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Chiropractic treatment of hand and wrist pain in older people: systematic protocol development Part 2: cohort natural-history treatment trial☆

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Abstract

Objectives: This study examines (*a*) the feasibility of continued research with an older population; (*b*) the variety of hand-wrist conditions presented by older patients; (*c*) the accommodations to standard chiropractic treatment for older patients; and (*d*) the validity, reliability, responsiveness of measures, and preliminary estimates of outcome of treatment for general hand-wrist pain.

Methods: A cohort of 55 volunteers, first evaluated over a 5-week natural-history baseline period, was offered 5-week chiropractic treatment and then interviewed at 6 months posttreatment. Descriptive and preliminary inferential analyses are reported. Start values for power analysis are offered.

Results: The project recruited a sample of 55 and retained 47 (85%) participants over 8 months, indicating feasibility of a larger project. Participants provided strong self-reported, albeit preliminary, evidence of benefit. Mean values and SDs of pain and strength measures are provided for future power calculations.

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Conclusions: Clinical research with older participants presenting with hand-wrist pain and dysfunction is feasible. Validity, reliability, and responsiveness of self-reports are demonstrated. The research presents preliminary evidence of the benefit of chiropractic treatment for older patients presenting with hand-wrist symptoms.

Introduction

Conditions of the upper extremities, particularly of the hand and wrist, often occur in older (60+ years of age) patients, but manual treatment protocols for this age group have not been identified or assessed. Because primary care, including chiropractic care, is often based on tentative, in-office diagnoses and not on more definitive and expensively generated criteria, general location and reported symptoms are frequently sufficient to guide care. This primary care research, concerning hand-wrist pain, therefore reflects the everyday reality of the chiropractic physician. This research examines (*a*) the feasibility of continued research with an older population; (*b*) the variety of hand-wrist conditions presented by older patients; (*c*) the accommodations to standard chiropractic treatment for older patients; and (*d*) the validity, reliability, responsiveness of measures, and preliminary estimates of outcome of treatment.

Complementary and alternative medicine (CAM), with allopathic care, comprise the health care system in the United States,[1-4] including care for conditions of the upper extremities.[5,6] Concurrent to the growing use of CAM is the increasing proportion of older people in the country. The combined effects of increased fertility and decreased mortality are "aging" the populations of Eurasia and the western hemisphere.[7] The aging of the world's population will be "one of the most important social phenomena of the next half century."[7]

Although current decreases in rates of disease and injury are followed by decreases in rates of disability in those older than 60 years, decreases in death rates for people with given disabilities increase the prevalence of those disabilities in the population as well as demands for health care appropriate to these disabilities.[8] Among potentially or actually disabling conditions commonly seen in the elderly are conditions of the hand and wrist.[9] For example, a recent prevalence report estimates that, relative to younger (25-34 years) people, older (55-64 years) people are 2 (women) to 5 (men) times as likely to be symptomatic for carpal tunnel syndrome.[10] In the same report, older men and women were found to be 3 times as likely to have electrophysiologic median neuropathy than the younger people.[10]

With the attractiveness of CAM and the growing proportion of older people in the country, it is not surprising that CAM providers, such as chiropractors, are treating an increasing number of older patients presenting with disabling conditions, including those of the hand and wrist.[11] In research concluded in part 1 of this project, chiropractors responding to focus groups and surveys indicated wide experience with older patients presenting with conditions of the upper extremities and provided suggestions for effective treatment.[12] Respondents stressed the importance of accommodating to older patients, using, for example, low-impact stretching exercises, rehabilitative passive stretching, traction, soft tissue work, and home exercises. Chiropractors further indicated that with older patients they considered "management" a more realistic concept in treating chronic conditions rather than "cure." Chiropractors reported that they often accommodated to older patients' comorbidities by using less force and a self-described "lighter touch." Some examples included using an activator, ultrasound, full-spine work, soft tissue work, passive stretches, myofascial release, teaching and assigning home exercises and postures, and offering nutritional counseling, including supplements.[12] This information was used to guide the development of the treatment protocol of the current research.

It is important to stress that the general focus of this research is on characteristics of older patients presenting with hand-wrist pain, and their treatment for hand-wrist pain, because these reflect the reality of the primary care chiropractor. The primary care physician provides relief and increased function to patients, as quickly and as inexpensively as possible. Providing definitive and specific diagnoses, often at high cost, is secondary and only considered when initial treatment has not provided benefit.

