Pain pattern classification and directional preference for patients with neck pain

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ABSTRACT

Objectives: Pain Pattern Classification (PPC) and Directional Preference (DP) have been shown to be predictive of health care outcomes and serve to guide orthopedic clinical decision making. We conducted a prospective, observational cohort study to verify the association between PPC, DP, and clinical outcomes.

Methods: Clinical outcome measures including pain intensity and disability were completed at first examination and follow-up by 335 patients. A Pearson's chi-squared test was used to determine differences in prevalence rates for the categorical variables, and two-sample t-tests were used to determine differences in rates for the continuous variables. A Tukey's range test was used to determine differences in follow-up pain intensity and disability for neck pain dual-classification schemes.

Results: The prevalence of DP was 82.4%. The prevalence of CEN, Non-CEN, and Non-Classifiable (NC) was 15.2%, 42.1%, and 25.1%, respectively. The prevalence of DP was lowest for patients with sub-acute symptoms and who were <45 years old. Patients classified as DP CEN had, on average 2.62 NDI units less than patients classified as Non-DP. Patients classified as DP CEN had, on average, 0.90 pain intensity units less than patients classified as Non-DP at follow-up. Patients who demonstrated DP CEN did not have clinically significant lower pain intensity or disability at follow-up than patients who demonstrated Non-DP.

Discussion: The results of this investigation need to be interpreted with caution with respect to the study design and its subsequent strengths and limitations.

Level of Evidence: 1b.

KEYWORDS

Cervical spine; neck pain; centralization; directional preference; McKenzie; practice-based evidence; orthopedic; musculoskeletal

Introduction

The high incidence, prevalence, and cost of neck pain are causing a human and economic toll [1,2]. In response to this challenge, health care providers are interested in improving condition management strategies for patients with neck pain. Research has suggested that matching diagnostic sub-groups to classification-based management strategies could lead to improved clinical, humanistic, and cost-related outcomes [3–6].

Two proposed classification methods for patients with neck pain are PPC and DP [7]. The use of PPC requires a standardized, operational definition of CEN. CEN and DP have been examined previously in relation to low back pain [8–11] and neck pain [7,10] and have been shown to provide a framework for predicting musculoskeletal outcomes. However, many previous studies have not employed a standardized, operational definition of CEN and DP, which may be influencing the broad range of prevalence and predictability findings.

Based on the principles of Mechanical Diagnosis and Therapy (MDT) [5], PPC and DP are established through a cause and effect assessment process whereby a provider monitors the symptomatic and mechanical effects of repeated and/or sustained unidirectional, end-range movements. These strategies attempt to elicit changes in symptom intensity, symptom location, and/or mechanical effects which establish classification, guide clinical decision-making, and inform prognosis [5].

The prevalence and predictive ability of PPC and DP by way of a standardized definition and their association with musculoskeletal outcomes has only been investigated once for patients with neck pain [7]. No other investigations have attempted to verify these findings. The purpose of this study is to verify the association between dual-classification schemes and clinical outcomes for patients with neck pain using a strict, operational definition of PPC by Werneke et al. [6] and an expanded definition of DP. We hypothesize that (1)

Figure 1. Flow of participants entering and included in the study.

patients who demonstrate DP CEN will have lower pain intensity and disability at follow-up than patients who demonstrate non-DP non-CEN, and (2) the prevalence of DP at first examination will be lowest for patients that have chronic neck pain and are greater than 65 years old.

Methodology

We conducted a prospective, observational cohort study. We analyzed data collected from 614 consecutive patients who presented to outpatient, private practice clinics with primary complaints of non-specific neck pain (see Figure 1). The TBD Institutional Review Board for Protection of Human Subjects and the TBD Institutional Review Board for Protection of Human Subjects approved the project. This study did not include any change in routine clinical practice, and patient informed consent was not required for the analysis and reporting of data.

Ten providers participated in the study (mean age: 39 years, range: 27–64; 30% females; mean years of clinical experience: 13.5). All providers participated throughout five private practice, outpatient orthopedic settings in Florida, Alabama, Oklahoma, South Carolina, and New York. Six providers were certified in MDT and four held their diploma in MDT. Two providers were Board Certified Orthopedic Clinical Specialists. All providers attained, at least, a bachelor's degree in physical therapy and four held their Doctor of Physical Therapy. Patients were included in the study by the managing provider if they presented with complaints of non-specific neck pain with or without radiation into the upper extremities. Patients were excluded from the study if they had cervical spine surgery within the preceding 12 months. Providers collected data from patients throughout the study period (February 2014–July 2015). However, not all providers collected data through the study period; two providers were unable to continue data collection after April 2014 and a third after February 2015.

