

## ORIGINAL RESEARCH

# Pain Drawing in the Assessment of Neurogenic Pain and Dysfunction in the Neck/Shoulder Region: Inter-Examiner Reliability and Concordance with Clinical Examination

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### ABSTRACT

**Background.** The pain drawing (PD) has proven to have good inter-examiner reliability and high sensitivity in assessing neurogenic pain and dysfunction (NP) originating from the lower back. Studies on its use in the neck/shoulder region have not been found.

**Objectives.** To investigate inter-examiner reliability of a first impression assessment of NP in the neck/shoulder region using a simplified PD made by the patient. Also, to investigate concordance between first impression assessment and a final assessment based on a complete clinical examination.

**Design.** A clinical trial on 50 primary care patients with discomfort in the neck/shoulder region assessed by two independent examiners. One examiner was experienced in assessing the PD and the other was not. A first impression assessment was based solely on the PD. A final assessment was based on clinical examination also including history interviews, physical examinations, and possible radiological reports. NP was considered if at least two physical examination findings indicated neurological deficit in the area of discomfort. Concordance between the first impression assessment and the final assessment was calculated as sensitivity with the final assessment as the key.

**Results.** Inter-examiner reliability based solely on the first impression assessment of the pain drawing reached 88% overall agreement and a sensitivity of 90%. Signs of NP were found in 92% of the patients according to the final assessment. Two thirds of the patients added to their pain drawing during the history interview.

**Conclusions.** First impression assessment of the PD seems to be a reliable, easily learned, and sensitive diagnostic method for assessing NP in the neck/shoulder region. NP may be greatly underestimated, especially as patients withhold symptoms of discomfort when they fill in the PD.

**Key Words.** Pain Drawing; Neck/Shoulder Region; Physical Examination; Reliability; Neurogenic Dysfunction

### Introduction

Pain drawings (PD) have been considered as a diagnostic method since at least the late forties

when Palmer presented an article on their use to differentiate organic from nonorganic pain [1]. Until lately, proponents of the PD has focused on its potential to assess nonorganic—more commonly called—psychogenic pain or dysfunction [2–12]. However, some have questioned the sensitivity of the PD in assessing psychogenic pain/dysfunction [4,8,13,14]. Instead, late studies have

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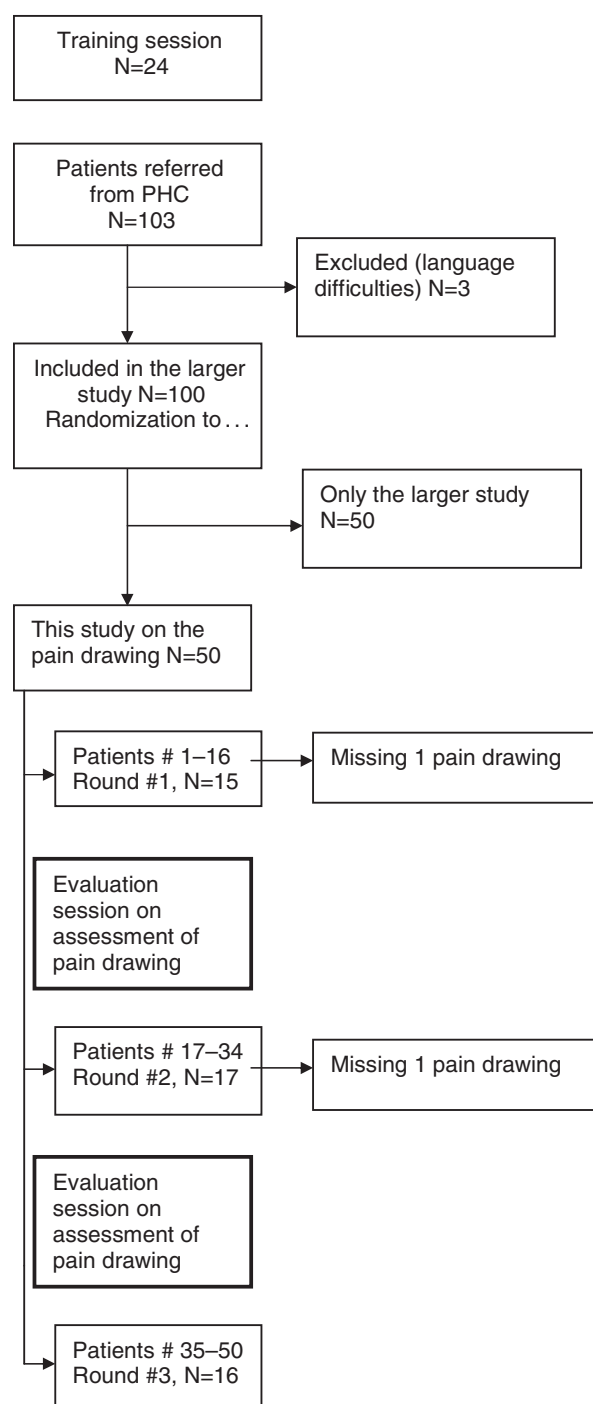
focused on the potential of the PD to assess neurogenic pain/dysfunction (NP) defined by the International Association for the Study of Pain (IASP) as “pain initiated or caused by a primary lesion or dysfunction of the nervous system.” These late studies on NP have shown that a PD can be a quick and simple, yet reliable and sensitive diagnostic method with good validity to assess NP originating from discs in the low back region [15–22]. Our hypothesis is that the potential of the PD holds true also in the assessment of NP originating from the neck/shoulder region. As we found no report on this assessment, our study may be the first to investigate the diagnostic potential of a PD made by the patient in the neck/shoulder region.

