

4-25-2017

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Recommended Citation

Holmes B, Brazauskas R, Cassidy LD, Wiegand RA. Factors in patient responsiveness to directional preference-matched treatment of neck pain with or without upper extremity radiation. *J Patient Cent Res Rev.* 2017;4:60-8. doi: [10.17294/2330-0698.1271](https://doi.org/10.17294/2330-0698.1271)

Published quarterly by Midwest-based health system Advocate Aurora Health and indexed in PubMed Central, the Journal of Patient-Centered Research and Reviews (JPCRR) is an open access, peer-reviewed medical journal focused on disseminating scholarly works devoted to improving patient-centered care practices, health outcomes, and the patient experience.

Factors in Patient Responsiveness to Directional Preference-Matched Treatment of Neck Pain With or Without Upper Extremity Radiation

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Purpose	Patient-related predictive factors in responsiveness to directional preference therapy for neck pain with or without upper extremity radiation (NP/R) have not been reported. A directional preference is any neck movement that, when performed repeatedly to end range, results in centralization and/or alleviation of NP/R. It was hypothesized that patient compliance with a prescribed, directional preference-matched home exercise program would improve positive responsiveness to NP/R treatment.
Methods	Patient-related factors thought to affect responsiveness to care were collected retrospectively from charts and de-identified for patients with NP/R who underwent chiropractic treatment at a multispecialty spine clinic from January 2014 through June 2015. Responsiveness was measured by calculating the percentage change in Neck Bournemouth Questionnaire (NBQ) scores over treatment time. Multiple linear regression was used to identify factors associated with positive responsiveness.
Results	Mean percentage change in patient NBQ score from initial intake to discharge was 50% (standard deviation: 32%). Of 104 patients meeting study inclusion criteria, 86 (83%) reported experiencing improvement after the first treatment session. Bivariate analysis of patient characteristics by compliance with directional preference-matched exercise indicated that compliant patients (n=95, 91%) demonstrated significantly greater responsiveness to care than did noncompliant patients, at 55% versus 25% change in NBQ score, respectively (P=0.0041). Four factors were statistically significant predictors of patient responsiveness to directional preference therapy for NP/R: patient compliance with directional preference-matched exercise (P=0.0023), patient age (P=0.0029), condition chronicity (P<0.0001), and whether the patient reported improvement of symptoms following initial treatment session (P=0.0003).
Conclusions	The results of this study suggest that patient compliance with directional preference exercise is associated with patient responsiveness to conservative treatment of NP/R, as are age, chronicity and report of immediate symptom improvement. (<i>J Patient Cent Res Rev.</i> 2017;4:60-68.)
Keywords	neck pain; directional preference; Bournemouth questionnaire

Neck pain is common among adults, with global annual incidence rates reported between 10.4% and 21.3%.¹ It is the fourth leading cause of disability globally.² Neck pain can

be accompanied by upper extremity radiation of pain, paresthesia, numbness or weakness, sometimes attributable to cervical radiculopathy. The annual age-adjusted cervical radiculopathy incidence rate in one large epidemiological survey in Minnesota was 83 per 100,000 persons.³

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Several conservative treatment options are available for neck pain, including “wait and see,”⁴ spinal mobilization or manipulation, home exercises, physical

therapy modalities, medications and epidural steroid injection. Evidence of the efficacy of conservative management is tenuous. Some evidence suggests that exercise may be beneficial for neck pain.⁵ Studies supporting conservative management of neck pain with upper extremity radiation are even sparser, and randomized controlled trials are needed to examine the clinical effectiveness of conservative treatments.⁶

One conservative treatment approach is called directional preference therapy. Variations of directional preference therapy have been studied and performed under different monikers, namely the McKenzie approach⁷ and mechanical diagnosis and therapy (MDT).^{4,8} Directional preference involves manual therapy, exercise therapy or both, which are predicated on the discovery of a “directional preference” during the physical examination. A directional preference is any specific neck movement that, when performed repeatedly to end range, results in centralization and/or alleviation of neck pain with or without upper extremity radiation (NP/R) as well as improved mechanical presentation (eg, improved active global range of motion).⁹ Once the preference has been ascertained, the directional preference practitioner may utilize, if necessary, the specific direction when performing manual therapy to the spine and match the direction in prescribing home exercises.

