Preliminary Examination of a Proposed Treatment-Based Classification System for Patients Receiving Physical Therapy Interventions for Neck Pain

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Background and Purpose

Neck pain frequently is managed by physical therapists. The development of classification methods for matching interventions to subgroups of patients may improve clinical outcomes. The purpose of this study was to describe a proposed classification system for patients with neck pain by examining data for consecutive patients receiving physical therapy interventions.

Subjects and Methods

Standardized methods for collecting baseline and intervention data were used for all patients receiving physical therapy interventions for neck pain over 1 year. Outcome variables were the Neck Disability Index (NDI), numeric pain rating, and number of visits. Treatment was provided at the discretion of the physical therapist. After the completion of treatment, each patient was classified by use of baseline variables. The interventions received by the patient were categorized as being matched or not matched to the classification. Outcomes for patients who received matched interventions were compared with those for patients who received nonmatched interventions. The interrater reliability of the classification algorithm was examined with a subset of 50 patients.

Results

A total of 274 patients were included in this study (74% women; age [$\bar{X}\pm$SD]=44.4$\pm$16.0 years). The most common classification was centralization (34.7%); next were exercise and conditioning (32.8%) and mobility (17.5%). The interrater reliability for classification decisions was high (kappa=.95, 95% confidence interval [CI]=0.87–1.0). A total of 113 patients (41.2%) received interventions matched to the classification. Receiving matched interventions was associated with greater improvements in the NDI (mean difference=5.6 points, 95% CI=2.6–8.6) and in pain ratings (mean difference=0.74 point, 95% CI=0.21–1.3) than receiving nonmatched interventions.

Discussion and Conclusion

The development of classification methods for patients with neck pain may improve the outcomes of physical therapy intervention. This study was done to examine a previously proposed classification system for patients receiving physical therapy interventions for neck pain. Receiving interventions matched to the classification system was associated with better outcomes than receiving nonmatched interventions. Although the design of this study prohibited drawing conclusions about the effectiveness of the system, the results suggest that further research on the system may be warranted.

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Neck pain is a common condition, with an annual incidence estimated at about 15%.[1] Patients with neck pain frequently are treated without surgery by primary care and physical therapy providers.[2–4] Within physical therapy, there appears to be a great deal of variation in choices of interventions,[5] indicating a degree of uncertainty about optimal strategies for these patients.[6] Increased variability in treatments has been suggested to adversely affect the quality of care[7]; this effect may partly explain why research on physical therapy outcomes has revealed smaller effect sizes for patients with neck pain than for patients with other musculoskeletal conditions.[3]

The literature on the nonsurgical treatment of patients with low back pain suggests that suboptimal clinical outcomes and practice variability may be related to the inability to identify a pathoanatomical cause for the majority of patients, creating uncertainty among practitioners operating within the traditional medical model.[8–10] It appears that the precise pathological etiology underlying many cases of neck pain may be similarly elusive.[11–14] Recognition of the inadequacy of the medical model for the condition of low back pain has led to the development of alternative methods for classifying patients into subgroups based on clinical characteristics to assist in treatment decision making.[15–17] There is evidence that these efforts can improve clinical outcomes for patients receiving physical therapy interventions.[18–21]

The development of classification methods based on clinical characteristics for the purpose of specifically directing nonsurgical treatment choices has not advanced for the condition of neck pain as it has for low back pain. Several authors have proposed strategies for the classification of patients with neck pain,[22–24] but little work on validation has been performed. We recently proposed a treatment-based classification approach that seeks to use information from the history and physical examination to place patients into 1 of 5 separate subgroups that provide a direction for the initial physical therapy treatment approach.[22]

The classification strategy was developed on the basis of evidence when possible, supplemented with expert opinion and common practice when necessary.[22] The rationale for the mobility classification is based on evidence generally supporting the use of manual therapy (either manipulation or mobilization) for patients with neck pain, particularly when these interventions are combined with exercise.[25] Further evidence from randomized trials suggests that manipulation or mobilization may be more effective for younger patients with more acute symptoms and without signs of nerve root compression.[26–29]

The rationale for the centralization classification is based on research demonstrating the prognostic significance of the centralization phenomenon.[30] For patients with distal symptoms and signs of nerve root compression, the promotion of centralization of symptoms is recommended as a treatment goal, and interventions such as retraction exercises and traction often are used.[31] The rationale for the exercise and conditioning classification is based on evidence of the effectiveness of exercise—in particular, strengthening exercises for the deep neck flexor, cervical spine, and upper-quarter muscles—for patients who have chronic neck pain but who do not have signs of nerve root compression.[32–36] The pain control classification encompasses patients with acute, traumatic onset of neck pain with a whiplash mechanism and with very high levels of pain and disability. Evidence for patients fitting this subgroup recommends mobilization,[37] neck active range-of-motion (ROM) exercises, and avoidance of immobilization (eg, cervical collar).[38,39] Finally, the headache classification includes patients with a chief complaint of headache presumed to originate from structures in the cervical spine.[40] The evidence for physical therapy interventions for patients with cervicogenic headaches supports strengthening of the deep neck flexor and upper-quarter muscles along with mobilization or manipulation of the cervical spine.[41]

