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Therapist's practice patterns for subsequent fall/osteoporotic fracture prevention for patients with a distal radius fracture

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ABSTRACT

Study Design: Cross-sectional survey.
Introduction: Multifactorial risk factor screening and treatment is needed for subsequent falls/osteoporotic fractures prevention (SFOFP), given the elevated risk among patients with distal radius fracture (DRF).
Purpose of the Study: The primary objective was to describe hand therapists' knowledge and clinical practice patterns for assessment, treatment, referral, and education with respect to SFOFP for patients with DRF older than 45 years. Secondary objective was to explore therapist's preferences in content and delivery of knowledge translation tools that would support implementation of SFOFP.
Methods: A cross-sectional multinational (Canada, the United States, and India) survey was conducted among 272 therapists from August to October 2014. Completed surveys were analyzed descriptively.
Results: Surveys were completed by 157 therapists. Most respondents were from the United States (59%), certified hand therapists (54%), and females (87%). Although 65%-90% believed that they had knowledge about SFOFP assessment, treatment, and referral options, 55% did not include it in their routine practice for patients with DRF. Most assessed medication history (82%) and never used a Fracture Risk Assessment Tool (90%) or lower extremity muscle strength testing (54%) to identify those at risk of secondary fractures. With respect to treatment, approximately 33% always used upper extremity muscle strengthening exercises. Most reported rarely (sometimes to never) using balance (79%), lower extremity muscle strengthening (85%), bone strengthening (54%), or community-based physical activity (72%) programs. Similarly, when surveyed about patient education, therapists rarely (sometimes to never) advised patients about web-based resources (94%), regular vision testing (92%), diet for good bone health (87%), bone density evaluation (86%), footwear correction (73%), and hazard identification (67%). Most hand therapists were interested to receive more information on SFOFP for patients with DRF. Nearly one-half preferred to have Web sites for patients, and two-fifth were in favor of pamphlets for patients.
Conclusion: Current practice patterns reveal care gaps and limited implementation with respect to SFOFP for patients with DRF. Future research should focus on web-based educational/knowledge translation strategies to promote implementation of multifactorial fall risk screening and hand therapist's engagement in SFOFP for patients with DRF.

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Introduction

A large US study conducted on 208,094 patients identified distal radius fractures (DRFs) as the most common long bone fracture.[1] DRF is well known to be associated with an elevated risk of subsequent falls and osteoporotic (OP) fractures at other skeletal sites.[2-5] In a prospective cohort study of 52 patients with fall-related DRF, 24% had 2 or more new falls during a period of 4 months after the DRF.[3] In our recent study of 94 participants followed during 4 years after fall-related DRF, 20% of the participants had subsequent falls and OP fractures.[6] Preferential bone loss and low bone density are found in people with DRF.[7,8] For example, a research study reported that 91% of 106 postmenopausal women with a DRF met the World Health Organization diagnostic criteria for osteopenia or osteoporosis when assessed for bone mineral density (BMD) using dual-energy X-ray absorptiometry, placing them at higher risk for future OP fracture.[8]

DRF in both men and women often precedes a cascade of declining mobility, balance, muscle strength, and physical activity, contributing to subsequent falls and fall-related injuries including fractures.[4,9-12] Multicomponent risk screening and physical therapy interventions targeting modifiable risk factors can decrease the risk of falling and future OP fracture among older adults.[13-19] Much of our current knowledge of practice patterns in subsequent falls/osteoporotic fractures prevention (SFOFP) relates to adults older than 65 years or patients with hip fracture rather than patients with DRF in general.[20-26] The risk for subsequent fall-related OP fractures and effectiveness of associated preventative treatment interventions are less established for adults who typically sustain a DRF at a middle age. This knowledge gap may explain why studies from the United States,[27-29] Canada,[30,31] Ireland,[32] and the United Kingdom[33] report that only 10%-20% of patients with DRF were assessed and treated for osteoporosis by the medical health professionals. On the other hand, these reports may indicate that the orthopedic community can do more to promote bone health among patients with DRF worldwide.

Reducing the gap between best evidence and practice requires an understanding of the context in which change must happen and addressing the barriers to uptake. There are reviews[34,35] supporting the knowledge creation of evidence-based fall/fracture risk assessment and clinical decision-making tools[36,37] and high-quality trials[19,38-41] evaluating strategies specific to SFOFP for patients with DRF including those between the ages of 45 and 80 years. Thus, knowledge regarding SFOFP applicable to hand therapy practice is available.[35,36,38-40,42] However, implementation of decision support tools is an important step for translating knowledge into the routine clinical practice of hand therapists who treat these fractures.[43]

In North America, most patients with DRF are treated by a registered physical therapist (PT), occupational therapist (OT), or certified hand therapist (CHT) after the injury.[44,45] These hand therapists have a unique opportunity to implement multifactorial fall risk assessment and prevention strategies.[34] However, studies suggest that rehabilitation of patients with DRF is primarily aimed toward managing pain, range of motion, and strength issues at the wrist and hand.[34,35,45] To our knowledge, it is unknown whether globally, hand therapists treating patients with DRF incorporate SFOFP in their current practice. Assessing the current practice patterns and practice context in different countries is important to assess whether evidence-practice gaps exist.