Eight clinical trials have assessed directional preference therapy in treating NP/R,^{7,10-16} but the trials lack definitive evidence of treatment efficacy. One systematic review assessed directional preference therapy for neck pain and concluded that directional preference therapy may not be significantly more effective than a “wait and see” approach for neck pain; however, skillset adequacy of the directional preference therapists in the included studies was questioned.⁴ Several studies have evaluated and supported directional preference therapy for lumbar spine pathology.¹⁷⁻²³

This study evaluated characteristics of NP/R patients and responsiveness to directional preference therapy. Recognizing both the theoretical value of directional preference-matched home exercise performance and the capability of self-management in patient-centered care to improve health outcomes, the investigators

conducting this study hypothesized that patient compliance with a prescribed, directional preference-matched home exercise program would improve responsiveness to conservative treatment of NP/R.

METHODS

The local institutional review board determined that this study, designed primarily as a quality assessment and improvement project, did not constitute human subject research.

A retrospective chart review was conducted for all patients who presented with axial NP/R and who demonstrated limited and/or painful active cervical range of motion, showed a directional preference on evaluation and underwent directional preference treatment by a single chiropractor at a spine clinic within a large health system from January 2014 through June 2015 (N=245). Patients whose symptoms and signs did not satisfy the above diagnostic criteria, who were younger than 18 years, who suspended care prematurely or for whom outcome data were incomplete were excluded from the study. Data were de-identified prior to statistical analysis.

Aside from the chiropractor, this study’s clinic team comprised an orthopedic spine surgeon, three orthopedic physician assistants and four pain proceduralists. Occasionally throughout the course of individual patient care, other treatment modalities were utilized as prescribed/performed by team physicians, assistants and proceduralists, including the prescription of anti-inflammatory, muscle relaxant, analgesic and anti-epileptic medication and epidural steroid injection. Treating members of the clinic team along with individual patients made the decision to utilize these modalities on a case-by-case basis. Anti-inflammatory, muscle relaxant and analgesic medications were prescribed in the presence of either neck pain alone or neck pain with upper extremity radiation. Anti-epileptic medication and epidural steroid injections were recommended only in cases of neck pain with upper extremity radiation.

Responsiveness to directional preference therapy was measured by changes in scores reported by the patient on the Neck Bournemouth Questionnaire (NBQ) pre- and post-treatment span. The NBQ is a reliable,

responsive and efficient outcomes measurement tool (Figure 1) to assess the effects of patients' neck conditions on seven aspects of their lives: pain, activities of daily living, social activities, anxiety, depression, work and fear-avoidance beliefs, and locus of control.²⁴⁻²⁷

This study assessed patient compliance with prescribed directional preference-matched home exercises as a predictive factor of positive response to directional preference therapy. Other patient characteristics analyzed as factors in responsiveness were: age, body mass index, comorbidities of anxiety or depression, diagnosis, sex, whether the patient reported improvement immediately following the first treatment session, payor, treatment dosage, number of treatments throughout course of care, smoking status, condition chronicity, and prescription medication usage (including epidural steroid injection).

On initial presentation to the chiropractor, the patient complaining of neck pain with or without upper extremity pain, numbness, paresthesia or weakness underwent directional preference assessment. The directional preference assessment process is well-described in the literature^{9,28} (and a synopsis is provided in this paper's introduction). Following the ascertainment of a directional preference in the patient with NP/R, exercise and manual therapies matched to the preferred direction were performed. NBQ scores were assessed at intake and every 2–4 weeks thereafter until the patient's condition was determined fixed and stable, and the patient was released from care.