Classification systems are designed to direct treatment and improve outcomes. Proposed systems should be examined to determine whether treatment decision making that matches the recommendation of a system results in better outcomes. Little work has been done to examine proposed classification systems for patients with neck pain. We sought to begin the process of examining the proposed system by prospectively collecting standardized information from the examination, interventions, and clinical outcomes of patients receiving physical therapy interventions for neck pain. We purposefully did not attempt to standardize the treatment decision making of the therapists. The purposes of this study were to examine the proposed treatment-based classification system by describing the prevalence of the subgroups in a sample of patients receiving physical therapy interventions for neck pain and to compare the other characteristics of patients placed in these subgroups. We also sought to examine the interrater reliabilities of the classification algorithm and the treatment-matching criteria and to compare the clinical outcomes of care when treatment decision making matched the system with the outcomes of care when decision making was not matched to the system.

Method

Procedures

Data for this study were collected from 4 outpatient physical therapy clinics of Intermountain Health Care, a private, nonprofit health care system. In each participating clinic, clinical outcomes are routinely tracked for all patients receiving physical therapy interventions. Each new patient is entered into an electronic database, and at each physical therapy session, a condition-specific disability outcome score and a numeric pain rating (from 0 to 10)[42] are collected and entered into the database. For patients with neck pain, the Neck Disability Index (NDI)[43] is the condition-specific disability measure used at each session. The NDI comprises 10 items related to neck pain and the patient's tolerance for daily activities, each scored from 0 to 5; the scores are summed and expressed as a percentage. The NDI is the most commonly used region-specific scale for patients with neck pain[44] and has been demonstrated to be a reliable and valid outcome measure for patients with neck pain.[45–48]

This study was a prospective longitudinal project involving the collection of standardized data from the examination, interventions, and outcomes of patients receiving physical therapy interventions for neck pain. Prior to data collection, a standardized baseline examination form was developed to gather consistent information on all patients. Key examination variables that were standardized for collection on all patients are shown in Table 1. A standardized form for recording interventions used during each physical therapy session was developed to record consistent intervention information. The categories of interventions recorded and the operational definitions used are shown in Table 2. Physical therapists working in participating clinics attended at least 2 training sessions conducted to famil-

Table 1.
Variables Standardized for Collection at the Baseline Examination for All Patients

Variables	Measurement Method
Duration of symptoms (d)	Patient self-report
Mode of onset of symptoms (gradual, sudden, traumatic, other)	Patient self-report
Symptom location (neck, head, scapula, shoulder, arm, hand) and most bothersome symptom location	Patient self-report
Aggravating or relieving factors	Patient self-report
Prior history of neck pain (yes or no) and frequency of prior episodes	Patient self-report
Disability attributable to neck pain	Neck Disability Index[43]
Pain intensity	11-point numeric pain rating[42]
Signs of nerve root compression (diminished strength, reflex, sensation)	Neurological examination
Cervical extension, flexion, side bending, and rotation (active range of motion)	Inclinometer measurement
Effect of cervical active range of motion on symptoms (increased pain, decreased pain, centralization, peripheralization)	Patient self-report during range-of-motion assessment[24]

Table 2.
Matched Treatment Components for Each Classification Category

Classification	Criterion	Proposed Matched Treatment Components
Mobility	The listed interventions must *both* be received within the first 3 sessions.	Cervical or thoracic mobilization or manipulation Strengthening exercises for the deep neck flexor muscles
Centralization	*Either* of the listed interventions must be received.	Mechanical or manual cervical traction (at least 50% of the sessions) Cervical retraction exercises (at least 50% of the sessions)
Exercise and conditioning	The listed interventions must *both* be received in at least 50% of the sessions.	Strengthening exercises for the upper-quarter muscles Strengthening exercises for the neck or deep neck flexor muscles
Pain control	The listed interventions must *both* be received within the first 3 sessions; immobilization with a cervical collar or similar device cannot be used.	Cervical spine mobilization Cervical range-of-motion exercises
Headache	The listed interventions must *all* be received.	Cervical spine manipulation or mobilization Strengthening exercises for the deep neck flexor muscles Strengthening exercises for the upper-quarter muscles