Method

This research was designed to be a prospective, single-group symptomatic-cohort investigation, involving 50 older (60+ years) participants. Baseline measures were made at 3 pretreatment baseline visits

that were used to determine eligibility and collect baseline data. In contrast to previous research with a working-age sample[5] that involved 9 weeks of treatment, the current project treatment was shortened to 5 weeks. The change was based on evidence indicating that most benefit was achieved by 5 weeks of care.[5] The number of treatments per week (from 3 to 1) was specified to include 3 treatments in the first week and then subsequently adjusted based on participant responsiveness to treatment.[5]

Posttreatment outcomes data were collected at 6-month posttreatment interviews. Primary data include self-reported symptom severity and functional status. Secondary end points include grip strength, pinch strength, algometric pressure-pain thresholds (PPTs).

Inclusion and exclusion criteria

Volunteers who qualified to become participants were 60 years or older with reported upper extremity hand, wrist, and/or arm pain and/or dysfunction. Participants were excluded if they had diagnostic nerve conduction studies (NCS) indicating severe symptoms that would probably require surgical intervention (eg, axonal degeneration and/or thenar atrophy) or major life-limiting conditions (eg, AIDS, cancer, severe depression, schizophrenia). Participants were included if they had no plans to move or travel outside the area of the Twin Cities over the next year and had obtained no chiropractic treatment for the presenting hand, wrist, and/or arm pain in the previous 60 days. Because the research was conducted in a real-life setting, participant travel (the "snowbird" phenomenon) was nevertheless encountered but did not adversely affect the pre-post analysis.

Chiropractic treatment protocol for older patients

Each participant in the project received 1 to 3 treatments per week for the 5-week treatment period. The basic treatment involved manual manipulation of the joints and soft tissues of the area extending from the wrist to the spine, inclusive of both cervical and thoracic areas. These areas included the joints of the carpal bones, wrist, elbow, shoulder, and the articulations of the cervical and thoracic spine. Also included were the soft tissues of the musculature surrounding the joints, consisting of areas of the forearm, upper arm, shoulder, and the upper back and neck.[13,14] Patients' pain complaints varied from the neck and trapezius, area to the shoulder, elbow, wrist, or hand. Patients were not specifically diagnosed pretreatment with carpal tunnel syndrome, tennis elbow, or any other specific conditions. Treating physicians isolated the pain-generating structure or identifying symptoms stemming from the shoulder, elbow, wrist, or hand. After the initial clinical examination, treatment was administered to the body part or parts to alleviate pain. Treatment also consisted of posture improvement, home self-stretches, massage, and application of ice or heat. The treatment is composed of chiropractic mobilization and manipulation, soft tissue work, McKenzie physical therapy assessment, and treatment with home instruction.

Following the findings of the informant interviews with chiropractors,[12] the research protocol focused on treatment of older patients with a lighter touch, use of traction, soft tissue work, passive stretching in the clinic, and home stretching and postural exercises. Furthermore, manipulation of joints included manual techniques[13] and did not incorporate the use of any specialized instruments or techniques that are not considered chiropractic standard of care (such as activator, ultrasound, electrical stimulation). Manipulation of the upper extremity consisted of high-velocity, low-force manual thrusts delivered to the identified articulations. Target joints were selected on the basis of motion and static palpation as well as manually eliciting pain of both soft tissue and osseous origin.

Multiple areas within the extremity and the spine were included in each treatment session. Participants received a brief evaluation at each of the treatment session consisting of manual palpation of the target joint(s) and palpation of target soft tissues adjacent to the joints in the extremity and upper back/neck. Treatment protocol was agreed to by participating chiropractors. Quality control was enhanced by videotaped observation of technique by chiropractors leading the research.

Primary outcomes

Our 2 primary outcomes were self-reported symptom severity and functional status, assessed using scales developed by Levine et al.[15-18] They argue, and we concur, that although assessment of outcomes traditionally has focused on objective testing of neuromuscular impairment from the findings in physical examinations, it is also important to measure self-reported relief of pain and increased functional status as the primary outcomes.[15] The group of Levine has developed 2 scales, the Symptom Severity Scale and the Functional Status Scale. These measures have been tested extensively in various patient populations and have been found to be reproducible, internally