Occasionally, NP/R symptoms returned after the patient was released and care was reinitiated, creating a subsequent course of treatment. After the NBQ scores were collected, the percentage change was calculated, meaning the difference between a patient's NBQ score at intake and at the conclusion of the treatment course, divided by the score at intake, and multiplied by 100, with positive percentages indicating improvement and negative percentages indicating decline.²⁹

Statistical Analysis

Patient characteristics were summarized with descriptive statistics. Patient-related factors were compared between exercise-compliant and exercise-

noncompliant groups using Wilcoxon rank-sum test for continuous variables and χ^2 test for categorical variables.

Multiple linear regression analysis was used to model patient responsiveness to directional preference therapy in relation to: age; body mass index; comorbidities of anxiety and/or depression (as determined by presence of anxiety and/or depression diagnoses in the patient's electronic medical record); NP/R primary diagnosis variation (neck pain without upper extremity radiation or neck pain with upper extremity radiation); sex; reported improvement after first treatment session (yes or no); payor (commercial or noncommercial insurance, the latter of which includes self-pay, personal injury, workers' compensation, Medicaid and Medicare); reported compliance with the home exercise program as prescribed; treatment dosage (number of treatments per days of treatment span); total number of treatments throughout the course of care; smoking status; chronicity of symptoms (acute/subacute or chronic/acute-on-chronic); and the use of prescription substances (anti-inflammatories, muscle relaxants, analgesics, anti-epileptics and/or epidural steroids). A backward elimination model selection procedure was used to identify statistically significant covariates to include in the model. Significance was defined as $P < 0.05$ throughout. SAS OnDemand for Academics software (SAS Institute, Cary, NC) was used to perform statistical analysis.

RESULTS

A total of 104 patients, undergoing a total of 119 treatment courses, met the inclusion criteria and were included in the analysis. The largest number of treatment courses per patient was four (which occurred in 1 patient); 8 of the 104 patients underwent two treatment courses and 2 patients underwent three courses. The average number of treatment sessions per course of care was 6.8 (Table 1). For analysis purposes, only a patient's first treatment course of NP/R was considered.

Also shown in Table 1, the mean age of study population was 47 years (standard deviation: 12.0), and 68% of patients were female. The mean change in NBQ score with respect to initial reported score was $50\% \pm 32\%$; 86 patients (83%) reported experiencing

BOURNEMOUTH QUESTIONNAIRE (NECK PAIN)

Put a CROSS in ONE box for EACH of the following statements that best describes your neck pain and how it is affecting you NOW. Please read each question carefully before answering.

- Q1** Over the past few days, on average, how would you rate your neck pain on a scale where '0' is 'no pain' and '10' is 'worst pain possible'?
- 0 1 2 3 4 5 6 7 8 9 10
- No pain
-
- Q2** Over the past few days, on average, how has your neck pain interfered with your daily activities (housework, washing, dressing, lifting, reading, driving, sleeping) on a scale where '0' is 'no interference' and '10' is 'completely unable to carry on with normal day-to-day activities'?
- 0 1 2 3 4 5 6 7 8 9 10
- No interference
-
- Q3** Over the past few days, on average, how much has your neck pain interfered with your normal social routine including recreational, social and family activities, on a scale where '0' is 'no interference' and '10' is 'completely unable to participate in any social and recreational activity'?
- 0 1 2 3 4 5 6 7 8 9 10
- X No interference X
-
- Q4** Over the past few days, on average, how anxious (uptight, tense, irritable, difficulty in relaxing/concentrating) have you been feeling, on a scale where '0' is 'not at all anxious' and '10' is 'extremely anxious'?
- 0 1 2 3 4 5 6 7 8 9 10
- Not at all anxious
-
- Q5** Over the past few days, how depressed (down-in-the-dumps, sad, in low spirits, pessimistic, lethargic) have you been feeling, on a scale where '0' is 'not at all depressed' and '10' is 'extremely depressed'?
- 0 1 2 3 4 5 6 7 8 9 10
- Not at all depressed
-
- Q6** Over the past few days, how do you think your work (both inside the home and/or employed work) have affected your neck pain, on a scale where '0' is 'make it no worse' and '10' is 'make it very much worse'?
- 0 1 2 3 4 5 6 7 8 9 10
- Make it no worse
-
- Q7** Over the past few days, on average, how much have you been able to control (help/reduce) and cope your neck pain on your own, on a scale where '0' is 'I can control it completely' and '10' is 'I have no control whatsoever'?
- 0 1 2 3 4 5 6 7 8 9 10
- I have complete control over my pain