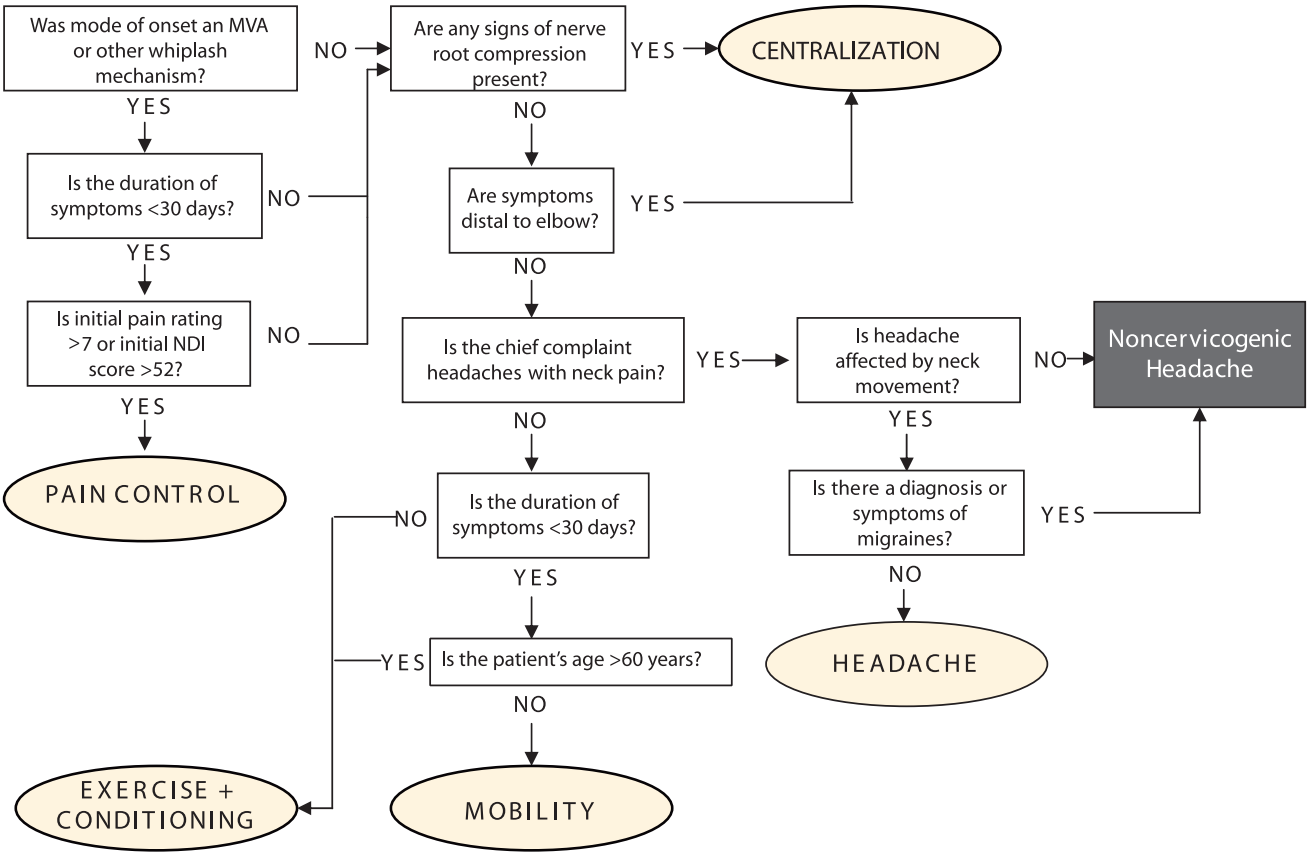

Figure.
Classification decision-making algorithm. MVA=motor vehicle accident, NDI=Neck Disability Index.

iarize the therapists with the standardized forms. The procedures used for examination items and the operational definitions of the interventions were reviewed. Interventions were discussed, but no explicit instruction in the classification process or clinical decision making was provided. The purpose of the training was to standardize data collection procedures, not to standardize treatment decision making.

Data collection was conducted from January to December 2004. During this period, all new patients who were determined by the physical therapists to have a primary complaint of neck pain were evaluated with the standardized form, and interventions were recorded with the standardized categories. No constraints were placed on the content or duration of treatment. After the completion of therapy, examination and intervention data were collected. For each patient, initial and final scores on the NDI and pain ratings and the number of physical therapy visits were obtained from the database.

Patient Classification

Using the proposed classification system, we developed an algorithm to prioritize the findings and place each patient into a classification category on the basis of variables from the baseline examination (Figure). A classification category was assigned for each patient by a reviewer who was unaware of the interventions used and the patient's clinical outcomes. A second reviewer, also unaware of the interventions and outcomes and unaware of the judgments of the first reviewer, classified a randomly selected subset of 50 patients to examine the interrater reliability of the classification algorithm.