Thus, the objectives of this study were as follows:

1. To describe the knowledge and clinical practice patterns for assessment, treatment, referral, and education of hand therapists with respect to SFOFP for patients with DRF older than 45 years.
2. To examine the interest and preferences of the hand therapists in terms of content and delivery format for knowledge translation (KT) tools that would support the implementation of SFOFP.

Methods

A cross-sectional multinational survey was conducted among hand therapists (defined as PTs, OTs, and CHTs licensed to practice in Canada, the United States, or India) from August 2014 to October 2014. Ethical approval for this study was granted by McMaster University/Hamilton Integrated Research Ethics Board (no. 14457).

Survey development and validation

A semistructured electronic survey questionnaire comprising open- and closed-ended questions that asked about SFOFP knowledge and associated clinical practice was developed through an iterative process. The content for items was developed using published literature,[2,5,13-19,34-41] previous practice surveys,[9,20-24,45,46] and discussion with clinicians who were PTs or CHTs with more than 2 years of experience in treating patients with DRF. The format was developed in consultation with experienced survey methodologists, and the checklist for reporting results of Internet e-surveys was followed.[47] Figure 1 represents the methodological process used to develop the survey. An assessment of validity (face and content) and clarity of the survey was conducted on a draft version with coauthors and 6 academic clinicians ($n = 4$ [PT, PhD]; $n = 1$ [CHT, PT, PhD]; and $n = 1$ [CHT, OT, PhD]) experienced in both DRF-specific content and survey methodology. Minor revisions were made to improve clarity and reduce respondent burden. The revised draft of the survey was pilot tested with 10 hand therapists using LimeSurvey (Hamburg, Germany). The hand therapists provided feedback on the accuracy of content, ambiguity, comprehensibility, length, repetitiveness, and burden. Minor revisions were made to the sequence and coding options to ensure that certain questions must be answered or can be skipped. The final version of the revised survey was mounted using the LimeSurvey program and opened for study respondents.

The survey questionnaire consisted of 28 questions describing the hand therapist's caseload; past behavior, knowledge, and current clinical practice patterns regarding SFOFP for patients with DRF, demographics about age, gender, country, professional designation, registration with a professional association, the highest level of education, graduation year, clinical experience in years, patient reimbursement, and clinical setting. The survey also included a question about preferences with respect to content and delivery format of KT tools and the likelihood that the therapist would use their preferred KT tool for implementing SFOFP in their clinical practice. The responses to the closed-ended questions were scored using a Likert-type scale[48] with responses varying from 1 to 5. For example, the responses on the frequency of involvement in SFOFP with respect to assessment, treatment, and education for DRF population were recorded as 1 (always), 2 (often), 3 (sometimes), 4 (rarely), and 5 (never). The 28 items and response options included in the survey questionnaire are provided in the Appendix.

Sampling frame

Our sampling frame consisted of hand therapists from Canada, the United States, and India. The therapists from India were targeted to obtain comparative data regarding practice patterns

