6.3)	0.63	6 (3.7)
Thyroid disease (%)	29 (27.9)	7 (25.9)	0.84	11 (34.4)	0.48	47 (28.8)
Depression	29 (27.9)	10 (37.0)	0.35	5 (15.6)	0.16	44 (27.0)
Current smoking (%)	4 (3.9)	2 (7.4)	0.60	2 (6.3)	0.63	8 (4.9)
More than 2 alcoholic drinks per day (%)	103 (99.0)	25 (92.6)	0.11	30 (93.8)	0.14	158 (96.9)
Median, no. of prescribed medications (IQR)	2 (0.0–3.5)	1 (0–3)	0.32	1 (0.0–2.5)	0.12	1 (0–3)
≥ 2 Rx medications (%)	54 (51.9)	11 (40.7)	0.30	12 (37.5)	0.15	77 (47.2)
Self-pay for osteoporosis medications (Y/N)	53 (51.0)	16 (59.3)	0.44	20 (62.5)	0.25	89 (54.6)
Previous bone health management						
Bone density measured previously (%)	90 (86.5)	24 (88.3)	0.99	26 (81.3)	0.57	140 (85.9)
T-score spine, mean (SD)	− 1.36 (1.1)	− 1.58 (1.5)	0.51	− 1.45 (1.6)	0.80	− 1.42 (1.3)
Lowest value spine, mean (SD)	− 1.73 (1.3)	− 1.73 (2.0)	0.99	− 2.05 (0.8)	0.38	− 1.78 (1.4)
T-score hip, mean (SD)	− 1.08 (0.8)	− 0.82 (0.9)	0.24	− 0.94 (1.2)	0.57	− 1.01 (0.9)
Lowest value hip, mean (SD)	− 1.50 (0.8)	− 1.26 (1.1)	0.34	− 1.47 (1.3)	0.92	− 1.45 (1.0)
Patient aware of previous BMD results (%)	51 (56.7)	14 (58.3)	0.88	18 (69.2)	0.25	83 (59.3)
Hormone replacement (%)	32 (30.8)	9 (33.3)	0.80	5 (15.6)	0.09	46 (28.2)
Calcium supplements (%)	60 (57.7)	12 (44.4)	0.22	18 (56.3)	0.89	90 (55.2)
Vitamin D supplements (%)	84 (80.8)	18 (66.7)	0.12	22 (68.8)	0.15	124 (76.1)

clinicians, it is important to note that age, comorbidity burden, and number of medications already prescribed were not associated with primary non-adherence or long-term adherence to bisphosphonate therapy in this sample. Secondly, one of the few factors associated with bisphosphonate adherence was whether patients had family members with osteoporosis—this speaks to the importance of awareness of the longer-term consequences of osteoporosis. Third, we found that rates of primary non-adherence were higher for patients randomized to the case manager arm (12%) than those randomized to follow-up with their own primary care physician (6%). There was also a trend towards lower adherence rate at 2 years in the case manager arm (53%), in which regular follow-up ended at 1 year, as compared with the educational intervention arm (67%) where primary care physician contact presumably continued throughout the 2-year observation period. Both

Fig. 1 Flow of trial participants

findings are consistent with the literature on the importance of established physician-patient relationships and continuity of care on the decision to take long-term preventive therapies [19, 20]. However, the Australian fracture liaison service trial [18] mentioned earlier did not find any difference between their case managed arm and their control arm (which similarly to ours, involved medication initiation by the specialized nurse and then follow up with each patient's primary care physician); however, it was even smaller than our study with only 74 patients completing 2-year follow-up.

Despite the proven efficacy of bisphosphonates in preventing fracture in patients with osteoporosis, adherence with bisphosphonate therapy is so low in the general population that bisphosphonate therapy in the community setting (as compared with clinical trials where adherence and persistence is generally high) may not actually reduce time to first fracture in patients with osteoporosis [21]. The effect of improving patient adherence to medications by 20% is equivalent to a roughly 20% improvement in efficacy [22]. Both interventions in this study were able to substantially increase