Interventions

Prior to data collection, we defined the intervention components matched to each classification in the proposed system on the basis of current evidence when possible and standard practice when necessary (Tab. 2). For the mobility classification, evidence supported defining the matched components as manual therapy (manipulation or mobilization of the cervical or thoracic spine) and strengthening exercises for the deep neck flexor muscles.[26,27,49] Because we anticipated rapid improvement in this classifica-

tion, these interventions had to be received within the first 3 sessions. High-quality evidence is lacking in the literature for the centralization classification. Common practice includes either cervical traction or neck retraction exercises to promote centralization[24,50–54]; therefore, these interventions were considered matched components. More specifically, traction (manual or mechanical) had to be received in at least 50% of the sessions or retraction exercises had to be received in at least 50% of the sessions to be considered matched components.

On the basis of evidence regarding interventions for patients with chronic neck pain, strengthening exercises for both the upper-extremity muscles and the cervical or deep neck flexor muscles were considered matched components for the exercise and conditioning classification.[32,36,55,56] Each component had to be received in at least 50% of the sessions. For the pain control classification, cervical mobilization and ROM exercises for the cervical spine were supported by evidence[37–39] and were considered matched components. Because of the acute nature of the condition, each component had to be received within the first 3 sessions. For the headache classification, evidence supported cervical mobilization or manipulation and strengthening exercises for the upper-quarter and deep neck flexor muscles as matched components.[41,57] All 3 components had to be received to be considered matched.

To examine the interrater reliability of determining treatment matching, another reviewer, unaware of the judgments of the first reviewer, was provided with the interventions used for the randomly selected subset of 50 patients mentioned above. This additional reviewer rated the treatment procedures as being matched or not matched to the classification categories.

Data Analysis

To permit the evaluation of clinical outcomes, the analysis included only patients with at least 2 physical therapy visits. The interrater reliabilities of the classification algorithm and the treatment-matching criteria were examined by calculating percentage agreement and kappa coefficients with 95% confidence intervals (CIs) between the judgments of the first and second reviewers. Equal category weights were used in the calculation of the kappa coefficients.

Descriptive statistics were calculated for the baseline characteristics of each classification category, including, for continuous variables, means with standard deviations or medians with ranges of scores and, for categorical variables, frequencies and percentages. Differences among classification categories were examined by analysis of variance, Kruskal-Wallis, or Pearson chi-square tests as appropriate. Clinical outcomes were calculated for each patient by computing the amounts of change in pain rating and NDI scores. To examine the outcomes of the classification categories, we compared clinical outcomes, including the number of sessions, by using Kruskal-Wallis tests, and we compared changes in pain rating and NDI scores across classification categories by using analysis of covariance with the age, sex, and baseline scores of the dependent variables serving as covariates.

The interventions received by each patient were examined by an investigator unaware of the outcome of treatment. On the basis of the necessary components for each classification category (Tab. 3), each patient's treatment was categorized as being matched or not matched to the patient's classification. Treatment was categorized as being matched if each of the necessary components for the patient's classification was received over the course of treatment. We compared the numbers of sessions for patients receiving matched treatments and those receiving nonmatched treatments by using independent *t* tests. We compared clinical outcomes (changes in NDI and pain rating scores) by using separate analysis of covariance procedures with covariates of age, sex, duration of symptoms, classification category, and baseline score for the outcome measure. We also compared the proportions of patients in the matched and nonmatched groups achieving the minimum detectable change (MDC) for the NDI by using chi-square tests. The MDC represents the smallest amount of change in an outcome measure that likely reflects true change rather than measurement error alone.[58] The MDC for the NDI has been defined as 8 points.[47] We categorized any patient with a change score of 8 or greater as achieving the MDC, whereas patients with a change score of 8 or less were categorized as not achieving the MDC. For the examination of the MDC, we excluded patients with a baseline NDI score of less than 10%. We also calculated the clinical outcomes for patients receiving matched treatments and those receiving nonmatched treatments within each category, and we report these values descriptively. Statistical comparisons were not performed because of inadequate power.

Results

A total of 297 patients with neck pain were evaluated during the study. Fifteen patients received only 1 session and were not included in the analysis. Eight patients classified as having noncervicogenic headaches were not included, leaving 274 patients for analysis. The characteristics of these patients are shown in Table 3. Fifty patients (age [$\overline{X}\pm$SD]= 44.2±12.7 years; 78% women) were randomly selected for the interrater reliability analysis. The selected patients did not differ from the non-