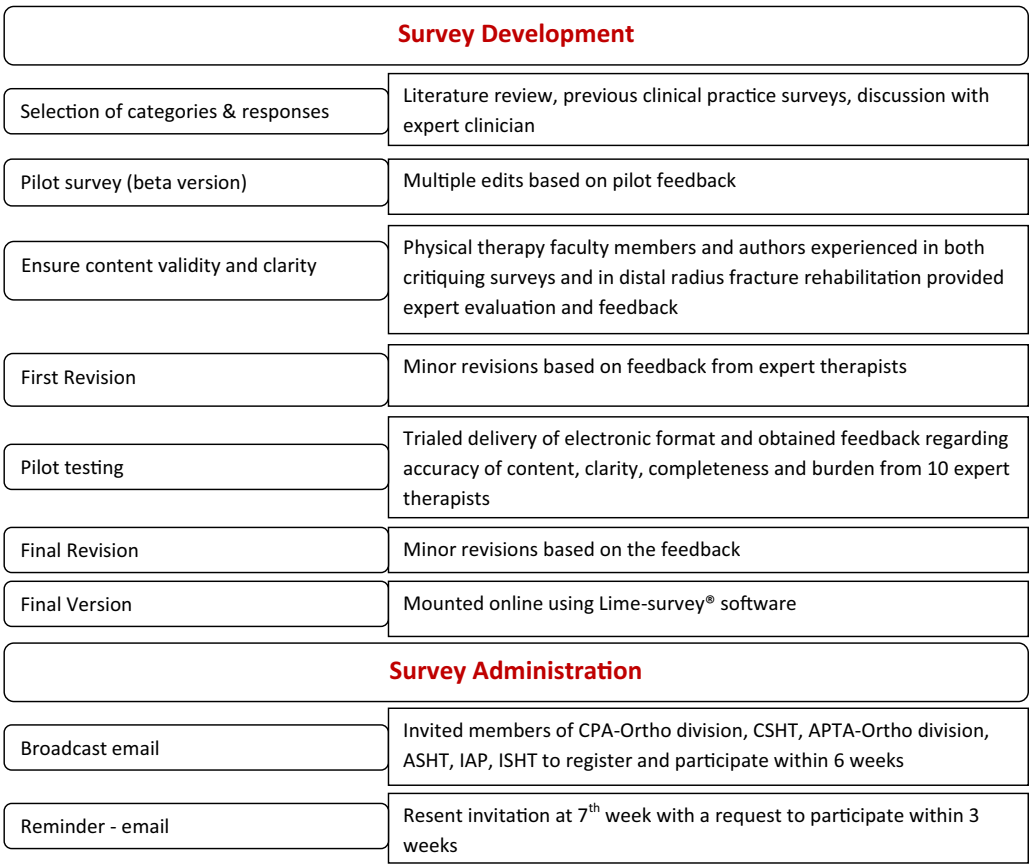

Fig. 1. Methodological process used for the survey development and administration. APTA = American Physical Therapy Association—Orthopaedic division; ASHT = American Society of Hand Therapists; CPA = Canadian Physiotherapy Association—Orthopaedics division; CSHT = Canadian Society of Hand Therapists; IAP = Indian Association of Physiotherapists; ISHT = Society of Hand Therapy, India. Adapted from MacDermid J.C., Walton D.M., Cote P. et al. Use of outcome measures in managing neck pain: an international multidisciplinary survey. *Open Orthop J.* 2013;7:506-520.

external to North America (Canada and the United States) where the risk of OP fractures is high.[49,50]

Six national professional organizations of therapists from Canada, the United States, and India were contacted by telephone and electronic correspondence. The organizations were requested for their assistance in the administration of the survey to their registered therapists most likely to provide DRF rehabilitation services, by means of a broadcast electronic mail (e-mail) containing the information about the survey and the registration link. All 6 professional organizations, the American Physical Therapist Association—Orthopaedic division, American Society of Hand Therapists (ASHT), Canadian Physiotherapy Association—Orthopaedic division, Canadian Society of Hand Therapists, Indian Association of Physiotherapists, and Indian Society for Hand Therapists, agreed to distribute the e-mail invitation. Invitations to complete the survey also were disseminated by electronic postings (eg, association Web site, e-newsletter, or Facebook page). To have similar numbers of respondents from each country, snowball sampling was also incorporated whereby hand therapists were requested to complete the survey and share the registration link with their colleagues or groups in their professional network.

Survey administration

Hand therapists received an e-mail invitation containing the registration link and letter of information from their respective professional organizations. To ensure the recruitment of a relevant sample, therapists were asked to respond only if they had treated a patient with DRF in the past 6 months. There were no incentives to participate. Those who registered to complete the electronic survey (registrants) immediately received an e-mail containing the link. Registrants were notified that by clicking the survey link, they were providing their electronic consent to participate in the study. To maintain anonymity, the identification tokens (name and e-mail address) that provided access to the survey were stored separately in a password-protected electronic database. The completed survey responses were immediately received by the authors. Respondents were requested to submit the completed survey responses within 6 weeks of receiving the survey link. On the seventh week, the associations forwarded 1 reminder e-mail to the target sample with a request to respond within 3 weeks.

Data analysis

To ensure precision of results obtained from the target sample, sample size was calculated using a sample size calculator.[51] At a 10% margin of error and 95% confidence level for the very large/unknown population size (estimated to be more than 10,000), we needed complete responses from 96 therapists. The expected response rate was set at 40%,[46] thus we targeted more than 240 therapists. Only data from respondents who answered every survey question apart from optional questions regarding demographics were imported from LimeSurvey into Statistical Package for the Social Sciences, version 18 (IBM Corporation, Armonk, NY), for the analysis. Data were checked for out of range values (eg, 0 or 6). Descriptive statistics and percentages were used to summarize data

for questions having categorical response options. Textual content analysis (replicable similar texts assigned under single meaningful theme) was used to interpret the open-ended responses to questions about knowledge and interest for SFOFP regarding assessment, treatment, and referral as well as for interpreting the therapists' open-ended comments with regard to the survey.

Results

Subjects

A total of 272 hand therapists expressed an interest in completing the survey. Of these, 157 (58%) submitted completed surveys and 115 (42%) did not. The detailed demographics of the respondents are presented in Table 1. Most therapists were from the United States (59%), females (87%), older than 50 years (47%), CHT (54%), registered members of ASHT (59%), with 15-30 years of clinical experience (42%), and were working in an outpatient clinical setting (80%). Nearly half (47%) of the therapists reported that most of their patients with DRF (76%-100%) had adequate medical coverage for their treatment. An insufficient response rate (4%) from India prevented meaningful comparison of clinical practice patterns between North America and India. However, the overall results were similar with or without inclusion of the responses from India (data not shown) due to which the pooled summary of results is presented in this article.