Providers collected patient self-reported outcome data and clinically examined responses at first examination, regularly throughout the care episode, and at discharge. The managing providers were responsible for determining and reporting inclusion, exclusion and discharge status. Two primary patient-reported outcomes were assessed: pain intensity and patient self-reported disability via the Numeric Pain Rating Scale (NPRS) and the Neck Disability Index (NDI), respectively. Pain intensity reported by the patient within 'the last few days' was assessed using an 11-point NPRS ranging from 0 ('No pain') to 10 ('Worst Pain Imaginable'). The NPRS has been shown to be reliable and valid [13,14] with a minimal detectable improvement of 4.1 points in patients with cervical radiculopathy [14]. The NDI is a patient self-report questionnaire for neck pain and is scored by initially calculating the score of each item (0–5-point scale), then summing all ten items. The score ranges from 0 to 50 with higher number indicating higher levels of disability. Stratford et al. reported a minimally important change in the NDI score of 5 points (out of 50) [15]. The NDI has been shown to be an acceptable clinical measure for patients with non-specific neck pain [13].

Two primary physical examination variables were collected at first examination: PPC and DP. PPC consisted of three categories: CEN, non-CEN, and NC. The finding of non-CEN includes patients whose resting symptoms do not move proximally toward the midline of the spine, do not change, or move distally away from the spine during examination. The finding of NC consists of patients who do not have symptoms at rest during the beginning of the physical examination. Patients' neck pain complaints were categorized into one of the three classification schemes by quantifying observed changes in the patient's symptom location during the physical examination as described by Werneke et al. [6]. Patients were asked to indicate the location of their symptoms, in a sitting position, by shading on a body diagram before and after physical examination testing. Providers determined and recorded the patient's neck pain PPC via an overlay template. Patients' neck pain was classified by the managing providers as having DP at first examination if it exhibited any of the following: (1) CEN, (2) a decrease in the patient's most relevant distal pain by at least two pain intensity units, (3) an increase in cervical spine range of motion via a bubble inclinometer, (4) patient reported improvement in their spinal range of motion (e.g. patients often stated 'it feels better'), (5) improvement in the patient's neurological signs (i.e. improvement in abnormal hypotonic or hypertonic upper extremity reflexes by $\geq$ one grade, upper extremity myotomes by $\geq$ one manual muscle test grade, sitting and/or supine upper limb tension tests by patient reported reduction in concordant symptoms, and/or upper extremity dermatomes by $\geq$ one grade), and (6) improvement in a patient's reported pain with a specific

functional task by at least two pain intensity units (e.g. turning head to look over shoulder, reaching overhead, or other functional based cervical spine, and/or upper extremity movement).

For measurement of cervical spine range of motion in flexion and extension, the inclinometer was placed on top of the patient's head aligned with external auditory meatus and then zeroed. Before and after repeated movement testing, the patient was asked to flex the head as far as possible, bringing the chin to the chest. The amount of cervical spine flexion was recorded. The patient was then asked to extend their head backward as far as possible. The amount of cervical spine extension was then recorded. If relevant to the patient's clinical presentation, a standard neurological examination was conducted. Upper extremity myotomes, dermatomes, reflexes, and tension tests were assessed before and after repeated movement testing. Myotomes and dermatomes were graded via the criteria set by the American Spinal Injury Association (ASIA) and reflex testing was graded via 0 = no response (always abnormal), 1+ = a slight but definitely present response (may or may not be normal), 2+ = a brisk response (normal), 3+ = a very brisk response (may or may not be normal), and 4+ = a tap elicits a repeating reflex or clonus) (always abnormal).