Table 3.
Comparison of Baseline Characteristics Among Classification Categories

Characteristic[a]	All Subjects (n=274)	Mobility (n=48)	Centralization (n=95)	Exercise and Conditioning (n=90)	Pain Control (n=16)	Headache (n=25)
Age, y, $\bar{X}$ (SD)	44.4 (16.0)	37.0 (11.6)[b]	43.9 (13.7)[b]	50.5 (18.6)[c,d]	39.3 (16.2)	41.2 (14.2)
% Women	73.7	70.8	73.7	70.0	87.5	84.0
Symptom duration, median (range)	48 d (1 d–24 y)	14 d[b,d,e] (4–30 d)	78 d[c,f] (7 d–20 y)	120 d[c,e,f] (7 d–24 y)	11.5 d[b,d,e] (1–21 d)	45 d[b] (6 d–3 y)
% of subjects with prior history of neck pain	45.4	39.6	45.3	42.7	37.5	72.0
% of subjects reporting the following aggravating factor:						
Looking up (n=254)	44.9	37.8[f]	51.8	41.2[f]	68.8[b,c,e]	30.4[f]
Looking down (n=253)	48.6	51.1	52.9	40.5	62.5	47.8
Rotation (n=254)	66.8	62.2[f]	71.3[f]	62.4[f]	93.8[b,c,d,e]	56.5[f]
Overhead arm use (n=237)	35.0	24.4	48.8	23.1	68.8	22.7
Flexion ROM, °, $\bar{X}$ (SD) (n=259)	46.1 (15.1)	49.1 (14.9)[f]	45.9 (15.2)	46.0 (12.9)[f]	33.7 (17.8)[b,c,e]	48.7 (17.2)[f]
Extension ROM, °, $\bar{X}$ (SD) (n=260)	45.7 (16.5)	46.8 (17.3)[f]	46.3 (15.9)	46.1 (15.6)[f]	33.2 (21.8)[b,c,e]	48.2 (14.4)[f]
Total rotation ROM, °, $\bar{X}$ (SD) (n=261)	111.7 (31.5)	116.7 (29.3)[f]	113.9 (28.6)[f]	110.6 (31.2)[f]	83.0 (42.6)[b,c,d,e]	116.0 (31.9)[f]
Total side-bending ROM, °, $\bar{X}$ (SD) (n=260)	67.0 (22.0)[f]	71.0 (22.2)[f]	69.3 (19.3)	63.2 (22.3)[f]	51.9 (29.8)[b,c,e]	73.9 (20.2)[f]
% of subjects in whom symptoms increased with the following ROM (n=259):						
Flexion	50.8	45.7[f]	53.8	42.9[f]	80.0[b,c]	58.3
Extension	51.4	54.3[b,f]	57.1[b,f]	36.1[c,d,f]	86.7[b,c,d,e]	54.0[f]
Rotation	68.3	69.6	69.2	63.9[f]	93.3[b,e]	62.5[f]
Side bending	67.6	67.4	71.4	59.0[e]	66.7	83.3[b]
% of subjects showing peripheralization with the following ROM (n=259):						
Flexion	3.9	0[d]	11.0[b,c]	0[d]	0	0
Extension	5.8	0[d]	14.3[b,c,e]	2.4[d]	0	0[d]
Rotation	6.2	0[d]	15.4[b,c,e]	1.2[d]	6.7	0[d]
Side bending	4.6	0[d]	11.0[b,c]	2.4[d]	0	0

[a] ROM=range of motion.
[b] Significantly different from exercise group.
[c] Significantly different from mobility group.
[d] Significantly different from centralization group.
[e] Significantly different from headache group.
[f] Significantly different from pain control group.

Table 4.
Comparison of Clinical Outcomes Among Classification Categories[a]

Outcome	All Subjects (n=274)	Mobility (n=48)	Centralization (n=95)	Exercise and Conditioning (n=90)	Pain Control (n=16)	Headache (n=25)
No. of therapy visits	5.6 (3.7)	5.0 (3.4)[b]	5.7 (3.5)	5.7 (3.6)	8.2 (5.8)[c]	4.8 (2.6)
NDI (initial)	35.7 (17.0)	32.9 (13.8)[b]	37.6 (16.4)[b]	30.8 (15.5)[b]	63.8 (13.5)[c,d,e,f]	33.8 (15.1)[b]
Pain rating (initial)	5.2 (2.4)	4.9 (2.2)[b]	5.3 (2.5)[b]	4.8 (2.3)[b]	7.9 (1.5)[c,d,e,f]	5.3 (2.7)[b]
NDI (final)	23.2 (16.5)	18.2 (14.2)[b,d]	27.0 (17.8)[c,f]	19.5 (13.7)[b,d]	34.5 (20.9)[c,f]	24.4 (16.1)
Pain rating (final)	3.8 (2.8)	2.6 (2.1)	3.6 (2.6)	3.7 (2.3)	3.7 (2.3)	3.8 (2.8)
Change in NDI	12.7 (13.9)	15.0 (13.2)[d]	10.6 (12.5)[b,c]	11.3 (12.5)[b]	29.6 (21.0)[d,e,f]	10.4 (12.3)[b]
Change in pain rating	1.9 (2.5)	2.3 (2.2)[d]	1.7 (2.2)[b,c]	1.7 (2.6)	4.2 (2.6)[f]	1.5 (3.0)
% of subjects achieving minimum detectable change in NDI	60.9	66.7	60.0	56.7	81.3	56.0