Table 1 Concurrent validity of measures

	Mean	SD	F_{df}	*P*
A. Primary (Katz) Self-report Scores				
1. ANOVA: Self-reported (Katz) Hand-Wrist Pain by Baseline NCS Symptom Status (Asx, Sx) (Note that Katz Pain Scale on Right Hands is Validated.)				
Right Hands (n)	24.11	5.31		
Asx (13)	21.19	3.33		
Sx (29)	25.41	5.55	$F_{1,40} = 6.43$	.015
Left Hands (n)	24.11	5.31		
Asx (17)	24.21	6.84		
Sx (25)	24.04	4.12	$F_{1,40} = 0.01$	.92
2. ANOVA: Self-reported (Katz) Hand-Wrist Functional Status by Baseline NCS Symptom Status (Asx, Sx)				
Right Hands (n)	15.29	5.43		
Asx (13)	15.08	4.65		
Sx (29)	15.38	5.82	$F_{1,40} = 0.03$	.87
Left Hands (n)	15.29	5.43		
Asx (17)	16.82	6.57		
Sx (25)	14.24	4.34	$F_{1,40} = 2.37$	.13
B. Secondary Measures: Algometric PPTs				
1. Algometric Assessments and Baseline NCS Symptom Status (Asx, Sx)[a,b]				
Right Hands (n)				
Palm-Up 1	7.52	2.62		
Asx (8)	7.50	1.83		
Sx (24)	7.52	2.86	$F_{1,30} = 0.00$	.96
Palm-Up 2	7.88	2.22		
Asx (5)	8.30	2.11		
Sx (21)	7.79	2.28	$F_{1,24} = 0.21$	.65
Palm-Down 1	8.38	3.09		
Asx (8)	8.38	2.95		
Sx (25)	8.38	3.19	$F_{1,31} = 0.00$	1.00
Palm-Down 2	8.32	3.55		
Asx (7)	7.93	3.38		
Sx (21)	8.45	3.67	$F_{1,26} = 0.11$	.74
Carpal Tunnel	17.12	5.45		
Asx (9)	15.61	5.75		
Sx (20)	17.80	5.31	$F_{1,27} = 1.00$	.32
Left Hands (n)				
Palm-Up 1	7.30	1.92		
Asx (10)	7.20	1.77		
Sx (13)	7.38	2.10	$F_{1,21} = 0.05$	.83
Palm-Up 2	7.79	1.82		
Asx (9)	7.00	1.06		
Sx (10)	8.50	2.11	$F_{1,17} = 3.70$	.07
Palm-Down 1	7.80	1.90		
Asx (10)	7.90	1.94		
Sx (13)	7.73	1.94	$F_{1,21} = 0.04$	.84
1. Algometric Assessments and Baseline NCS Symptom Status (Asx, Sx)[a,b]				
Palm-Down 2	7.95	2.44		
Asx (8)	7.69	3.12		
Sx (11)	8.14	1.96	$F_{1,17} = 0.15$	.70
Carpal Tunnel	18.09	6.29		
Asx (10)	17.30	4.28		
Sx (12)	18.75	7.71	$F_{1,20} = 0.28$	.60
C. Secondary Measures: Strength Assessments by Sex—Tip, Key, and Grip Baseline Strength and NCS Symptom Status of Affected Hand (Asx, Sx)				
Women's Right Hands (n)				
Tip	7.99	2.15		
Asx (11)	8.27	1.47		
Sx (20)	7.83	2.47	$F_{1,29} = 0.29$	0.60
Key	9.63	2.94		
Asx (11)	11.21	1.92		
Sx (20)	8.77	3.08	$F_{1,29} = 5.66$	0.02
Grip	53.29	14.87		
Asx (11)	57.88	11.39		
Sx (20)	50.77	16.19	$F_{1,29} = 1.66$	0.21
Women's Left Hands (n)				
Tip	7.73	1.73		
Asx (14)	7.60	1.90		
Sx (17)	7.84	1.62	$F_{1,29} = 0.15$	0.70
Key	9.73	2.81		
Asx (14)	9.29	2.82		
Sx (17)	10.10	2.84	$F_{1,29} = 0.63$	0.43
Grip	51.54	9.91		
Asx (14)	51.60	11.23		
Sx (17)	51.49	9.03	$F_{1,29} = 0.00$	0.97
Men's Right Hands (n)				
Tip	11.60	3.74		
Asx (1)	9.33			
Sx (9)	11.85	3.87	$F_{1,8} = 0.38$	0.55
Key	14.80	3.92		
Asx (1)	13.67			
Sx (9)	14.93	4.13	$F_{1,8} = 0.08$	0.78
Grip	75.43	18.18		
Asx (1)	75.33			
Sx (9)	75.44	19.28	$F_{1,8} = 0.00$	1.00
Men's Left Hands (n)				
Tip	11.70	2.49		
Asx (3)	12.33	2.19		
Sx (7)	11.43	2.72	$F_{1,8} = 0.26$	0.63
Key	14.73	2.94		
Asx (3)	14.78	4.25		
Sx (7)	14.71	2.63	$F_{1,8} = 0.00$	0.98

(*continued on next page*)

Table 1 (continued)

Men's Left Hands (n)				
Grip	69.50	20.78		
Asx (3)	68.67	23.90		
Sx (7)	69.86	21.37	$F_{1,8} = 0.01$	0.94
D. Secondary Measures: VAS 10-point (10 = "unbearable") Scale Pain Reports—Baseline VAS Pain and NCS Symptom Status of Affected Hand (Asx, Sx)				
Affected Right Hands (37)				
VAS	3.49	2.18		
Asx (9)	4.17	1.48		
Sx (28)	3.27	2.34	$F_{1,35} = 1.16$	0.29
Affected Left Hands (30)				
VAS	2.97	1.83		
Asx (11)	2.68	1.90		
Sx (19)	3.13	1.82	$F_{1,28} = 0.41$	0.53

Abbreviations: Asx, asymptomatic; Sx, symptomatic.