Most (63%) had treated less than 10 patients with DRF in the past 6 months, some (31%) treated 10-30 patients, and a minority (6%) had treated more than 30 patients. When therapists were asked to report whether they include SFOFP as a part of their assessment, treatment and referral for patients with DRF, 55% of the total sample reported "*no*."

Knowledge regarding subsequent fall/Fracture Risk Assessment Tool, treatment, and referral

The knowledge of the respondents with respect to assessment tools, treatment strategies, and referral options that can be used for SFOFP among patients with DRF is presented in Table 2. Most of the therapists indicated that they have knowledge of assessment (67%), treatment (89%), and referral (83%) for SFOFP.

Clinical practice patterns for assessment, treatment, and education

Table 3 summarizes the frequency with which various assessment measures were used for patients with DRF. Medication history is the most commonly assessed factor that might affect falls with 82% of the therapists assessing this *always*. Most therapists reported that they *always* assessed upper extremity muscle strength (63%) and comorbidities (57%) in their clinical practice. Most (72%-81%) *sometimes* or *rarely* or *never* assessed physical and cognitive fall/fracture-related risk factors, such as balance, lower extremity (LE) muscle strength, fear of falling, proprioception, cognition, and mobility aid requirement. Most participants responded that they *never* used the Fracture Risk Assessment Tool (FRAX) and LE muscle strength testing (90% and 54%, respectively).

Table 4 summarizes the frequency with which various treatment strategies were used for patients with DRF. One-third of the therapists reported that they *always* instructed patients in upper extremity muscle strengthening exercises. Only one-fourth of therapists *always* or *often* prescribed a home-based physical activity program. Most therapists (54%-85%) *sometimes* or *rarely* or *never* prescribe exercises for balance, LE strengthening, or bone strengthening, and community-based physical activity programs only.

Table 1
Demographic characteristic of study participants (n = 157)

Demographics	*N* (%) of respondents
Age group (y)	
20-29	17 (11)
30-39	23 (15)
40-49	43 (27)
50+	74 (47)
Gender	
Female	136 (87)
Male	21 (13)
Country of current clinical practice[a]	
Canada	57 (37)
India	6 (4)
the United States	92 (59)
Professional designation[b]	
PT	69 (44)
CHT	84 (54)
OT	77 (49)
Other[c]	5 (3)
Professional association membership[b]	
CPA—Orthopaedic division	49 (31)
CSHT	15 (10)
APTA—Orthopaedic division	6 (4)
ASHT	93 (59)
IAP	5 (3)
ISHT	1 (1)
ACOTRO	1 (1)
AOTA	45 (29)
AIOTA	0 (0)
Other[d]	17 (11)
Education (highest degree completed)[a]	
Baccalaureate	81 (52)
Master's	60 (39)
Doctorate	15 (9)
Postdoctorate	0 (0)
Clinical experience (y)	
>30	48 (31)
15-30	66 (42)
10-15	13 (8)
5-10	12 (8)
3-5	6 (4)
1-3	10 (6)
<1	2 (1)
Type of clinical setting	
Rural	34 (22)
Urban	68 (43)
Outpatient	125 (80)
Inpatient	10 (6)
Private	68 (43)
Public	33 (21)
Other[e]	15 (10)
Patients with adequate medical coverage for hand therapy	
0%	2 (1)
1%-25%	21 (13)
26%-50%	18 (12)
51%-75%	42 (27)
76%-100%	74 (47)

PT = physical therapist; CHT = certified hand therapist; OT = occupational therapist; CPA = Canadian Physiotherapy Association (Orthopedic Division); CSHT = Canadian Society of Hand Therapists; APTA = American Physical Therapy Association—orthopedic division,; ASHT = American Society of Hand Therapists; IAP = Indian Association of Physiotherapists; ISHT = Society of Hand Therapy, India; ACOTRO = Association of Canadian Occupational Therapy Regulatory Organization; AOTA = The American Occupational Therapy Association; AIOTA = All India Occupational Therapist Association.

[a] *N* does not equal 157 because the response to this question was optional.

[b] *N* does not equal 157 because respondents selected all response options that applied.

[c] Athletic trainer, licensed massage therapist, owner, wound care certified professional, and certified gunn intramuscular stimulation practitioner.

[d] American Association for Hand Surgery, Barbados Paramedical Professions Council, Canadian Academy of Manipulative Physiotherapy, Canadian Association of Occupational Therapists, Certified Lymphedema Therapist, North Carolina Board of Occupational Therapy, Ohio Occupational Therapy Association, New England Hand Society, Performing Arts Medical Association, Rajiv Gandhi University of Health Sciences, Connecticut Occupational Therapy Association, Texas Society for Hand Therapy, and Texas Occupational Therapy Association.