Patients with discomfort in the neck/shoulder region present symptoms that are often interpreted to indicate muscular or psychogenic dysfunction with few anticipated (and noted) clinical findings [23,24]. However, Hult in 1954 noted that muscular pain was frequently associated with disc disease indicating a NP [25]. Our experience is that careful clinical examination of patients with discomfort in the neck/shoulder region often reveals signs of neurologically disturbed sensory and/or motor function in the area of discomfort and that a simplified PD made by the patient can predict these signs of NP.

The four objectives of this clinical study on primary care patients with discomfort in the neck/shoulder region were to investigate 1) the inter-examiner reliability of a first impression assessment of NP using a simplified PD; 2) the process of learning how to use the simplified PD in the assessment of NP; 3) the concordance (sensitivity and specificity) in the assessment of NP between the first impression assessment of the simplified PD and a final assessment based on a complete clinical examination; and 4) how often patients add to or delete information from the self-explanatory PD as they received further instructions.

## Methods

This study is part of a larger study with the objective of evaluating the diagnostic process in the assessment of patients with discomfort in the neck/shoulder region [26]. As shown in the study flow in Figure 1, a training session on 24 patients with discomfort in the neck/shoulder region was conducted before the start of this study to promote conformity in performing and assessing the diagnostic methods. Approval was obtained from the local ethics committee.



**Figure 1** Study flow. PHC = primary healthcare center.

## Examiners

Two examiners, a physician (B) and a Doctor of Naprapathy (M)—a certified manual therapist—working at a sports medicine clinic, were both experienced in assessing patients with discomfort in the neck/shoulder region. However, examiner B had several years of experience with a simplified PD

and also of using bimanual sensibility testing with spurs while examiner M did not have that experience. Examiner B was used to especially looking for neurological findings, and examiner M was more used to looking for muscular findings and explanations to discomfort in the neck/shoulder region.

### Patients

Fifty patients were recruited between November 1998 and April 1999 from six primary healthcare centers (PHCs) in the Stockholm area. The PHCs were instructed to consecutively refer all patients, aged 16–66 years, who met the inclusion criteria: neck and/or shoulder discomfort with or without radiating pain. Exclusion criteria were inability to understand and speak Swedish, previous examination at the clinic during the past 3 years for neck and/or shoulder disorder, or factors contra-indicating a complete examination such as a serious infection or fracture. Referral could be performed with or without prior examination and/or treatment. Referred patients were invited by phone or letter to participate in the study. No one refused. Three referred patients were excluded due to language difficulties. Two pain drawings and one protocol for a physical examination were excluded due to incompleteness; consequently, some calculations are based on 48 instead of 50 patients. The patient characteristics are shown in Table 1. The average patient was a 44-year-old woman with 9.5 months of chronic discomfort at a level of 70 mm on the visual analog scale (VAS).