[a] No significant differences in data for evaluation list 2 and evaluation list 3.

[b] "Palm-up" denotes assessment of the extensor carpi ulnaris muscle; "palm-down," assessment of the extensor carpi radialis brevis and extensor carpi radialis longus muscles; "carpal tunnel," assessment of the carpal tunnel, palmar side.

consistent, valid, and responsive to clinical change.[16] The self-report used in this research is the Condition-Specific TyPE carpel tunnel syndrome assessment series, developed by Katz and Levine et al at the Brigham and Women's Hospital[17] and made available to the project through the nonprofit Health Outcomes Institute. The Katz severity and functional status subscales have reliability (test-retest Pearson correlation of 0.91 and 0.93), internal consistency (Cronbach $\alpha = .89$ and .91), and criterion validity in comparison to grip and pinch strength testing (correlations of 0.38 and 0.47 for severity and 0.50 and 0.60 for functional status, respectively). All correlations are statistically significant at least at the $P < .05$ level.

Secondary outcomes

Nerve conduction studies were conducted according to standards in the "Practice Parameter for Electrodiagnostic Studies in CTS Summary Statement" developed by the American Association of Electrodiagnostic Medicine in conjunction with the American Academy of Neurology and the American Academy of Physical Medicine and Rehabilitation.[18]

Median and ulnar sensory, motor, and mixed nerve conduction studies were performed. Electrodiagnostic criteria supportive of hand-wrist diagnoses included a median nerve distal latency (palm to wrist, 8 cm) that exceeded the corresponding ulnar mixed nerve distal latency (palm to wrist, 8 cm) by more than 0.4 milliseconds or a median distal motor latency that exceeded the ipsilateral ulnar distal motor latency by more than 1.8 milliseconds. Electrodiagnostic studies were performed at baseline and again at 6 months posttreatment to assess categorical change in diagnosis and severity.

A pressure-sensing device known as the pressure algometer has been developed for the purpose of quantifying tenderness upon palpation. Studies have been performed to determine the pain-pressure threshold (PPT) and/or pain tolerance of individuals as well as to demonstrate the intra- and interrater reliability of the instrument.[19,20] If symptomatic pain was reported by a patient, pressure-pain (PPT) in pounds was assessed at the center of the belly of the 2 of the following symptomatic muscles: extensor carpi ulnaris ("palm-up"), extensor carpi radialis brevis ("palm-down"), and/or the carpal tunnel, palmar side ("carpal tunnel").

Tip pinch and key pinch strength were evaluated using the thumb and index fingers and recorded using a pinch gauge (B&L Engineering, Sante Fe Springs, CA). For tip pinch, the participant placed the tip of the thumb on one side and the tip of the index finger on the other side of the instrument as if to make an "O" and squeezed. For key pinch, the participant placed the thumb pad on one side and the lateral aspect of the middle phalanx of the index finger on the other side of the instrument and squeezed. The examiner demonstrated the technique before the participant performed it. The examiner handed the instrument to the participant with the dial facing down while instructing the participant of its use. The examiner held the safety cord at all times to prevent the participant from dropping the instrument. Each test was performed 3 times on each hand, alternating hands with each test, and results from the 3 tests were averaged for the final

Table 2 Characteristics of the participants (n = 47)

	n	Percentage
Age Category (y)		
60-65	24	51
66-70	10	21
71-75	5	11
76-80	5	11
81-85	3	6
85+	0	0
Sex (Female)	32	68
Marital Status		
Single	4	8
Married	28	60
Divorced	10	21
Widowed	5	11

Table 3 Hand-wrist complaints and diagnoses at baseline (n = 47)

Self-reported Affected Hands	n	Percentage
Right Only	13	19
Left Only	9	28
Both Hands	25	53
Total Right	38	81
Total Left	34	72
Neurological (NCS) Diagnoses	n	Percentage
Affected Right Hands		
Mild CTS	2	4
Moderate CTS	13	28
Severe CTS	1	2
Mild Ulnar Elbow	1	2
Moderate Ulnar Elbow	1	2
Mild Ulnar	2	4
Moderate Ulnar	5	11
Mild Median Sensory	2	4
Moderate Median Sensory	4	9
Total Symptomatic (of 47)	31	66
Drop	1	2
Normal Right Hand	13	28
Missing	2	4
	47	100
Affected Left Hands		
Mild CTS	4	9
Moderate CTS	11	23
Severe CTS	1	2
Mild Ulnar Elbow	1	2
Moderate Ulnar Elbow	0	0
Mild Ulnar	2	4
Moderate Ulnar	2	4
Mild Median Sensory	3	7
Moderate Median Sensory	3	7
Total symptomatic (of 47)	27	58
Drop	1	2
Normal Left Hand	17	36
Missing	2	4
	47	100

measure for each hand.[21,22] Strength assessments are given as pounds of pressure.