[e] Nonprofit hospital, community-based setting, physician-owned clinic, satellite to major hospital, suburban, hospital based, trauma center, Veterans Affairs Medical Center, Workplace Safety and Insurance Board clinic, and Health Claims for Auto Insurance facility.

Table 2
Assessment, treatment, and referral options for secondary fall/osteoporotic fracture prevention in patients with distal radius fractures identified by 157 study participants

Assessment measures	Treatment strategies	Referral options
Balance	Assistive devices	Audiologist
Blood test	Activity modification	Bone density testing
BMD/bone scan	Balance exercises	Chiropractor
CAROC	Bone strengthening exercise	Community osteoporosis exercise program
Cognition	Calcium supplements	Endocrinologist
Environmental assessment	Core muscle strengthening	Family doctor
Fear of falling	Diet modification	Fitness trainer
FRAT	Endurance exercises	Kinesiologist
FROP-Com	Environment modification	Geriatrician
FRAX	Fall prevention education	Multidisciplinary fall prevention program
Gait	Home safety education	Neurologist
History of falls	Muscle strengthening	OT
Muscle strength testing	Exercises	Optometrist
Medication history	Proprioception training	Orthopedic surgeon
Reaction time	Weight bearing exercises	Osteoporosis Canada
Vertigo		PT
Vision		Physiatrist
		Rehabilitation therapist
		Rheumatologist
		Social worker
		Tai Chi instructor
		Vestibular

BMD = bone mineral density; CAROC = Canadian Association of Radiologists and Osteoporosis Canada Risk Assessment tool; FRAT = Falls Risk Assessment Tool; FROP-Com = Falls Risk for Older People in the Community; FRAX = Fracture Risk Assessment Tool; OT = occupational therapist; PT = physical therapist.

Table 5 summarizes the frequency with which various educational strategies were used for patients with DRF. Less than one-half of the therapists reported that they *always* or *often* educated their patients to incorporate muscle strengthening exercises as part of activities of daily living. About one-third of therapists (26%-35%) *always* educated their patients about the importance of physical activity, bone health, and postural correction. Most therapists (86%-94%) did not advise their patients to access web-based resources providing information on bone health, regular vision testing, daily nutrients for good bone health, or a referral for OP fracture risk assessment. Furthermore, 64%-73% of respondents *sometimes* or *rarely* or *never* educate their patients regarding safe footwear, the impact of comorbidity on bone health, identification of fall hazards in the community, or to move in a safe, slow, and controlled manner.

Table 3
Clinical practice pattern for secondary fall/osteoporotic fracture prevention: assessment

Assessment measure	Utilization (%)				
	Always	Often	Sometimes	Rarely	Never
FRAX	1	2	5	2	**90**
Balance testing	11	12	19	20	38
LE muscle strength testing	11	8	12	15	**54**
Upper extremity muscle strength testing	**63**	24	11	1	1
Physical activity assessment questionnaire	29	16	19	10	26
Participation assessment questionnaire	24	15	15	8	38
Fear of falling question	13	15	19	19	34
Proprioception assessment	9	16	26	18	31
Cognitive assessment	12	10	24	20	34
Gait/mobility aid assessment	18	10	18	16	38
Comorbidity questionnaire	**57**	9	5	7	22
List of medications	**82**	9	4	3	2

FRAX = Fracture risk assessment tool; LE = lower extremity.
Bolded numerals denote responses provided by at least ≥50% of the participants.

Interest/preferences regarding information and tools

Many therapists (85%) reported an interest in receiving more information on SFOFP for patients with DRF. Among these respondents, interest in assessment, treatment, and referral was 79%, 69%, and 55%, respectively. The summary of preference of tools is presented in Figure 2. More than 50% of therapists were in favor of Web sites for patients and therapists, and 40% of therapists recommended pamphlets for patients. Fewer therapists (15%-25%) preferred to have applications and online workshops for therapists, applications for patient self-assessment, and YouTube videos. Less than 15% of participants preferred applications for patient self-treatment, a hands-on educational workshop/training session at conferences, educational webinars for patients, a textbook chapter in the entry-level physical therapy education curriculum, or electronic reminders to the therapists.

When therapists were asked to report their likelihood for implementing SFOFP in their ongoing clinical practice if we provide an appropriate tool, their responses were primarily positive: *extremely likely* (45%), *likely* (40%), *neutral* (11%), *unlikely* (3%), and *extremely unlikely* (1%).

Open-ended comments with regard to the survey

The open-ended comments with similar representation were categorized under 4 broad themes.