### Randomization and Initial Procedure

A randomization list made by a statistician ensured that patients entering the study were evenly distributed regarding starting with either examiner B or examiner M. Upon arrival at the clinic, a secretary met the patient and handed out two protocols, the simplified PD (Figure 2) and a questionnaire (Appendix I), to be completed before being seen by an examiner. Self-explanatory

instructions were written on the protocols. The secretary was asked to remind patients to follow the instructions and give a complete description of all their discomfort on the protocols and also not to talk with the examiner until after the first assessment of the PD. The completed protocols were then copied so that the first examiner to meet the patient would receive the original protocols and the second examiner the copies.

### First Impression Assessment of the PD

A first impression assessment of NP was made using the PD as the only diagnostic method. This was conducted with no communication other than a word of greeting as the examiner received the PD from the fully dressed patient. The assessment answered the questions of NP yes or no, side (left and/or right), and nerve level(s) (root C2–T7 and/or plexus) considered to be affected. The examiner then proceeded to make a complete clinical examination.

### Second Assessment after the Clinical Examination

A second assessment of NP, answering the same questions as noted above, was made after the complete clinical examination. The complete clinical examination included a discussion of the simplified PD, a further history interview, and a physical examination. Each assessment was successively written in ink on a protocol and could not be changed upon receiving further information. The patient then changed rooms, and the other examiner repeated the assessment sessions without knowledge of previous findings.

### Final Assessment

The physician did the final assessment of NP as he met the patient and reviewed the previous assessments and any possible radiological reports. A report, with recommended treatment, was written to the family physician in charge of the patient. The total time each patient spent at the clinic was about 2 h.

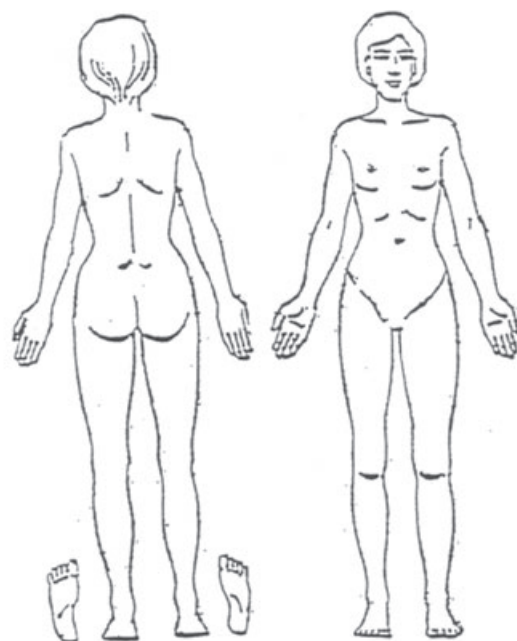
**Table 1** Patient characteristics (N = 50)

Age	Mean (range) years	43.5	(25–66)
Sex	Women/men N (%)	37/13	(74/26)
Pain level (VAS 1–100)	Median (range)	70	(20–100)
Duration of discomfort	N		%
Acute, <1 week	0		0
Subacute, 1 week–3 months	18		36
Chronic, >3 months	32		64
Median (range)	9.5 months (9 days–60 years)		

VAS = visual analog scale.

Where have you had discomfort and what kind of discomfort?

Shade all areas where you have experienced pain/discomfort this past week, and make the shading darker where you have had more discomfort. Describe the kind of discomfort next to the figure: buzzing, tingling, pricking, aching, cramp, etc.



When and how much discomfort?

How has the pain/discomfort varied since the first time you experienced it?