THANK YOU VERY MUCH FOR YOUR TIME IN COMPLETING THIS QUESTIONNAIRE

Figure 1. Neck Bournemouth Questionnaire. (Republished from <http://www.aecc.ac.uk/>, with permission from the Anglo-European College of Chiropractic [Bournemouth, United Kingdom] and author Jennifer E. Bolton.

Table 1. Patient Characteristics

Characteristic	Patient population (N=104)
Mean age, years \pm SD	46.8 \pm 12.0
Age < 55 years, n (%)	75 (72%)
Age \geq 55 years, n (%)	29 (28%)
Mean body mass index \pm SD	28.3 \pm 7.2
Mean percentage change in questionnaire score with respect to initial score \pm SD	50% \pm 32%
Patients with anxiety, n (%)	29 (28%)
Patients with depression, (%)	31 (30%)
Diagnosis	
Neck pain without UE radiation, n (%)	62 (60%)
Neck pain with UE radiation, n (%)	42 (40%)
Sex	
Female, n (%)	71 (68%)
Male, n (%)	33 (32%)
Patients who experienced improvement following first treatment session, n (%)	86 (83%)
Payor	
Commercial, n (%)	91 (87.5%)
Noncommercial (self, personal injury, workers' compensation, Medicaid, Medicare), n (%)	13 (12.5%)
Patient compliance with directional preference-matched home exercise program, n (%)	95 (91%)
Mean treatment dosage, number of treatments per days of treatment span \pm SD	0.2 \pm 0.1
Mean number of treatments per episode \pm SD	6.8 \pm 4.5
Patients who smoke, n (%)	20 (19%)
Chronicity	
Acute/subacute, n (%)	39 (37.5%)
Chronic/acute-on-chronic, n (%)	65 (62.5%)
Prescription substances	
Anti-inflammatory, n (%)	32 (31%)
Muscle relaxant, n (%)	28 (27%)
Analgesic, n (%)	22 (21%)
Anti-epileptic, n (%)	9 (9%)
Epidural steroids, n (%)	10 (10%)

SD, standard deviation; UE, upper extremity.

improvement after the first treatment session, and 95 patients (91%) reported being compliant with the prescribed home exercise program. A majority of patients (n=65, 62.5%) suffered from chronic or acute-on-chronic pain as opposed to acute/subacute pain. Chronic pain was defined as neck and/or upper extremity pain that had been persistent for greater than 3 months, acute pain defined as less than 7 days, subacute pain defined as lasting between 7 days and 3 months, and acute-on-chronic pain defined as a flare-up of acute or subacute pain in the presence of underlying chronic pain.

Table 2 shows the results of the bivariate analysis of patient characteristics by compliance with prescribed directional preference-matched home exercise. Exercise-compliant patients (“exercisers”) demonstrated significantly improved responsiveness to care compared with noncompliant patients (“nonexercisers”), with a 55% and 25% change in NBQ score, respectively (P=0.0041). Only 25% of exercisers experienced depression compared with 78% of nonexercisers (P=0.0010). Payor classification varied significantly between the two groups as well — 91% of exercisers were commercially insured, whereas 44% of nonexercisers were noncommercially insured (P=0.0024). No statistically significant difference between exercisers’ and nonexercisers’ chronicity of symptoms was found.