Theme 1 reflected the identified need for simple assessment and treatment of SFOFP strategies for patients with DRF. Exemplar statements addressing this theme are: “Very excited that you are doing this! Much needed. We just need some guidance on methods to make the process easy and research based and to help us feel more confident with our assessment and treatment.”; “This survey certainly increased my awareness of this issue. I would typically refer any patient who is at risk to PT for assessment and treatment so just having a tool to initiate the conversation would be helpful.” Theme 2 reflects the increased awareness among respondents to consider SFOFP for their patients with DRF. Examplars of this theme are as follows: “This survey has done a very good job of making me realize the importance of falls prevention/OP fracture risk factor identification”; “I feel it is often mistaken as negativity or a burden to the system. If I could intervene myself it would be beneficial to the patient and the system”; “Thank you for bringing this absence of assessment and treatment related to fracture and osteoporosis to my/other therapists’ attention”; “While I regularly discuss with patients their bone density in relation to their fracture, fall prevention is an area I had not thought about that needs to be addressed.”; and “This has crystallized my need to add falls prevention to my treatment protocol for the 45 + DRF clients.” Theme 3 addresses the concern around reimbursement for the therapy visit. Exemplars of this theme are as follows: “There is what should be done, and then there is the reality of the situation. Reimbursement is a huge driving force. Insurance companies may deny reimbursement if the assessment and treatment are not directly related to the diagnosis for which the patient was referred. Patients are also constrained by Medicare Cap and financial considerations. Community referrals and team approach with PT would be ideal” and “My Medicare patients only have 1 hour with me so, I do not really have the time to address these issues during my therapy session. I talk to my patients about talking to their doctors to give them a script for PT emphasizing the danger of

Table 4
Clinical practice pattern for secondary fall/osteoporotic fracture prevention: treatment

Treatment	Utilization (%)				
	Always	Often	Sometimes	Rarely	Never
Balance exercises	10	11	22	20	37
LE muscle strengthening exercises	9	6	19	11	**55**
Upper extremity muscle strengthening exercises	**75**	17	6	2	0
Weight bearing/bone strengthening exercises for example, a walking program	22	24	19	17	18
Community-based physical activity/aerobic exercise programs	6	22	37	18	17
Home-based physical activity/aerobic exercise programs	27	26	26	11	10

LE = lower extremity.
Bolded numerals denote responses provided by at least ≥50% of the participants.

falling especially during our winters." Theme 4 addressed the unwillingness among patients and the inconsistency among health care professionals to consider preventive rehabilitation for subsequent falls/OP fractures after DRF. Examplars of theme 4 are: "Most of my patients deny that there is an issue which makes it difficult to intervene. There is no one else in my facility that shows concern for multiple falls/fractures"; "Some of the questions asked related to how often treatment was provided, or how likely it would be that you implement falls/OP fracture prevention. Related to this, I think consistency among healthcare professionals would assist in patient buy-in to this preventative treatment. Many times, it is the patient's unwillingness to continue with therapy, once their wrist is functioning at a level that no longer limits their work or activities of daily livings. If they are receiving consistent information regarding their risk of future falls/fracture from all healthcare professionals they encounter, they may be more likely to pursue this treatment or adhere to recommended exercise programs specific to LE strength or balance, etc. related to their fall and fracture risk."

Discussion

This survey suggests that there is a low implementation of fall/OP fracture risk screening and related treatments in the DRF rehabilitation process in North America (and perhaps globally). This is contrary to emerging research evidence that suggests that therapists are ideally positioned to implement effective screening/assessment and interventions to prevent subsequent falls/OP fractures among patients with DRF.[34-36,52,53]

Most therapists believed that they have knowledge regarding assessment tools, treatment strategies, and referral options available for SFOFP for patients with DRF, whereas 55% reported that they did not implement SFOFP in their routine clinical practice. This indicates that therapists' knowledge is not the main barrier to SFOFP. Similarly, a survey of the clinical practice behavior of orthopedic surgeons revealed that they had the knowledge that low trauma fractures in patients older than 50 years required investigation for osteoporosis, yet 56% of those surgeons routinely discharged their patients with DRF without initiating or requesting an investigation for OP fracture risk.[54] Only 7%-10% of surgeons routinely assessed, treated, and referred their patients with DRF.[54] The reasons for gaps between knowledge and action can be complex. They can include environmental barriers such as lack of time, space, funding, and staff to complete the tests and interventions, the scope of practice issues, lack of emphasis in clinical practice guidelines, professional training, culture, and expectations. For example, the American Academy of Orthopaedic Surgeons practice guidelines for DRF do not emphasize screening or conservative interventions for subsequent fall/OP fracture prevention.[55] Osteoporosis Canada guidelines and the National Osteoporosis Foundation clinician guide for prevention and treatment of osteoporosis do not provide sufficient direction on conservative management for subsequent fall/fracture prevention for those with DRF.[56,57]

Various cross-sectional studies have identified balance, muscle strength, gait, cognition, physical capacity, BMD, and quality of life to be markedly lower among patients with DRF.[9,11,58] The impairments associated with fracture risk are highly amenable to rehabilitative interventions. A systematic review of randomized controlled trials has shown that 15% of falls can be prevented by multifactorial fall risk screening.[59] The intervention studies report

Table 5
Clinical practice pattern for secondary fall/osteoporotic fracture prevention: education