**Figure 2** Pain drawing.

### *Pain Drawing (Simplified)*

The simplified PD, shown in Figure 2, included a drawing of a human body (front and back), a time-discomfort VAS, 0–100, and self-explanatory instructions to the patient to shade all areas of discomfort. No special marks signifying different qualities of discomfort were asked for—a simplification compared with a standard PD. Patients were asked to use their own words to note the sort of discomfort they experienced next to the figure (pain descriptors). The assessment of the PD was based on patterns of NP principally following upper body dermatomes, myotomes, and sclerotomes [27,28].

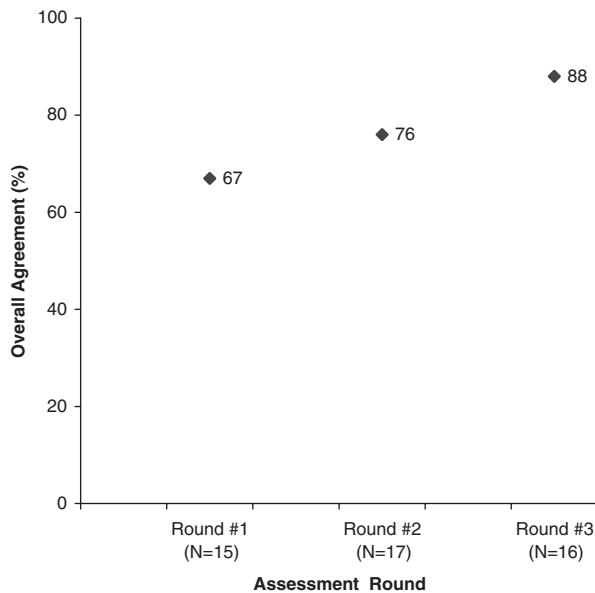
### *History Interview*

The history interview included two steps, a discussion of the PD and a further interview based on

the questionnaire shown in Appendix I. The discussion of the PD was aimed at ensuring that all aspects of it were correctly filled in. Changes in the PD in the form of additions, deletions, and/or clarifications were made in red ink by the patient. The subsequent interview based on the questionnaire included details of debut, duration, level of pain and dysfunction, and the effect of treatments. The patient had filled in this protocol in black ink. During the interview, clarifying or additional questions could be asked, although not about radiological findings. Changes in the questionnaire responses were made in red ink by the examiner.

### *Radiological Findings*

Radiological findings were discussed only in the final assessment interview. A radiological examination of the neck and/or shoulder was



**Figure 3** Inter-examiner reliability in first impression assessment of neurogenic pain/dysfunction using the simplified pain drawing (N = 48).

known to have been conducted sometime during their life by 20 patients (40%), 16 (32%) of these during the last 3 years. One of these 16 examinations was a magnetic resonance image (MRI) of the neck, and the other 15 were plain radiographs. One patient referral included the results of the plain radiographic examination. The rest of the radiological examination results were not given, but several patients related that they had been told that the examination showed “no fault.”

### Physical Examination

The technique of the physical examination and how each test was analyzed is described in Appendix II. A total of 66 clinical tests were performed. Emphasis was on neurological tests of sensibility, strength, and reflexes in the upper body, and also nerve stretch tests and traction/compression of the neck.

### Definition of a Positive Assessment of NP

A positive assessment of NP in the physical examination was made if two or more of the neurological tests in the physical examination rendered positive observations in the same dermatome/myotome/sclerotome area as where the patient noted discomfort on the PD [29]. For example, if sensibility to pain was decreased in the C6 dermatome of the affected side(s) and strength of elbow flexion and/or a weak brachioradialis reflex

was detected at the same side(s), it would be assessed as NP in that area of discomfort. The neurological tests included in our study are described in Appendix II. The nerve stretch test was not counted as specific enough to render a positive assessment of NP.

The final assessment of NP was based on the data from the PD, the anamnesis, and the complete results of the physical examinations. All the data were combined into a single judgment made by examiner B.

### Evaluation Sessions

Two evaluation sessions of 15–30 min each were held one third and two thirds of the way into the study, respectively, to promote learning, resulting in three assessment rounds where the examiners had increased experience in assessing the PD.