Results of multiple linear regression are summarized in Table 3. Compliance with a prescribed directional preference-matched home exercise program was positively associated with responsiveness to directional preference therapy (P=0.0023), and condition chronicity was negatively associated (P<0.0001). Patient age \geq 55 years and noted improvement of symptoms following the initial treatment session also were both positively associated with responsiveness to therapy (P=0.0029 and P=0.0003, respectively).

Patient responsiveness to directional preference therapy based on combinations of patient characteristics within the best-fit linear regression was estimated (Table 4). Analysis was repeated to include all treatment episodes. Results of this secondary analysis (data not shown) were very similar to the presented analysis, which involved only the first treatment episode.

Table 2. Patient Characteristics by Compliance With Prescribed Home Exercises

Characteristic	Exercisers (n=95)	Nonexercisers (n=9)	P
Median BMI (range)	27 (18–55)	28 (20–42)	0.2883
Median percentage change in score (range)	55% (-18%–100%)	25% (-44%–69%)	0.0041
Age			0.7306
Age < 55 years, n (%)	70 (74%)	5 (56%)	
Age ≥ 55 years, n (%)	25 (26%)	4 (44%)	
Patients with anxiety, n (%)	24 (25%)	5 (56%)	0.0528
Patients with depression, n (%)	24 (25%)	7 (78%)	0.0010
Diagnosis			0.7951
Neck pain without UE radiation, n (%)	57 (60%)	5 (56%)	
Neck pain with UE radiation, n (%)	38 (40%)	4 (44%)	
Sex			0.5214
Female, n (%)	64 (67%)	7 (78%)	
Male, n (%)	31 (33%)	2 (22%)	
Improvement following first session, n (%)	80 (84%)	6 (67%)	0.1836
Payor			0.0024
Commercial, n (%)	86 (91%)	5 (56%)	
Noncommercial, n (%)	9 (9%)	4 (44%)	
Median treatment dosage, n/day (range)	0.1 (0.03–0.5)	0.1 (0.03–0.3)	0.0988
Median treatments per episode, n (range)	6 (2–30)	4 (3–7)	0.0101
Patients who smoke, n (%)	17 (18%)	3 (33%)	0.2614
Chronicity			0.3219
Acute/subacute, n (%)	37 (39%)	2 (22%)	
Chronic/acute-on-chronic, n (%)	58 (61%)	7 (78%)	
Prescription medication			
Anti-inflammatory, n (%)	31 (33%)	1 (11%)	0.1812
Muscle relaxant, n (%)	24 (25%)	4 (44%)	0.2150
Analgesic, n (%)	20 (21%)	2 (22%)	0.9346
Anti-epileptic, n (%)	7 (7%)	2 (22%)	0.1298
Epidural steroids, n (%)	8 (8%)	2 (22%)	0.1795

BMI, body mass index; UE, upper extremity.

DISCUSSION

The general agreement among health scientists is that patient engagement and participation in health care, such as via home exercise performance, are beneficial; however, clinical trials and reviews specifically evaluating directional preference therapy for NP/R are sparse and insufficiently informative. While the results of this study are consistent with previous studies that support the use of directional preference therapy in treating NP/R,^{7,10-16} our results also explicate specific patient-related factors in responsiveness to directional preference therapy outside the practitioner-related factors studied prior. For instance, these findings suggest a possible mechanism behind limited

responsiveness of neck pain patients to directional preference therapy reported in the systematic review by Takasaki and May,⁴ as 61 of the 100 patients from two of the five trials studied by the authors had suffered from neck pain for more than 3 months. Our finding that chronicity of symptoms is a predictive factor in patient responsiveness to care may provide an explanation of limited responsiveness to directional preference therapy in those two trials.