The following upper extremity myotomes were assessed: C5 – Elbow flexors (Biceps, Brachialis), C6 – Wrist extensors (Extensor Carpi Radialis Longus and Brevis), C7 – Elbow extensors (Triceps), C8 – Finger flexors (Flexor Digitorum Profundus) to the middle finger, and T1 – Small finger abductors (Abductor Digiti Minimi). The following upper extremity dermatomes were assessed via light touch: C2 – At least 1 cm lateral to the occipital protuberance (alternatively 3 cm behind the ear), C3 – Supraclavicular Fossa (posterior to the Clavicle) and at the midclavicular line, C4 – Over the Acromioclavicular Joint, C5 – Lateral (radial) side of the Antecubital Fossa (just proximal to elbow crease), C6 – Thumb, dorsal surface, Proximal Phalanx, C7 – Middle finger, dorsal surface, Proximal Phalanx, C8 – Little finger, dorsal surface, Proximal Phalanx, and T1 – Medial (ulnar) side of the Antecubital Fossa, just proximal to the Medial Epicondyle of the Humerus. The following upper extremity reflexes were assessed via a standard reflex hammer: Muscle stretch reflexes of the Biceps (C5–C6), Brachioradialis (C5–C6), and Triceps (C7). Upper limb tension was assessed via Elvey's Upper Limb Tension Test with a median nerve bias.

Patient characteristics were collected at first examination by the managing providers through patient self-report methods. The following continuous variables were measured: Age, Medication for Condition, Symptom Acuity, Previous Surgery, Fear-Avoidance Beliefs at first examination, pain intensity at first examination, NDI at first examination, and Number of Comorbid Conditions. The following categorical variables were measured:

Gender, Facility, Provider, Previous History of Condition, Imaging, Payer, Exercise History, and Referral Type.

Patient-reported outcomes and physical examination data were collected by the managing provider at first examination, regularly throughout the care episode, and at discharge through patient self-report and provider-reported methods. Patients were asked to complete self-report measures (i.e. the NPRS and the NDI) immediately before the first examination, at regular intervals determined by the managing provider immediately after follow-up examinations, and then at discharge.

Our primary aim was to analyze the association between DP CEN and non-DP non-CEN, and report the prevalence of classification groups. The dual-classification schemes recommended by Werneke et al. [6,8] were as follows: (1) DP CEN, (2) DP non-CEN, (3) DP NC, (4) non-DP non-CEN, and (5) non-DP NC. To determine prevalence rates, we used Pearson's chi-squared tests to determine differences in prevalence rates for the categorical variables, and used two-sample t-tests for the continuous variables. We applied the Bonferroni correction for significant *p*-values to avoid type 1 error. To determine differences in follow-up pain intensity and disability, we used Tukey's range test (i.e. one of the pairwise comparison methodologies) for patients who were classified as DP CEN, DP non-CEN, DP NC, non-DP non-CEN, and non-DP NC at first examination. We utilized a multiple regression methodology to investigate DP prevalence considering Age, Gender, Facility, Provider, Symptom Acuity, Medication for Condition, Previous History, Imaging, Previous Surgery, Number of Comorbid Conditions, Payer, Exercise History, Referral Type, NDI at first examination, Fear-Avoidance Beliefs at first examination, and pain intensity at first examination.

Prior to the start of the study, participating providers and supporting administrative personnel received three, one-hour training sessions regarding data collection and management practices. Providers were advised to review a standard operating procedure developed by our research network. The document included detailed instructions on study procedures, operational definitions of the constructs being measured, and sample case study vignettes. Providers in the study were advised to use scripted introductions and standardized procedures when administering self-report questionnaires and physical examination tests.

Results

Six hundred and forty-one consecutive patients entered the clinic during the study period. Forty-four patients did not start data collection resulting in a participation rate of 92.8%. Reasons for not commencing data collection included: Late for Appointment (25.6%). Other (23.3%), Seen on a Single Occasion and Provided with a HEP Only (18.6%), Cognitive Deficits (16.3%), Contraindication and

Table 1. Patient characteristics.