Full handgrip strength was tested with an adjustable handle dynamometer with a trained examiner. The test occurred with the participant in a seated position with the shoulder abducted and neutrally rotated, the elbow flexed 90°, and the forearm and wrist in a neutral position. The examiner instructed the participant to squeeze the instrument 3 times with the tester recording the strength each time. The handle on the dynamometer was set at the second position for all 3 tests. The examiner demonstrated the technique before the participant performed it. Strength assessments were reported sex-specific. Results from the 3 tests are averaged for final measure.[21,22]

Finally, a 10-point visual analog scale (VAS), with 10 indicating extreme pain, was used to assess hand and wrist pain.[23,24]

Statistical analysis

Preliminary descriptive analysis of the pilot data examined baseline characteristics across the sample to establish stability of health status during the 5-week baseline period using SPSS software (SPSS Inc, Chicago, Ill). Concurrent validity was assessed by comparing each participant's baseline self-reports, pain, and strength data with his or her baseline electrodiagnostic symptom status. Test-retest reliability of the measures was assessed with correlational analysis using data collected at baseline 1 and baseline 3. Responsiveness was evaluated by correlating the change in self-reported hand-wrist pain, established as a valid indicator of effectiveness, to the change in self-reported functional status and algometric and strength measures. Finally, repeated-measures multivariate analysis of variance analyses performed using STATISTICA for Windows (StatSoft Inc, Tulsa, Okla), controlling for sex in analyses of variables reflecting physical strength and using data from baseline 1 and 6-month follow-up interviews, were used to estimate preliminary treatment effects.

Before they provided written consent to their participation, all participants were advised that both specific and generalized side effects may occur with chiropractic therapy, although the incidence of such risks is rare. The research design was reviewed and approved by the institutional review board committee at the Northwestern Health Sciences University (Bloomington, Minn).

Results

Data that address the research questions are presented. We include, for comprehensibility, brief comments on the meaning of these specific results. Results for the 28 analysis of variance (ANOVA) concurrent validity analyses (Table 1) are provided as start values in power calculations for future clinical trials.

Feasibility

Fifty-five participants were recruited with the assumption that we would lose 5 (10%) people. In fact, the project lost 8 of the initial participants, and

47 (85%) completed baseline interviews, treatment, and the 6-month interview. Of the 8 people dropping out, 2 reported that the nerve conduction studies were too painful. The remaining 6 did not specify their reason for dropping out of the research. The sample can be described as predominantly women and "young-old," that is, from 60 to 85 years of age. Almost 3 in 4 participants were between 60 and 70 years old. Half of the sample was younger than 65 years, the usual retirement age. Characteristics of the 47 participants are given in Table 2.

Presenting hand-wrist conditions

Participants reported problems affecting their right hands (n = 38) and left hands (n = 34), and symptomatic right hands (n = 31) and left hands (n = 27) were identified using electrodiagnosis (nerve conduction velocities). Although problems with ulnar and non–carpal tunnel problems with the median nerve were found, the most commonly diagnosed condition (34% of right and left hands) was carpal tunnel syndrome. Conditions presented by the 47 participants are given in Table 3.

Assessment of measures

Self-report, pressure-pain, and strength assessments were evaluated for concurrent validity, reliability, and responsiveness. These measures were also examined (multivariate analysis of variance) for sex effect, and this effect was found to be significant for strength assessments. As a result, self-reports and pressure-pain assessments were analyzed by affected hands, and strength assessments were analyzed for affected hands within sex. Primary measures were the self-reported pain and function scales. Secondary analysis was conducted with pressure-pain and strength data. Results of these analyses are provided in Table 1.

Table 4 Reliability of measures

Test-Retest [5 wk] Correlations: Within-Individual Reliability of Baseline Scores	Baseline 1→Baseline 3
Katz Pain Scores	0.748*
Katz Function Scores	0.843*
PPT	
Palm-Up Right	0.624*
Palm-Down Right	0.777*
Carpal Tunnel Right	0.402
Palm-Up Left	0.403
Palm-Down Left	0.203
Carpal Tunnel Left	0.336
Strength	
Tip Strength Right	0.892*
Key Strength Right	0.893*
Grip Strength Right	0.940*
Tip Strength Left	0.886*
Key Strength Left	0.909*
Grip Strength Left	0.935*
Pain: VAS Scores	0.549*

* $P < .001$.