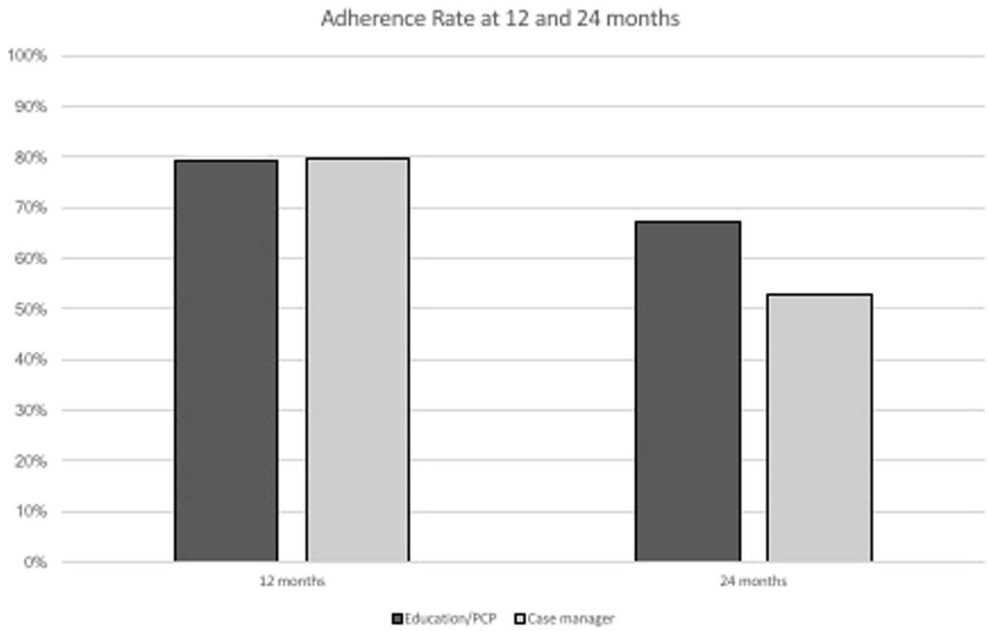

Fig. 2 Adherence rates in both study arms

adherence rates compared to reported general clinical practice rates of less than 50% [23].

A recent Cochrane review of 182 randomized trials testing various strategies for improving adherence reported that most interventions failed to significantly impact adherence or outcomes [24]. A systematic review of interventions to improve adherence and persistence to osteoporosis medications yielded only seven studies, of which only three reported significant improvement in adherence, with effect sizes ranging from 0.17 to 0.58 [25]. Although interventions differed, periodic follow-up interaction between patients and health professionals appeared to be beneficial. To improve adherence and persistence, we need a better understanding of how various factors at the level of patients, healthcare providers, and the health system modulate this issue so that more effective interventions or follow-up mechanisms can be developed and evaluated [26, 27]. The most promising approaches to improve patient adherence appear to focus on reducing dose frequency, multidimensional labor-intensive educational interventions revolving around monitoring and feedback, or increased continuity with healthcare providers [20, 24]. As seen in our study, adherence decreased in the case manager group in year 2 when regular follow-ups decreased.

Table 2 Factors associated with adherence on multivariate analysis

	Adjusted odds ratio (95% CI)
Age	1.0 (1.0 to 1.1)
Income	
< $30,000	0.2 (0.1 to 0.6)
$30,000 to $49,999	0.4 (0.1 to 1.1)
$50,000 to $69,999	0.9 (0.4 to 2.0)
$70,000 and above	Referent
Female	2.4 (0.5 to 12.1)
Case managed arm	1.0 (0.5 to 2.1)
Family history	2.1 (1.0 to 4.4)
Satisfied with medical care	2.3 (1.1 to 4.8)

Although this evaluation was a pre-planned analysis from a randomized trial with patient self-report cross-referenced with pharmacy records to establish adherence (using standard literature-based definitions), there are some study limitations. First, while we conducted our trial in a single metropolitan region in Canada where there is universal access to healthcare, including BMD testing, medication costs are at least partially borne by patients. Thus, while we believe our results are generalizable to other health care centers, systems, and countries where universal access medical systems exist, without more detailed information on how much each patient had to co-pay for their medications, we cannot be certain that medication costs were not a predictor of poor adherence. Second, as with any clinical trial where behavior is monitored, it is possible that our observed adherence rates were better than those seen in clinical practice due to the Hawthorne effect—future studies need to examine adherence in non-trial participants. Finally, our sample size may have been too small to tease out small magnitude differences in characteristics between adherent and non-adherent patients. For example, the small number of males in our study sample reduced our power to detect any differences in adherence by sex. For that reason, we included sex (and report the aOR for female sex in Table 2) even though it was not statistically significantly related to adherence.

In conclusion, both arms of this randomized controlled trial achieved substantially better bisphosphonate adherence than