### Statistical Analysis

Inter-examiner reliability in assessments was calculated as percentages of overall agreement. Concordance between first and final assessment was measured as percent sensitivity, with the final assessment considered as the key. Sensitivity and specificity of all assessments in diagnosing NP in this study were calculated in relation to the final assessment based on the complete clinical examination. The number of patients who made changes in the PD above the lower scapula (Th7) or in the arm–hand was calculated in percent. The statistical package STATA 7 for Windows [30] was used for the calculations.

## Results

### Inter-Examiner Reliability in First Impression Assessment of NP Using the PD

The inter-examiner reliability for the first impression assessment of NP using the simplified PD as the only diagnostic method increased for each assessment round and reached an agreement of 88% in round 3 as shown in Figure 3.

### Final Assessment of NP

The final assessment of NP based on the complete clinical examination is shown in Table 2. Four out of five patients were assessed as having discomfort originating from the cervical spine, and nine out of 10 patients were assessed as having NP in the area of discomfort, with three (6%) originating from the brachial plexus and the rest from the spine.



**Table 2** Final assessment (N = 50)

Origin of discomfort	N	%
Neck	39	78
Shoulder	2	4
Neck and shoulder	5	10
Other	4	8
Total	50	100
Neurogenic pain/dysfunction in area of discomfort	46	92

### Concordance between First and Final Assessment of NP

The concordance in the assessment of NP between the first impression assessment of the simplified PD and the final assessment based on the complete clinical examination, expressed as sensitivity, increased for both examiners between the first and the second assessment rounds, where it reached about 90% and remained at that level in the last round. The mean sensitivity for all assessments was 84% for examiner B and 82% for examiner M.

### Number of Patients Who Made Changes in the PD

The number of patients who made changes in the PD in the neck/shoulder region above the lower scapula, including the head and/or the arm–hand, during the history interview was 30 (60%) for examiner B and 36 (72%) for examiner M. All changes were additions. An example of a PD before and after the history interview is shown in Figure 4.

### Pain Descriptors Used by the Patients on the PD

There were a total of 14 different pain descriptors used by the patients on the PD. The most common descriptors were ache (35), pricking (12), numbness (10), tingling (9), and cramp (6).

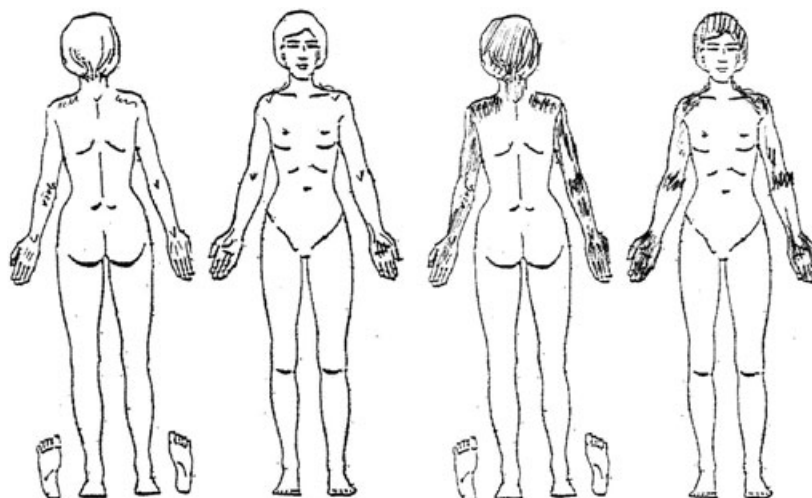
Ache was more common in areas proximal to the spine, while other descriptions were used distally. Eleven patients did not use any pain descriptors as they filled in the PD.