Table 5 Responsiveness of measures

Within-Individual Responsiveness: Improvement in Measure Correlated With Improvement in Validated (Table 1) Katz Pain Scores for Right Hands	Correlation With Change in	
Change in	Mean (SD)[a]	Katz Pain
Katz Pain Scores	4.69 (5.75)	–
Katz Function Scores	2.70 (4.02)	0.488*
PPT		
Palm-Up Right	2.53 (3.03)	0.535 (NS)
Palm-Down Right	1.97 (3.11)	0.600 (NS)
Carpal Tunnel Right	4.95 (4.75)	−0.151 (NS)
Strength		
Tip Strength Right	1.12 (1.76)	0.137 (NS)
Key Strength Right	0.69 (3.13)	−0.152 (NS)
Grip Strength Right	1.13 (8.46)	0.209 (NS)
Pain: VAS Scores	2.11 (2.25)	0.462*

NS, Not significant.

[a] Positive mean change scores indicate mean improvement for the sample.

* $P < .001$.

Concurrent validity

The extent to which baseline primary outcome measures of severity of pain and functional status covary with a general, gold-standard baseline electrodiagnosis (NCS) symptom status was assessed using ANOVA. Electrodiagnostic symptom status was coded "symptomatic" if a diagnosis other than "normal" was given and "asymptomatic" if the participant diagnosis was "normal."

Primary measures

Concurrent validity of self-reported pain and functional status associated with positive findings on electrodiagnosis in samples of participants with affected right and left hands was not consistently established. Of the several comparisons, the concurrent validity of the baseline self-report of pain associated with right-hand electrodiagnostic positive findings ($F_{1,40} = 6.43$ and $P = .015$) exceeded the single-test rejection criteria ($P < .05$). Concurrent validity of pain vs left-hand electrodiagnostic findings and functional

Table 6 Preliminary outcome

	Baseline 1 vs 6-mo Follow-up	
	2-Point Repeated-Measures ANOVA	
	F_{df}	*P*
Primary Measures (Reduced Self-reported Pain and Increased Self-reported Function)		
Katz Pain Scores	$F_{1,44} = 47.26$	.0000*
Katz Function Scores	$F_{1,44} = 31.54$	.0000*
Secondary Measures (Improved PPT, Strength, VAS Pain)		
PPT		
Palm-Up Right	$F_{1,14} = 10.51$	.0059
Palm-Down Right	$F_{1,14} = 6.01$	.0280
Carpal Tunnel Right	$F_{1,9} = 10.88$	.0093
Palm-Up Left	$F_{1,9} = 10.21$	.0109
Palm-Down Left	$F_{1,9} = 3.08$	.1131
Carpal Tunnel Left	$F_{1,7} = 0.73$	.4209
Strength		
Tip Strength Right (Female)	$F_{1,20} = 3.19$	.0891
Tip Strength Right (Male)	$F_{1,9} = 14.98$	.0038
Key Strength Right (Female)	$F_{1,20} = 4.14$	.0553
Key Strength Right (Male)	$F_{1,9} = 0.26$	.8765
Grip Strength Right (Female)	$F_{1,20} = 0.04$	.8428
Grip Strength Right (Male)	$F_{1,9} = 0.78$	.3994
Tip Strength Left (Female)	$F_{1,18} = 11.35$	.0034
Tip Strength Left (Male)	$F_{1,4} = 9.77$	.0353
Key Strength Left (Female)	$F_{1,18} = 0.72$	.4077
Key Strength Left (Male)	$F_{1,4} = 0.95$	.3848
Grip Strength Left (Female)	$F_{1,18} = 0.34$	.5697
Grip Strength Left (Male)	$F_{1,4} = 0.00$	.9846
Pain: VAS Scores	$F_{1,44} = 39.67$	.0000*

* $P < .001$.

status vs both right- and left-hand electrodiagnosis was not established. Data are presented in Table 1.

Secondary measures

Concurrent validity of algometric PPTs and hand strength was also assessed in comparison to electrodiagnosis. Concurrent validity of the PPTs was not consistently demonstrated. Strength measures—tip, key, and grip strength—for females and males, and for the VAS scale, was also not demonstrated. Data are presented in Table 1.

Reliability

Primary measures

Test-retest correlations indicated that Katz pain and functional status self-reports were reliably measured across the 3 interviews during the 5-week baseline period. Data are given in Table 4.

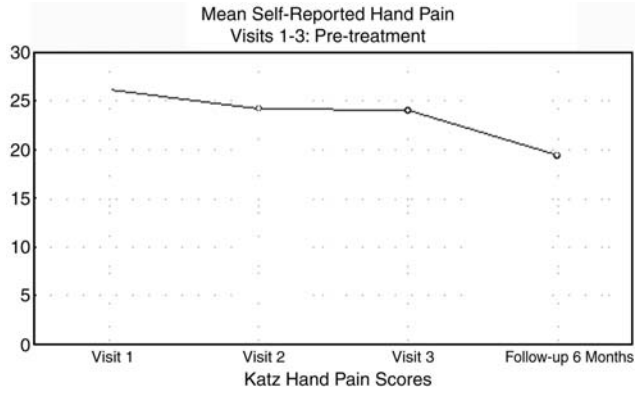

Fig 1. Repeated-measures ANOVA analysis of decreased Katz hand pain reports: baseline 1, 2, and 3 data over 5 weeks and post–5-week chiropractic treatment 6-month follow-up.