Education	Utilization (%)				
	Always	Often	Sometimes	Rarely	Never
Importance of bone health	28	29	29	10	4
Importance of physical activity for bone health and future fracture prevention	35	32	22	8	3
Importance of incorporating muscle strengthening exercises in ADL	47	29	17	6	1
Importance of incorporating weight-bearing exercises in ADL	36	26	20	10	8
Importance of balance training while performing ADL	17	18	23	21	21
Community resources/programs for improving physical activity levels	8	23	35	24	10
Safe, slow, and controlled movement transitions especially for twisting and bending activities	14	22	27	19	18
Postural correction	26	35	27	7	5
Referral for osteoporosis evaluation/BMD testing	3	11	25	30	31
Web-based resources for bone health information	2	4	19	31	44
Diet for bone health	6	7	18	28	41
Advice on footwear to reduce falls	9	18	27	20	26
Hazard identification strategies for home	13	30	29	17	11
Hazard identification strategies for community	8	24	27	18	22
Impact of comorbidity on bone health	10	18	27	23	23
Advice on regular vision testing	3	6	27	26	39
Advice on lifestyle modification	12	29	31	15	13

ADL = activities of daily living; BMD = bone mineral density.

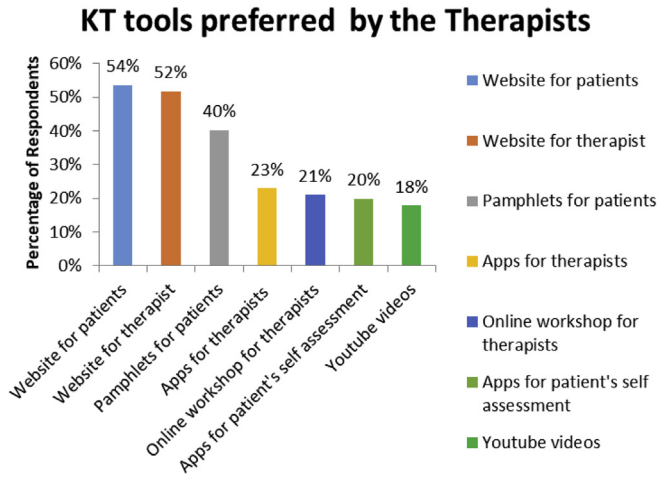

Fig. 2. Knowledge translation (KT) tools preferred by the therapists.

up to 50% reductions in falls.[60] There are studies supporting the role of screening for and treatment of modifiable risk factors, such as balance, muscle strength, physical activity, and BMD among patients with DRF.[19,34,52] A research study suggests that therapists can use reliable outcome measures to screen these risk factors in a DRF population.[36] For example, the Timed Up and Go test can be used to assess balance, the Activity-Specific Balance Confidence scale can be used to assess fear of falling, the Rapid Assessment of Physical Activity scale can be used to assess physical activity level, and Chair Stand Test can be used for functional muscle strength testing of the LE.[36] Similarly, interventions that target modifiable risk factors could include Tai Chi for improving balance, progressive resistive exercises for strengthening muscles, aerobics for improving physical activity level, weight-bearing exercises for improving bone health, and so on.[19,34,52] Nevertheless, most therapists who participated in our study (>75%) missed the opportunity to investigate risk factors. The hand therapy and other rehabilitation literature has increasingly addressed this knowledge to action gap,[2,5,34,35,45,53,61] and this may have influenced the knowledge and interest of our respondents. However, this knowledge and interest need to be harnessed into action by using the screening and prevention strategies for SFOFP in routine clinical practice to achieve the benefits of reducing the economic, social, and individual burden of subsequent fractures.

Currently, BMD assessment using dual-energy X-ray absorptiometry is considered the gold standard for identifying an individual's risk for OP fractures.[62] However, in our study, only 3%-11% of therapists routinely referred their patients with DRF for BMD assessment (Table 5). This might be seen as an out of scope practice, but therapists certainly can educate/recommend that their patients with fall-related DRF seek a referral for BMD and other bone health-related assessments. We realize that time to assess modifiable risk factors and cost/accessibility associated with BMD testing could be few of the barriers for the therapists and patients, respectively. However, FRAX is a scientifically validated, freely available, user-friendly web-based fracture prediction tool, which uses easily obtained clinical risk factors for assessing an individual's 10-year fracture probability and can be used with or without BMD results.[63] Since FRAX was released in 2008 and our respondents had 15-30 years of experience, this could explain an apparent lack of awareness of this tool as nearly 90% of therapists in our study had never used it. Our results align with the results of audits conducted in Ontario,[30] Quebec,[64] and Manitoba[65] where it was consistently reported that more than 80% of fragility fracture patients did not receive appropriate screening such as BMD testing and pharmacotherapy or any other treatment for osteoporosis.