This study has limitations. Several data points are patient-reported, such as NBQ scores, chronicity, improvement following initial treatment session, compliance with directional preference home

Table 3. Multivariate Analysis of Change in NBQ Score

Variable	Coefficient (SE)	P
Intercept	19% (10%)	0.0614
Compliance with home exercise	21% (7%)	0.0023
Chronicity of symptoms	-23% (5%)	<0.0001
Patient age ≥ 55 years	17% (6%)	0.0029
Improvement following initial treatment session	22% (6%)	0.0003

NBQ, Neck Bournemouth Questionnaire; SE, standard error.

Table 4. Estimated Patient Responsiveness to Directional Preference Therapy

Compliance with home exercise (yes or no)	Chronicity of symptoms (chronic/acute-on-chronic or acute/subacute)	Age ≥ 55 years	Improvement following initial treatment session	Estimated responsiveness
No	Chronic/acute-on-chronic	No	No	-4%
No	Chronic/acute-on-chronic	Yes	No	13%
No	Acute/subacute	No	No	18%
No	Chronic/acute-on-chronic	No	Yes	17%
No	Acute/subacute	Yes	No	36%
No	Chronic/acute-on-chronic	Yes	Yes	34%
No	Acute/subacute	No	Yes	40%
No	Acute/subacute	Yes	Yes	57%
Yes	Chronic/acute-on-chronic	No	No	16%
Yes	Chronic/acute-on-chronic	Yes	No	33%
Yes	Acute/subacute	No	No	39%
Yes	Chronic/acute-on-chronic	No	Yes	38%
Yes	Acute/subacute	Yes	No	59%
Yes	Chronic/acute-on-chronic	Yes	Yes	55%
Yes	Acute/subacute	No	Yes	61%
Yes	Acute/subacute	Yes	Yes	78%

exercises and smoking status. These data are subjective reports and potentially carry social desirability bias (for example, the underreporting of smoking and overreporting of exercise compliance). Also, some of these reports relate to the patient's experience with pain. Because pain and its effects are a subjective experience, some level of subjectivity is inescapable. Nevertheless, by comparing percentage change of NBQ scores — which are intrapersonal ratios and therefore control for personalization³⁰ of the pain experience — instead of raw NBQ scores, data volatility is maximally neutralized and interpersonal

comparability maximally facilitated. Small patient numbers limited some comparisons, particularly regarding nonexercisers.

Because the study population was predominantly Caucasian and commercially insured — a make-up that accurately reflects the overall patient population at our clinic — findings are not generalizable. However, they will inform processes to assess and improve quality at our institution (and perhaps those that are similar) as well as motivate and guide further research of directional preference therapy for

NP/R. These findings may inform further assessment of larger samples in more demographically diverse settings. Dissemination of these results may motivate patients to comply with directional preference home exercises and also encourage regional clinicians to enlist patient involvement when treating NP/R. Local directional preference practitioners also can use these findings to inform themselves and patients of likelihood of responsiveness to care at the early outset of treatment, which could be financially, emotionally and therapeutically beneficial to the patient.

CONCLUSIONS

Patient compliance with directional preference exercise is associated with patient responsiveness to directional preference therapy in conservative care treatments of neck pain. Patients 55 years of age or older, those with acute/subacute chronicity and those who report symptom improvement following the first treatment session showed significant improvement. Implementation of these findings could improve care of patients with neck pain, with or without upper extremity radiation, at a local level.

Patient-Friendly Recap

- Patients experiencing persistent neck pain with or without arm symptoms have several treatments at their disposal. Often, a conservative course of “directional preference” therapy is chosen.
- Directional preference refers to neck movements that, when performed repeatedly, result in centralization or alleviation of pain. Patients using directional preference therapy may be assigned home exercises as part of their treatment plan.
- The authors found that compliance with these exercises, along with patient factors such as age ≥ 55 and noted improvement after initial treatment session, contributed significantly to success of therapy.

Conflicts of Interest

None.

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