Table 3 Health-related quality of life outcomes by adherence status

	Adherent at 12 months ($n = 104$)	Non-adherent at 12 months ($n = 27$)	p value comparing adherent vs. non-adherent	Primary non-adherence ($n = 32$)	p value comparing adherent vs. primary non-adherent
Baseline					
SF-12 Physical component score, median (IQR)	49.1 (37.0–55.1)	46.6 (39.3–55.4)	0.99	46.2 (42.1–51.7)	0.68
SF-12 Mental component score, median (IQR), mean (SD)	54.0 (45.9–58.6)	50.5 (43.3–58.4)	0.46	48.0 (41.3–54.6)	0.06
OptQOL Physical function score, median (IQR)	33.3 (14.3–47.7)	33.3 (14.3–66.7)	0.40	28.6 (14.3–54.8)	0.83
OptQOL Adaptation score, median (IQR)	51.9 (48.2–59.3)	55.6 (44.4–63.0)	0.44	57.4 (48.2–59.3)	0.41
OptQOL Fear score, median (IQR)	66.7 (36.1–88.9)	57.4 (48.1–59.3)	0.25	69.4 (48.9–86.1)	0.99
DASH score, median (IQR), mean (SD)	50.0 (38.6–60.2) 48.5 (16.9)	36.4 (63.6) 49.8 (14.4)	0.94	46.6 (38.6–52.3) 46.4 (12.1)	0.30
12 months					
SF-12	$n = 104$	$n = 27$		$n = 29$	
PCS, median (IQR), mean (SD)	53.1 (44.6–55.5) 49.5 (8.4)	53.5 (43.2–56.6) 49.8 (52.3)	0.42	53.2 (47.1–55.6) 50.2 (9.2)	0.67
MCS, median (IQR), mean (SD)	56.1 (51.0–58.2) 53.7 (8.1)	55.9 (46.3–58.8) 53.5 (55.9)	0.62	56.9 (51.2–58.6) 53.9 (7.9)	0.80
OptQOL*	$n = 104$	$n = 27$		$n = 32$	
Physical function score, median (IQR), mean (SD)	95.3 (81.0–100.0) 87.2 (16.8)	100.0 (71.4–100.0) 84.5 (24.5)	0.62	95.2 (85.7–100.0) 89.9 (15.5)	0.59
Adaptation score, median (IQR), mean (SD)	63.0 (55.6–83.3) 68.6 (17.5)	63.0 (48.2–66.7) 61.2 (22.2)	0.24	63.0 (59.3–92.6) 68.5 (16.8)	0.72
Fear score, median (IQR), mean (SD)	88.9 (72.2–100.0) 81.9 (21.4)	88.9 (72.2–100.0) 81.5 (23.8)	0.95	88.9 (77.8–100.0) 84.3 (19.0)	0.76
DASH	$n = 104$	$n = 27$		$n = 30$	
DASH score, median (IQR), mean (SD)	6.8 (2.3–13.6) 11.3 (12.3)	4.6 (0.0–22.7) 13.2 (17.1)	0.53 0.59	4.6 (0.0–13.6) 8.9 (10.9)	0.20 0.30
24 months					
SF-12	$n = 97$	$n = 25$		$n = 30$	
PCS, mean (SD)	53.0 (43.8–56.2) 48.9 (10.1)	53.8 (50.0–55.5) 53.8 (8.3)	0.85	52.7 (45.4–56.5) 50.7 (7.7)	0.62
MCS, mean (SD)	55.9 (50.2–57.9) 53.8 (8.3)	57.5 (44.8–58.8) 52.5 (9.2)	0.62	57.9 (55.6–58.8) 54.1 (9.0)	0.27
OptQOL*	$n = 101$	$n = 25$		$n = 31$	
Physical function score, mean (SD)	95.2 (76.2–100.0) 84.3 (23.5)	100.0 (76.2–100.0) 86.1 (22.4)	0.38	100.0 (90.5–100.0) 91.1 (13.4)	0.32
Adaptation score, mean (SD)	63.0 (55.6–81.5) 66.0 (17.6)	63.0 (55.6–66.7) 64.3 (16.4)	0.75	63.0 (59.3–66.7) 65.47 (16.07)	0.66
Fear score, mean (SD)	94.4 (77.8–100.0) 84.3 (21.6)	100.0 (88.9–100.0) 88.7 (18.3)	0.25	94.4 (77.8–100.0) 86.7 (19.1)	0.72
DASH	$n = 101$	$n = 25$		$n = 30$	
DASH score, mean (SD)	4.6 (0.0–15.9) 10.7 (14.3)	4.6 (0.0–25.0) 12.6 (14.8)	0.73	5.7 (0.0–13.6) 7.6 (7.37)	0.78

HRQL health-related quality of life, *SF-12* Short Form-12, *PCS* physical component score, *MCS* mental component score; *SD* standard deviation, *OptQoL* Osteoporosis Quality of Life Index, *DASH* Disabilities of the Arm, Shoulder, and Hand Index

seen in general clinical practice. Although higher income has consistently been shown to be associated with higher adherence [28], the importance of family history (which likely correlates with better patient knowledge about osteoporosis and the consequences of not taking bisphosphonates), and satisfaction with current medical care on adherence has not been previously reported. This adds to the growing body of evidence supporting the importance of patient and primary care provider education and regular follow-up with healthcare providers.

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Compliance with ethical standards

Conflicts of interest None. SR Majumdar held the Endowed Research Chair in Patient Health Management supported by the Faculties of Medicine and Dentistry and Pharmacy and Pharmaceutical Sciences at the University of Alberta. LA Beaupre holds the David Magee Endowed Chair for Musculoskeletal Research at the University of Alberta. BH Rowe is supported by a Tier I Canada Research Chair in Evidence-Based Emergency Medicine from CIHR. FA McAlister is supported by the Alberta Health Services Chair in Cardiovascular Outcomes Research.

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