### Positive Neurological Findings in the Area of Dysfunction at First Physical Examination

The number and sort of positive neurological findings in the area of dysfunction at the first physical examination of each respective patient is shown in Table 3. Most positive neurological findings were carried out by sensibility testing (32.5%) and the least by reflex testing (15.5%). The sensitivity of the neurological tests to discern NP as judged by the final assessment was highest for the sensibility test (83%) and lowest for the reflex tests (39%). There were 38 patients with at least two positive neurological findings in the first assessment. On the 46 patients where the final assessment diagnosed the area of dysfunction as an area of NP, there were a total of 116 positive neurological findings in the first assessment. This signifies there was an average of 2.5 out of 4 possible positive neurological findings in each area of dysfunction already in the first assessment.

### Discussion

Our study showed that first impression assessment of the simplified PD seems to be a reliable, easily learned, and sensitive diagnostic method for assessing NP in the neck/shoulder region. Patients withheld information when they filled in the PD. An additional finding was that NP was very common in our primary care population, and this may challenge previous reports.



**Figure 4** Example of pain drawing before and after history interview. Assessed as neurogenic pain/dysfunction due to a C6 radiculopathy.

**Table 3** Positive neurological findings in the area of dysfunction at first physical examination of each patient (N = 50)

Patient ID	Neurological Test				Total Number of Positive Tests
	Sensibility	Reflex	Strength	Neck Compression and/or Traction	
1	1	0	1	0	2
2	1	1	0	1	3
3	1	1	1	1	4
4	0	0	0	0	0
5	1	1	1	0	3
6	1	1	1	0	3
7	1	0	1	0	2
8	1	1	0	1	3
9	0	1	0	1	2
10	1	0	0	1	2
11	1	0	1	1	3
12	1	0	1	0	2
13	1	0	1	1	3
14	1	1	0	1	3
15	1	1	1	1	4
16	1	0	0	1	2
17	1	0	1	1	3
18	0	0	0	0	0
19	0	0	1	1	2
20	1	0	1	1	3
21	1	0	1	1	3
22	1	1	1	1	4
23	1	1	1	1	4
24	0	0	1	0	1
25	1	0	1	1	3
26	1	0	1	0	2
27	1	0	1	1	3
28	1	1	1	1	4
29	1	1	1	1	4
30	0	0	0	1	1
31	1	1	1	1	4
32	1	0	0	0	1
33	0	1	0	0	1
34	1	0	0	0	1
35	1	0	1	0	2
36	1	0	0	0	1
37	0	0	1	0	1
38	0	0	0	0	0
39	0	1	0	1	2
40	1	1	0	1	3
41	1	1	1	0	3
42	1	0	1	1	3
43	1	0	1	1	3
44	1	0	0	1	2
45	1	0	0	0	1
46	0	0	1	0	1
47	0	1	0	1	2
48	1	0	1	1	3
49	1	0	0	1	2
50	1	0	1	1	3
Sum of positive tests	38	18	30	31	117
Percent	32.5	15.5	25.5	26.5	100
Sensitivity <sup>†</sup> (%)	83	39	65	65	
Specificity <sup>†</sup> (%)	100	100	100	75	

<sup>†</sup> Sensitivity and specificity in diagnosing neurogenic pain/dysfunction (NP) is calculated in relation to the final assessment based on the complete clinical examination. In the final assessment, four patients were assessed as having no NP in the area of dysfunction. The results of these four patients are shaded in this table.

Previous reports on pain have considered NP to be a rare reason for pain, “resistant to standard treatments” and frequently symptoms and signs have been ascribed to psychogenic causes or

plainly ignored [31,32]. However, new drugs and treatment alternatives offer hope to those affected. Consequently, the assessment of NP and discerning it from other forms of pain or dysfunction is a

primary task, and identification of diagnostic methods is now considered important clinical and research features [23,32–34].

The special features of this research include, first, the observation that a simplified PD can be used as a reliable (88% inter-examiner overall agreement) and sensitive (90%) diagnostic method to assess NP in the neck/shoulder region. This observation is in line with previous research on patients with discomfort in the low back region [16,17,20–22].