[a] Data are reported as mean (SD) unless otherwise indicated. NDI=Neck Disability Index.
[b] Significantly different from pain control group.
[c] Significantly different from mobility group.
[d] Significantly different from centralization group.
[e] Significantly different from headache group.
[f] Significantly different from exercise group.

selected patients with respect to age, sex, baseline NDI and pain rating scores, duration of symptoms, or prior history of neck pain ($P>.05$). The percentage agreement between raters for classification judgments for these 50 patients was 96% (kappa=.95, 95% CI=0.87–1.0). One randomly selected patient was classified as having noncervicogenic headaches, leaving 49 patients for the examination of treatment-matching judgments. The percentage agreement between raters was 98% (kappa=.96, 95% CI=0.88–1.0).

The centralization category had the largest number of patients (n=95, 34.7%); next were the exercise and conditioning (n=90, 32.8%), mobility (n=48, 17.5%), headache (n=25, 9.1%), and pain control (n=16, 5.8%) categories. The baseline characteristics for these categories are shown in Tables 3 and 4. Patients in the exercise and conditioning category tended to be older and, along with those in the centralization cat-

Table 5.
Comparison of Baseline Characteristics and Clinical Outcomes for Patients Receiving Treatments Matched to Their Classifications and Patients Receiving Treatments Not Matched to Their Classifications[a]

Characteristic or Outcome	Patients Receiving Matched Treatments (n=113)	Patients Receiving Nonmatched Treatments (n=161)
Age, y, $\bar{X}$ (SD)	44.7 (15.2)	43.8 (16.5)
% women	74.3	73.3
Symptom duration, median (range)	46 d (1 d–24 y)	48 d (4 d–12 y)
% of subjects with prior history of neck pain	40.7	48.1
No. of therapy visits	6.3 (3.6)	5.2 (3.7)
NDI (initial)	37.8 (18.3)	34.4 (15.9)
Pain rating (initial)	5.2 (2.5)	5.2 (2.4)
NDI (final)	21.4 (16.4)[b]	24.4 (16.6)[b]
Pain rating (final)	2.8 (2.3)[b]	3.6 (2.5)[b]
Change in NDI[c]	16.4 (15.3)[b]	10.1 (12.2)[b]
Change in pain rating[c]	2.3 (2.6)[b]	1.6 (2.4)[b]
% of subjects achieving minimum detectable change in NDI	72.5[b]	53.8[b]

[a] Data are reported as mean (SD) unless otherwise indicated. NDI=Neck Disability Index.
[b] Significant difference between the groups ($P<.05$).
[c] Change scores were adjusted for age, sex, duration of symptoms, and baseline pain and disability scores.

Table 6.
Clinical Outcomes Within Each Classification Category for Patients Receiving Matched and Nonmatched Interventions[a]

Characteristic of Outcome	Mobility		Centralization		Exercise and Conditioning		Pain Control		Headache	
	Matched	Nonmatched	Matched	Nonmatched	Matched	Nonmatched	Matched	Nonmatched	Matched	Nonmatched
No. of patients	18	30	56	39	26	64	10	6	3	22
Age, y, $\overline{X}$ (SD)	38.8 (10.9)	35.9 (12.1)	44.6 (13.0)	43.0 (14.9)	53.0 (17.1)	49.5 (18.9)	38.4 (19.5)	40.8 (9.6)	33.0 (6.0)	40.4 (13.5)
% women	72.2	70.0	67.9	82.1	76.9	67.2	100	66.7	100	81.8
No. of therapy visits	4.9 (2.3)	5.0 (4.0)	6.0 (3.3)	5.4 (3.8)	6.0 (3.3)	5.4 (3.8)	9.6 (5.9)	5.8 (5.3)	5.0 (1.7)	4.8 (2.7)
NDI (initial)	34.1 (10.9)	32.2 (15.4)	37.7 (17.9)	37.4 (14.1)	29.7 (16.0)	31.3 (15.4)	65.0 (11.1)	61.8 (17.7)	33.0 (23.6)	34.0 (13.7)
Pain rating (initial)	5.1 (2.0)	4.7 (2.3)	5.0 (2.4)	5.7 (2.6)	4.1 (2.2)	5.0 (2.3)	8.2 (1.8)	7.3 (0.82)	5.3 (4.4)	5.3 (2.4)
NDI (final)	15.9 (11.7)	19.5 (15.5)	24.8 (18.0)	30.0 (17.2)	15.6 (12.4)	21.1 (14.0)	28.2 (18.0)	45.0 (22.6)	18.0 (17.4)	25.3 (16.1)
Pain rating (final)	2.1 (1.8)	2.9 (2.2)	3.2 (2.4)	4.2 (2.7)	2.7 (2.4)	3.3 (2.2)	2.9 (1.4)	5.0 (3.0)	2.0 (2.0)	4.1 (2.8)
Change in NDI[b] (95% CI)	18.6 (13.1, 24.1)	12.8 (8.5, 17.0)	13.5 (10.3, 16.6)	7.4 (3.4, 11.0)	15.0 (10.7, 19.2)	9.8 (7.1, 12.5)	36.9 (23.0, 50.9)	17.3 (−1.6, 36.2)	22.3 (6.2, 38.3)	8.8 (3.3, 14.4)
Change in pain rating[b] (95% CI)	3.0 (2.1, 3.9)	1.9 (1.2, 2.5)	2.0 (1.4, 2.5)	1.3 (0.66, 2.0)	2.0 (1.1, 2.8)	1.5 (1.0, 2.1)	5.3 (3.7, 6.9)	2.4 (0.23, 4.5)	4.2 (0.55, 7.8)	1.2 (−0.10, 2.4)
% of subjects achieving minimum detectable change in NDI	66.7	66.7	71.4	43.6	61.5	54.7	90.0	66.7	100	50.0