Characteristics	First examination only (<i>n</i> = 235)	First examination and follow-up data (<i>n</i> = 335)
Age (y)	49.6 ± 14.9 (12–89)	52.0 ± 15.9 (13–91)
Missing	0.4%	0.0%
Gender		
Male	32.8%	38.2%
Female	66.8%	61.8%
Missing	0.4%	0.0%
Symptom acuity		
Acute (0–2 weeks)	17.9%	21.2%
Sub-acute (3–11 weeks)	29.4%	30.4%
Chronic (≥12 weeks)	51.1%	46.9%
Missing	1.7%	1.5%
Surgical history		
None	93.2%	93.7%
1 or more	3.4%	5.4%
Missing	3.4%	0.9%
Medication for condition		
None	45.5%	46.0%
1 or more	53.6%	53.4%
Missing	0.8%	0.6%
Imaging		
None	49.8%	45.7%
1	36.6%	40.0%
2 or more	12.3%	13.7%
Missing	1.3%	0.6%
Exercise history		
1 or 2 times per week	26.0%	27.5%
At least 3 times per week	39.1%	37.3%
Seldom or not at all	31.1%	33.1%
Missing	3.8%	2.1%
Referral type		
Primary care	53.6%	57.0%
Specialist	17.0%	13.1%
Self	6.4%	8.4%
Other	22.1%	21.2%
Missing	0.9%	0.3%
Number of comorbid conditions		
None	26.0%	23.0%
1	24.3%	25.4%
2 or 3	29.8%	33.4%
4 or more	14.5%	15.8%
Missing	5.5%	2.4%
Payer		
Auto	3.0%	7.8%
Health maintenance organization (HMO)	80.0%	54.6%
Medicaid	0.4%	0.0%
Medicare Part B	1.7%	4.8%
Patient private pay	0.4%	0.0%
Preferred provider organization (PPO)	13.2%	30.5%
Workers' compensation	0.0%	1.2%
Other	1.3%	1.2%
Missing	0.4%	0.0%
Fear-avoidance beliefs		
High fear	35.3%	37.3%
Low fear	54.9%	56.7%
Missing	9.8%	6.0%
NDI first examination	14.6 ± 7.3 (1–38)	13.4 ± 7.4 (0–43)
Missing	10.6%	10.4%
Pain intensity first examination	5.2 ± 2.4 (0–10)	5.1 ± 2.3 (0–10)
Missing	3.4%	2.1%

Referred Back to Physician/Specialist (4.7%), Refused (4.7%), Out of Paperwork (4.7%), and Blind or Impaired Vision (2.3%). The characteristics of the study participants are displayed in Table 1.

Table 2. Prevalence of directional preference and pain pattern at first examination (*n* = 335).

	CEN, %	NC, %	Non-CEN, %	Missing, %	Total, %
DP	14.9	21.5	34.0	11.9	82.4
Non-DP	0.0	2.7	6.6	2.4	11.6
Missing	0.3	0.9	1.5	3.3	6.0
Total	15.2	25.1	42.1	17.6	100.0

Table 3. Prevalence of directional preference and pain pattern vs. acuity (*n* = 335).

	Acute, %	Sub-acute, %	Chronic, %
DP	69.0	66.7	73.2
DP & Cen	18.3	15.7	13.4
DP & NC	15.5	24.5	21.7
DP & Non-Cen	35.2	26.5	38.2
Non-DP	15.5	10.8	10.8
Missing	15.5	22.5	15.9

Notes: *p*-value = 0.46 utilizing a chi-squared analysis to determine if the prevalence of the DP and PPC groupings stayed consistent between for each category (i.e. acute, sub-acute, and chronic).

Values are proportions (percent) of patients or prevalence rates (95% confidence interval).

Compared to patients with first examination and follow-up data (*n* = 335; 58.8% completion rate), patients with first examination data only (*n* = 235) had a higher prevalence of PPO health insurance and a lower prevalence of HMO health insurance ($\chi^2 = 45.74$, *df* = 7, *p*-value = 0.0000). Reasons for not completing follow-up data collection were: Lost to Follow-Up (91.1%), Other (4.7%), Insurance Coverage (1.7%), Unrelated Medical Problems (1.3%), Late for Appointment (0.9%), and Increased Pain (0.4%).

We converted the following continuous variables to categories: Age – <45 y, 45–65 y, and >65 y; Symptom Acuity – Acute (0–2 weeks), Sub-Acute (3–11 weeks), and Chronic (≥12 weeks); Surgical History – None and 1 or More; Medication for Condition – None and 1 or More; Number of Comorbid Conditions – None, 1, 2 or 3, and 4 or More; Imaging – None, 1, and 2 or More; Fear-Avoidance Beliefs – Low Fear (<14) and High Fear (≥14).

Dual-classification schemes were categorized as follows: DP CEN, DP non-CEN, DP NC, non-DP non-CEN, and non-DP NC. The prevalence of DP was 82.4%. The prevalence of CEN, non-CEN, and NC was 15.2, 42.1, and 25.1%, respectively (see Table 2). The prevalence of DP was lowest for patients with sub-acute symptoms and who were <45 years old (see Tables 3 and 4).