Fear of falling has been proven to be one of the important risk factors for future falls among patient with DRF;[3] however, only 13%-15% of therapists screen for fear of falling. The nature of our survey limits our ability to explore the rationale for the respondents' assessment choices. In this case, lack of time is unlikely to explain why therapists do not ask a single question, "Are you afraid of falling?". Perhaps therapists do not view screening for relative risk factors that might lead to subsequent falls/fractures in this middle-aged patient population as their responsibility given the immediate focus on rehabilitation from the acute wrist injury.

Most of the therapists in our study assessed upper extremity muscle strength and treated this problem. Patients referred for rehabilitation therapy after DRF are expected to present with wrist/hand pain, swelling, loss of grip strength, reduced range of motion, and limited function.[66-68] Furthermore, reduced upper extremity muscle strength is common to many hand injuries and thus addressing this problem aligns well with usual practice. Attention to more global health issues including bone health and fracture risk may be less normative in this practice setting. Our study findings that attention to bone health in patients with DRF is lacking highlights the important need for actionable steps to incorporate SFOFP as part of DRF rehabilitation.

Our respondents have expressed their interest in incorporating SFOFP into their management of patients with DRF. Therefore, we believe that it would be useful to teach skills suitable for implementing SFOFP for patients with DRF in routine clinical practice through continuing professional education facilitated by the knowledge brokers, medical residency programs/physical therapy educational curriculum, and Web site-based SFOFP courses. Given the knowledge to action gap, the survey focused on identifying the preferred KT strategies to reduce this gap. More than half of the therapists reported that they would prefer to have Web sites and pamphlets on SFOFP for their patients to access as compared with applications, online workshops, YouTube videos, educational webinars, or electronic reminders. The lack of patient awareness around the potential for their DRF to be related to fragility fractures and osteoporosis has been reported previously.[69] We are aware of numerous freely available web-based educational resources disseminated by national and international osteoporosis organizations for improving bone health for patients who are at risk of OP fractures. However, we noted that in our study, only 2%-4% of therapists have routinely educated their patients about these resources. Thus, therapists treating patients with DRF might benefit from exposure to these resources and collaboration with other health care professionals involved in SFOFP programs.

The limitations of our study are important to consider when interpreting these findings. The self-reported subjective knowledge assessed in our study may not truly reflect the actual knowledge of the respondents. Although we targeted 3 countries in this study and used traditionally successful recruitment strategies, 96% of respondents were from North America. These responses are unlikely to be representative of practice in India so we are not able to generalize our findings or describe differences in clinical practice patterns among the countries. Working through neither professional associations nor networks was successful for recruiting therapists from India; different strategies for international recruitment need to be pursued in future research. Our recruitment method prevents us from calculating the actual response rate as we did not know a total number of therapists who received our invitation and had caseloads that included adults with DRF older than 45 years. Therefore, the modified response rate[70] was calculated based on the number of therapists who accepted our invitation and the number of therapists who completed the

survey. Finally, volunteer bias may influence our findings as those who did not complete the survey might be less interested in SFOFP.

Despite these limitations, we conducted a fully powered study. Overall, we describe knowledge, practice patterns, and preferences of therapists treating patients with DRF in Canada, the United States, and India. This understanding is an essential step to ensure that KT strategies to promote therapist's incorporation of SFOFP for patients with DRF are developed and disseminated in a manner that is acceptable and appropriately targeted to these knowledge users. Through this survey, we identified areas of future research including developing KT strategies and investigating feasibility, acceptability, and effectiveness of those KT strategies to improve therapists' implementation of SFOFP in patients with DRF. Furthermore, we recommend further studies to establish the effectiveness of strategies for identifying risk factors and treating the subgroup of people with fall-related DRF at elevated risk for subsequent falls and fractures.

Conclusion

Despite reporting adequate knowledge, most of the therapists (>75%) surveyed missed the opportunity to investigate modifiable risk factors that are associated with falls and OP fractures for patients with DRF. Therapists are interested in implementing SFOFP and prefer to have simple web-based tools for themselves and their patients with DRF to assist with implementation. This suggests the need for development and evaluation of KT tools to promote patient and therapist engagement in SFOFP after DRF. Overall, greater attention to secondary fracture prevention in hand therapy practice is needed.

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Supplementary data

Supplementary data related to this article can be found at https://doi.org/10.1016/j.jht.2018.03.001.

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1. Data were obtained through
   a. chart reviews
   b. interviews of patients and therapists
   c. surveys of surgeons and physicians' assistants
   d. surveys of therapists
2. How many respondents felt they were well versed in SFOFP
   a. almost all
   b. less than half
   c. a solid majority
   d. almost none
3. What % of respondents did NOT use a fracture risk assessment tool in their day-to-day clinical practices
   a. 90
   b. 75
   c. 50
   d. 25
4. Participants expressed interest in having _____ available as a source of information
   a. textbooks
   b. web sites
   c. social media
   d. DVDs
5. The investigation showed that hand therapists are very well versed in SFOFP and diligent in conveying that information in their day-to-day clinical practices
   a. true
   b. false

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