[a] Data are reported as mean (SD) unless otherwise indicated. CI=confidence interval, NDI=Neck Disability Index.
[b] Change scores were adjusted for age, sex, duration of symptoms, and baseline pain and disability scores.

egory, had longer symptom durations. Patients in the pain control category had less ROM and were more likely to experience symptom aggravation with ROM. Patients in the centralization category were most likely to experience peripheralization with ROM. Patients in the pain control category had higher baseline NDI and pain rating scores (Tab. 4). Patients in the centralization category experienced fewer changes in NDI and pain rating scores than those in the mobility and pain control categories.

Overall, 113 patients (41.2%) received interventions that were matched to the prespecified treatment components, whereas 161 (58.8%) received nonmatched interventions. The pain control category had the highest percentage of patients receiving matched interventions (62.5%); next were the centralization (58.9%), mobility (37.5%), exercise and conditioning (28.9%), and headache (12.0%) categories. There were no baseline differences between patients receiving matched interventions and patients receiving nonmatched interventions for age, sex, duration of symptoms, and NDI and pain rating scores (Tab. 5). After adjustment for all covariates, patients receiving matched interventions showed greater changes in both NDI scores (mean difference for adjusted scores=5.6, 95% CI=2.6–8.6) and pain rating scores (mean difference for adjusted scores=0.74, 95% CI=0.21–1.3) (Tab. 5). Nine patients (4 receiving matched interventions and 5 receiving nonmatched interventions) had baseline NDI scores of less than 10% and were excluded from the examination of achieving the MDC for the NDI. Among patients receiving matched interventions, 72.5% achieved the MDC; in comparison, 53.8% of patients receiving nonmatched interventions did so (P=.002). Descriptive information for patients receiving matched and nonmatched interventions within each classification category is shown in Table 6.

Discussion

Physical therapists working in outpatient settings frequently treat patients with neck pain.[59] The prognosis for neck pain is not consistently good, with many people experiencing persistent pain and disability,[60] even with physical therapy intervention.[3,61] Experience with the treatment of patients with low back pain has shown that developing guidelines for classifying patients into smaller subgroups based on clinical characteristics and matching these classifications to management strategies likely to benefit them can improve the outcomes of care provided by physical therapists.[18,20,21] Classification strategies also can increase the power of clinical research,[19] enhancing efforts to develop evidence that can favorably affect clinical practice by identifying evidence-based practice patterns for particular subgroups of patients.[62]

Developing a classification structure requires the consideration of numerous attributes. Classification categories that are both mutually exclusive and comprehensive must be described. Although aspects of a patient's clinical presentation typically can fit several categories, a useful classification system must be able to prioritize these findings to permit physical therapists to make clinical decisions and researchers to define homogeneous subgroups for future studies. In this article, we have described specific criteria for membership within each classification category and a decision-making algorithm to prioritize these criteria (Figure). Using our mostly clinical experience, we prioritized findings associated with the pain control classification first and findings associated with the centralization classification next. The results of the present study showed that the decision-making algorithm could be applied consistently by different examiners considering the same patient data (kappa value for interrater agreement=.95), but only additional research can evaluate and refine the algorithm so that it results in the best outcomes for patients. Additional research is also necessary to further examine the overall reliability of the classification system, not just the proposed algorithm.