We analyzed the effect of PPC and DP on disability and pain intensity at follow-up. Due to low prevalence data, we converted non-DP non-CEN and non-DP NC into one classification category, non-DP. Patients classified as DP CEN had, on average 2.62 NDI units less than patients classified as non-DP (see Table 5). Patients classified as DP CEN had, on average, 0.90 pain intensity units less than patients classified as non-DP at follow-up (see Table 6). Patients who demonstrated DP CEN did not have clinically significant lower disability or pain

Table 4. Prevalence of directional preference and pain pattern vs. age ($n = 335$).

	<45 y, %	45–65 y, %	>65 y, %
DP	66.0	71.4	75.0
DP & Cen	15.1	15.5	13.2
DP & NC	19.8	21.7	23.5
DP & Non-Cen	31.1	34.2	38.2
Non-DP	14.2	11.8	7.4
Missing	19.8	16.8	17.6

Notes: χ^2 p -value = 0.85.

Values are proportions (percent) of patients or prevalence rates (95% confidence interval).

Table 5. Follow-up neck disability index pair comparison ($n = 335$).

Comparison group	Reference group	Mean difference	95% CI	p -value
DP & NC	DP & Cen	0.29	[−2.53, 3.10]	0.99
DP & Non-Cen	DP & Cen	3.23	[0.65, 5.82]	0.01
Non-DP	DP & Cen	2.62	[−0.76, 6.00]	0.19
DP & Non-Cen	DP & NC	2.95	[0.69, 5.21]	0.00
Non-DP	DP & NC	2.33	[−0.80, 5.47]	0.22
Non-DP	DP & Non-Cen	−0.61	[−3.55, 2.32]	0.95

Note: The Mean Difference was calculated by subtracting the mean change in NDI score from first examination to follow-up for the Comparison Group from the mean change in NDI score from first examination to follow-up for the Reference Group (Reference Group mean change minus Comparison Group mean change = Mean Difference).

intensity at follow-up than patients who demonstrated

Table 6. Follow-up pain intensity index pair comparison ($n = 335$).

Comparison group	Reference group	Mean difference	95% CI	p -value
DP & NC	DP & Cen	0.24	[−0.72, 1.19]	0.92
DP & Non-Cen	DP & Cen	0.82	[−0.06, 1.71]	0.08
Non-DP	DP & Cen	0.90	[−0.23, 2.03]	0.17
DP & Non-Cen	DP & NC	0.59	[−0.19, 1.36]	0.21
Non-DP	DP & NC	0.66	[−0.38, 1.71]	0.36
Non-DP	DP & Non-Cen	0.08	[−0.90, 1.06]	1.00

Note: The Mean Difference was calculated by subtracting the mean change in NPRS score from first examination to follow-up for the Comparison Group from the mean change in NPRS score from first examination to follow-up for the Reference Group (Reference Group mean change minus Comparison Group mean change = Mean Difference).

non-DP. The average time to discharge for patients with DP CEN and non-DP was 26.3 and 30.4 days, respectively.

Discussion

Our primary findings in this investigation were that (1) patients who demonstrated DP CEN did not have clinically significant lower pain intensity and disability at follow-up than patients who demonstrated non-DP, and (2) DP prevalence was lowest for patients with sub-acute symptoms and who were <45 years old. This study aimed to corroborate a previous investigation which sought to determine if classifying patients into specific sub-groups via a standardized, operational definition of CEN and DP was associated with clinical outcomes.

We found a low prevalence rate for the overall non-DP non-CEN and non-DP NC categories and subsequently modified our classification schema to (1) DP CEN, (2) DP non-CEN, (3) DP NC, and (4) non-DP. The prevalence of CEN in previous reports has ranged between approximately 20 and 40% for patients with neck pain [6,16,17]. However, these prevalence rates may be influenced by the lack of a standardized, operational definition of CEN. In this investigation, the prevalence rate of CEN was considerably lower (15.2%). However, one major difference between our study and a previous study by Edmonds et al. [7], which utilized a standardized definition of CEN, was that we included the NC classification. Omitting all patients without pain at rest would increase the prevalence of CEN. Other factors which may have affected the lower prevalence of CEN include differences in populations studied and variations in training levels of the providers. Training level may have played a role in a provider's ability to elicit CEN across a broad patient population, although this needs to be further studied.

We hypothesized that the prevalence of DP would be lower in older patients (>65 years old) with chronic symptoms (≥ 12 weeks). We found that DP was more prevalent in patients with chronic symptoms. Previous research has shown DP to be more prevalent in patients with acute symptoms, which contradicts our findings [7]. Similar to previous research, we found that DP was not associated with age. Due to the lack of consistent and significant findings, these results support the notion that the current operational definition of DP may be limited and in need of further investigation. A future investigation reporting the prevalence and predictive ability of individual and clustered DP constructs and their association with clinical outcomes is warranted.