Secondary measures

All strength and self-reported measures were shown to be reliably measured. Algometric assessments, with the exception of right-hand palmar assessments, were not demonstrated to be reliable. Data are presented in Table 4.

Responsiveness

Primary measures

The self-report of pain in affected right hands was found to be a valid indicator of improvement (Table 1). To examine similar responsiveness to treatment in the remaining outcome variables, we calculated and correlated the change within the participant's hand pain with the change in the examined variables. Self-reported change in functional status was strongly

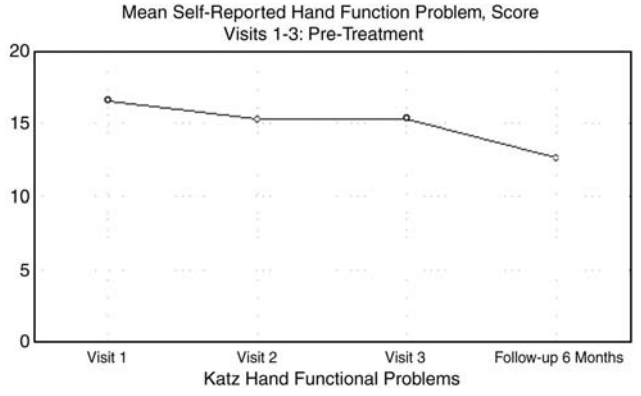

Fig 2. Repeated-measures ANOVA analysis of improved Katz hand function reports: baseline 1, 2, and 3 data over 5 weeks and post–5-week chiropractic treatment 6-month follow-up.

correlated with self-reported pain, and therefore considered responsive. Data are presented in Table 5.

Secondary measures

Because change in the self-reported functional status and VAS pain scale were correlated with change in the validated indicator of benefit, the Katz pain report, these self-reported measures were shown to be responsive indicators of therapeutic effect. Responsiveness of algometric and strength measures was not demonstrated. Data are given in Table 5.

Preliminary treatment outcome

Primary measures

Repeated-measures data, from the primary self-reports of pain and functional status and using baseline, first-visit, and 6-month follow-up data, provided preliminary evidence of benefit. Data are given in Table 6. Figs 1 and 2 provide graphic display of stability during the 3-interview baseline period and change from baseline to 6-month follow-up interview. Note that the 4-period graphics portray variation in 4 measurements over time but are only included for illustrative purposes. The 2-period, first visit–to–follow-up, repeated-measures statistical test information regarding outcome using all measures is the basis of the analysis and is provided in Table 6.

Secondary measures

With the intriguing exception of the tip strength data (both sexes and both hands), and the self-reported VAS data, within-participant changes indicated by the secondary pressure-pain and strength measures were not significant. Regarding improvement in tip pinch strength, the increase in tip strength may be the result of eliminating entrapment of the anterior interosseous nerve. This nerve can become entrapped between the deep and superficial heads of the pronator teres muscle, resulting not only in wrist and hand pain, but also in a motor deficit to the flexor pollicis longus and flexor digitorum profundus. Decreased strength in these muscles results in decreased tip strength. Treatments used by the chiropractors in this research were aimed at relieving tension in the anterior muscles of the forearm, and it is these treatments that likely eliminated entrapment of the anterior interosseous nerve, allowing tip strength to improve. Data are given in Table 6.

Discussion

This article is the second part of a 2-part report. The central finding of both the first[12] and second parts has been that involving older participants, especially the young-old (60-85 years), is feasible. More specifically, our research indicates that a substantial number of older people (in the present case, 85% of the initial group) will present a variety of conditions of the upper extremities and comorbidities, and will reliably maintain their involvement in treatment and data collection.

Our results of the assessments of the primary and secondary measures are mixed. The primary measures are self-reported, and perhaps because they involve conscious report from a whole organism and do not focus on objective reports from a particular location, these measures were found, in multiple-condition research, to be reliable, responsive, and indicative of preliminary outcome. The more focused physical assessments (pressure-pain and strength measures) might be better used in single-condition research.

Limitations of the project also include lower numbers of data points in the algometric assessments owing to frequent conflicts with teaching schedules preventing clinician-team members from being available to measure PPTs during participant interviews.

Conclusion

The preliminary outcomes of the research are that chiropractic protocols derived for older patients and treating both spine and the upper extremities for hand-wrist pain are promising. These results are based on the self-reported measures. In a single-group design, these findings are only suggestive, not definitive. They could have resulted from data gathered from a Hawthorn-like effect by participants who were particularly pleased to be involved in the project, especially when treatment began.