In order to maximize clinical utility, classification systems need to be as comprehensive as possible. The system examined in the present study primarily addresses patients with neck pain and associated symptoms (eg, headache and upper-extremity symptoms) believed to be attributable to dysfunctions of the cervical spine. The decision-making process for screening patients for nonmechanical etiologies is not addressed in this system. Patients with neck pain referred from other structures (eg, temporomandibular joint) are not considered in this system. For patients with neck pain and associated symptoms, the system is designed to assign a specific category to each patient. The literature supports the notions that distinctions between patients with acute symptoms and patients with chronic symptoms[63,64] and between patients with and patients without signs and symptoms associated with nerve root compression[65] are important for treatment decision making. Patients with acute, traumatic onset (eg, whiplash injury)[66] and those with headache as a predominant symptom[41] also may represent distinct categories of patients. Further research is needed to determine whether additional subgroups should be added to the system.

Ultimately, the most important attribute of a classification system is its

ability to improve patient outcomes when it is used for treatment decision making in clinical practice. Research must demonstrate that outcomes are better when patients receive interventions matched to their classifications than when they receive nonmatched interventions. The design of the present study does not permit any conclusions about the effectiveness of this system for improving clinical outcomes to be drawn. The necessary research design to eventually document the superiority of any decision-making system is a randomized trial.[67] In the present study, we used a prospective, observational design as a preliminary step toward this end. The results of the present study showed an association between receiving matched treatments and experiencing greater reductions in pain and disability. These findings encourage further research examining the effect of classification methods on clinical outcomes for patients with neck pain.

We examined the overall clinical outcomes of patients receiving treatments that were judged to be matched or not matched to their classifications. Because of the small numbers of patients in some classifications, we did not separately examine the association between clinical outcomes and receiving matched treatments within each classification category. The intent of a classification system is to define combinations of treatments that uniquely benefit patients with certain characteristics. If all patients with neck pain are equally likely to receive benefit from the same combinations of treatments, then classification becomes unnecessary. Further research is needed to examine the relationship between clinical outcomes and receiving matched treatments within each classification category.

The most common classification among the patients in the present study was centralization. This classification was identified by the presence of signs of nerve root compression or symptoms distal to the elbow. Patients in this classification also were more likely to show peripheralization with active ROM at the baseline examination, a finding that may be useful to consider as a classification criterion for this subgroup of patients. Overall, this classification was associated with fewer changes in NDI and pain rating scores than other classifications, a finding that is consistent with the poorer prognosis reported for people with radicular findings in other reports.[14,68] The exercise and conditioning classification was the second most common classification and had the second lowest rate of matched interventions. The exercise and conditioning classification includes older patients with more chronic symptoms than the other classifications. Matched interventions, as indicated by evidence in the literature, focus on strengthening the upper-quarter and cervical muscles. The low rate of matched interventions in this classification may indicate a tendency for therapists not to emphasize strengthening in this subgroup of patients. Patients in the mobility classification tended to experience the most change in pain and disability, consistent with literature supporting a better prognosis for patients with acute neck pain but without radicular symptoms.[11,14]

Fewer patients were classified into the headache or pain control classifications. In the headache classification, very few patients received matched interventions (deep neck flexor strengthening, cervical spine manipulation or mobilization, and upper-extremity strengthening). As indicated above, this finding may represent a tendency among the therapists participating in this project not to emphasize strengthening interventions. As expected, patients in the pain control classification reported more pain and disability and greater ROM restrictions, were more likely to report aggravation of symptoms with various movements than patients in other classifications at baseline, and reported the most change in pain and disability with treatment.

The design of the present study has several limitations and potential for bias in the results. Patients were not randomly assigned to receive matched or nonmatched treatments. Despite statistical control for baseline variables such as age, sex, duration of symptoms, and baseline pain or disability scores, important disparities between patients receiving matched treatments and patients receiving nonmatched treatments within each classification may have contributed to the observed differences. Therefore, the present study cannot provide evidence for the predictive validity of the proposed system. Only a study randomizing patients to receive matched or nonmatched treatments could provide such evidence.

Another limitation is the lack of standardization of the intervention procedures. It was left to the physical therapists in the present study to categorize the interventions that were provided. There were likely a wide variety of specific procedures included within many of the categories, such as upper-extremity strengthening exercises. We attempted to record only the basic category of each treatment, not specific techniques or parameters. We did not record the dosage or intensity of exercise or the specific manual techniques used. On the basis of research on patients with low back pain suggesting better outcomes with more standardized interventions than with therapist-selected interventions,[69] we believe that the presence of associa-

tions between categories of treatment and outcomes for subgroups of patients in the present study suggests the potential for the identification of even greater treatment effects in future research with more specific and standardized interventions. Further research is required to determine the critical parameters needed within a treatment category to standardize interventions for the purpose of achieving optimal outcomes.

Conclusion

Developing classification strategies for patients receiving physical therapy interventions for neck pain is an important priority considering the frequency with which such patients are treated by physical therapists. In the present study, we examined a previously proposed treatment-based classification system for patients receiving physical therapy interventions for neck pain. We found associations between receiving interventions matched to the system and better clinical outcomes. These preliminary results suggest opportunities for further research.

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