We believe that the high prevalence and low predictive ability of DP stem from the operational definition of DP. Certain DP constructs may be more prevalent and less predictive of clinical outcomes than other DP constructs. Since a patient's condition only needed to exhibit one DP construct in order to be classified into the DP category, the DP category may have been excessively inflated. A future study which examines these individual DP constructs may verify the validity of this hypothesis. No studies to date have examined the individual DP constructs for patients with neck pain. Another potential reason for the high prevalence of DP may have been some ambiguity in the interpretation of certain DP constructs. For example, a positive change in range of motion is enough to warrant a patient being included in the DP group, but the exact magnitude of the necessary range of motion change has not been established. We did not instruct the clinicians to consider the standard error of measurement with bubble inclinometry and the patient's condition was included in the DP group if it demonstrated a one-degree improvement in cervical range of motion. A future study should record the magnitude of this change and consider the standard error of

measurement when determining the effect on classification and clinical outcomes.

We also hypothesized that patients classified as DP CEN would have lower pain intensity and disability at follow-up than patients who demonstrated non-DP non-CEN. We were unable to find significant differences in these domains between the groups. The lack of a clinically meaningful difference in pain intensity between these groups verifies the findings of a previous report which concluded that DP- and CEN-based categories were not predictive of pain intensity outcomes for patients with neck pain [7]. However, in regards to patient self-reported changes in disability, our findings do not coincide with this previous report which found that DP CEN had greater improvements in disability at follow-up than patients who demonstrated non-DP non-CEN. This was an unexplained finding and further studies should consider the limitations of our approach and make modifications to the analysis and reporting of data.

This study has several limitations in regard to data acquisition and study design. Although the participating clinicians were instructed to collect DP and CEN data on all patients, DP data on 11.9% of patients and PPC data on 17.6% of patients were missing. Additionally, as per protocol, participating providers were encouraged to collect data immediately before the first examination, at regular intervals determined by the managing provider immediately after follow-up examinations, and then at discharge. The length of time between collection of first examination data and follow-up data was not standardized. Future studies should consider assessing clinical outcomes at several different intervals of time during the care episode. For example, patients classified and treated as DP CEN may produce more rapid and significant improvements in clinical outcomes during the first week of treatment, whereas non-DP non-CEN may only produce similar improvements over a longer duration of treatment. These findings could provide insight into understanding the typical clinical trajectory of these diagnostic subgroups. Our study is unable to determine a difference in clinical outcomes when measuring outcomes utilizing a more discretionary, and arguably more generalizable, collection approach and future studies should consider studying PPC and DP associations and outcomes during short-, medium-, and long-term time periods.

It is not uncommon that sub-group classification categories change over time and future studies need to consider change in PPC and DP classification and the related effect on clinical outcomes. Our investigation did not consider change in classification on subsequent visits. Patients initially classified as non-DP non-CEN may have been reclassified to more favorable classification category which could be influencing their improvements relative to DP and CEN. Furthermore, we did not report the initial pain intensity and disability at first examination for each sub-group. To make more clinically meaningful

interpretations, further studies should consider reporting pain intensity and disability magnitude of change as well as baseline values. We included an improvement in cervical spine range of motion as a determinant of the presence of DP during the physical examination without consideration of the standard error of measurement of cervical spine bubble inclinometry. Future studies should consider the standard error of measurement when using change in cervical spine range of motion as a determinant for the presence or absence of DP.

Conclusion

Our primary findings suggest that (1) patients who demonstrated DP CEN did not have a clinically significant lower pain intensity and disability at follow-up than patients who demonstrated non-DP, and (2) DP prevalence was lowest for patients with sub-acute symptoms and who were <45 years old. This investigation provides insight into the benefits and opportunities for improvement of this study design approach. To better understand the clinical trajectory of these diagnostic sub-groups, further investigations should consider associating classification categories with outcomes at short-, medium-, and long-term time points as well as assessing the stability of PPC and DP after first examination and its association with outcome.

Contributors

RJY conceived and designed the study, obtained funded and ethics approval, analyzed the data, wrote the article in whole/part, and revised the article. MT analyzed and reported the data. MW collected and analyzed the data, and wrote the article in part. JT collected and analyzed the data.

Disclosure statement

No potential conflict of interest was reported by the authors.

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