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References

1. Eisenberg DM, Kessler RC, Foster C, Norlock FE, Calkins DR, Delbanco TL. Unconventional medicine in the United States: prevalence, costs, and patterns of use. N Engl J Med 1993;328: 246-52.
2. Eisenberg DM, Davis RB, Ettner SL, et al. Trends in alternative medicine use in the United States, 1990-1997: results of a follow-up survey. JAMA 1998;280:1569-75.
3. Kessler RC, Davis RB, Foster DF, et al. Long-term trends in the use of complementary and alternative medical therapies in the United States. Ann Intern Med 2001; 135(4):262-8.
4. Eisenberg DM, Kessler RC, Van Rompay MI, et al. Perceptions about complementary therapies relative to conventional therapies among adults who use both: results from a national survey. Ann Intern Med 2001;135(5):344-51.
5. Davis PT, Hulbert JR, Kassak K, Meyer JJ. Efficacy of conservative medical and standard chiropractic treatments for carpal tunnel syndrome: a randomized controlled trial. J Manipulative Physiol Ther 1998;21(5):317-26.
6. O'Connor D, Marshall S, Massy-Westropp N. Non-surgical treatment (other than steroid injection) for carpal tunnel syndrome. Cochrane Database Syst Rev(1):CD003219.
7. Preston SH, Martin LG. Introduction. In: Preston SH, Martin LG, editors. Demography of aging. Washington: National Academy Press; 1994. p. 1-7.
8. Manton KG, Stallard E. Medical demography: interaction of disability dynamics and mortality. In: Preston SH, Martin LG, editors. Demography of aging. Washington: National Academy Press; 1994. p. 217-78.
9. McCarthy KA. Peripheral neuropathy in the aging patient: common causes, assessment, and risks. Top Clin Chiropr 1999;6(4):56-61.
10. Atroshi I, Gummeson C, Johnson R, Ornstein E, Ranstam J, Rosen I. Prevalence of carpal tunnel syndrome in a general population. JAMA 1999;282(2):153-8.
11. Spaite DW, Criss EA, Valenzuela TD, Meislin HW, Ross J. Geriatric injury: an analysis of pre-hospital demographics, mechanisms, and patterns. Ann Emerg Med 1990;19: 1418-21.
12. Hulbert JR, Printon R, Osterbauer PJ, Davis PT, LaMaack R. Chiropractic treatment of hand and wrist pain in older people: systematic protocol development, Part 1: Informant interviews. J Chiropr Med 2005;4(3):144-50.
13. Leahy PM. Myofascial release technique and mechanical compromise of peripheral nerves of the upper extremity. Chiropr Sports Med 1992;6(4):139-49.
14. Bergmann T. Chiropractic technique: principles and procedures. New York: Churchill and Livingstone; 1993.
15. Levine DW, Simmons BP, Koris MJ, et al. A self-administered questionnaire for the assessment of severity of symptoms and functional status in carpal tunnel syndrome. J Bone Joint Surg 1993;75A(11):1585-92.
16. Katz JN, Gelberman RH, Wright EA, Abrahamson SO, Lew RA. A preliminary scoring system for assessing the outcome of carpal tunnel syndrome. J Hand Surg 1994;19A(4):531-8.
17. Katz JN, Simmons BP, Fossel AH. TyPE specification: carpal tunnel syndrome 1993. Bloomington (MN): Health Outcomes Institute; 2001.
18. American Association of Electrodiagnostic Medicine and American Academy of Physical Medicine and Rehabilitation. Practice parameters for electrodiagnostic studies in carpal tunnel syndrome. Neurology 1993;43:2404-5.
19. Fischer A. Pressure algometry in quantification of diagnosis and treatment outcome. J Musculoskelet Pain 1998;6(1).
20. Nussbaum E. Reliability of clinical pressure-pain algometric measurements obtained on consecutive days. Phys Ther 1998;78(2):160-9.
21. Mathiowetz V, Kashrnan N, Volland G, Weber K, Dowe M, Rogers S. Grip and pinch strength: normative data for adults. Arch Phys Med Rehabil 1985;66:69-74.
22. Mathiowetz V, Weber BS, Volland G, Kashman N. Reliability and validity of grip and pinch strength evaluations. J Hand Surg 1984:222-6.
23. Stuart AL, Hays RD, Ware JE. The MOS Short-Form General Health Survey: reliability and validity in a patient population. Med Care 1988;26:724-35.
24. Tarlov AR, Ware JE, Greenfield S, Nelson EC, Perrin E, Zubkoff M. The Medical Outcomes Study: an application of methods for monitoring the results of medical care. JAMA 1989;262:925-30.