Second, we have shown that the process of learning to assess NP through the use of a simplified PD seems to be quick and simple. The inter-examiner agreement reached 88%, with a sensitivity of about 90% for both examiners after only two evaluation sessions. Had we not conducted a training session on 24 patients before the actual study, the percentage may have been lower. However, we found that after two brief evaluation sessions, the agreement increased by 21%, and the sensitivity for assessing NP increased by 29% for the inexperienced examiner. These numbers indicate a quick and simple learning process.

Third, we have shown that patients tend to withhold some of their symptoms of discomfort when they are asked to give a full account. This challenges the notion that patients exaggerate their report of discomfort to impress or otherwise get the attention of the examiner. Our study shows the opposite, as we found that two thirds of the patients added symptoms of discomfort after having already been asked to give a full report. Our impression is that patients tend to “fragment” their symptoms of pain and dysfunctions to fit some idea of what they themselves and/or the examiner may understand. However, this “fragmentation” may make it more difficult to assess patterns of NP just as a few pieces of a jigsaw puzzle make it more difficult to envision the final pattern than if more pieces are shown at start.

Fourth, the astounding high percentage (92%) of patients with clinical findings indicating NP presents a challenge to the notion that NP is rare in the general population [23,24]. However, the presence of NP in the neck/shoulder region as assessed by the PD was confirmed by the findings in the structured physical examination, in more than four fifths of the patients. Consequently, a question is whether this was a selected study population with cervical radiculopathy and/or plexus dysfunction. Our response is that we repeatedly during the study period admonished the participating PHCs to follow the instructions to consec-

utively refer all patients with neck and/or shoulder discomfort. The fact that only one patient had been examined with an MRI of the cervical spine, although the median duration of discomfort for all patients was almost 10 months, supports the idea that our patients were not a selected population with suspected cervical radiculopathy. Furthermore, our observation of a high prevalence of NP originating from the cervical spine is in accordance with that of Heffez et al. [35], who, in 2004, presented a study on patients with fibromyalgia where was found signs of NP (myelopathy) originating from the cervical spine in more than four out of five patients. None of the patients had been neurologically examined previous to the study, even though the mean duration of symptoms was 8 years [35]. Our impression is that our study patients, before entering the study, were likewise not considered as having NP, but rather “just” musculoskeletal dysfunction, and consequently had not been examined neurologically.

### *Limitations of the Study*

The limitations of the study include the fact that the number of patients in the sample without NP (4 out of 50) was too small to draw conclusions regarding the specificity of the PD and consequently its value as an instrument to exclude NP. The small number of patients without NP also made it less suitable to estimate reliability by kappa statistics, which would otherwise be the method of choice. Kappa statistics are to be preferred over percent overall agreement, as this method takes into account the agreement that is expected to occur due to chance alone. However, kappa values become unstable when there is limited variation in the sample as occurs when there is a high agreement and/or most of that agreement is limited to only one of the possible rating choices [36], as in our study.

A second limitation is the lack of a gold standard for assessment of NP by the use of the simplified PD in the upper body. The dermatome map by Netter [27] served as a major guide in this assessment. However, we believe that some symptoms of discomfort drawn on the simplified PD may be assessed as symptoms of neurological disturbance in myotomes and/or sclerotomes [28]. Therefore, in the absence of previous studies on this assessment, we had to rely on our own experience of how patterns of discomfort, marked on the PD, correlate to clinical findings of neurologically disturbed motor and/or sensory function. Consequently, this study may be seen as a



pilot study in the assessment of the simplified PD.

A third limitation is that one may question whether there was a shared bias between examiners in the physical examination lending toward a high percentage of positive neurological observations. This can not be ruled out, although a part of this study, presented in a previous article [26], investigated the inter-examiner reliability of each clinical test and the test where we had the least common experience from the start, and yet the highest inter-examiner reliability was the sensibility test with which we made the majority (33%) of the positive neurological observations as noted in Table 3.

A fourth limitation is that there is no universal definition on what clinical findings should render the diagnosis of NP. In this study, we defined the assessment of NP as discomfort in a dermatome/myotome/sclerotome area where we made at least two or more positive observations in neurological tests in the physical examination. This definition is in accordance with the proposed assessment procedure by Hansson et al. [37]. However, further studies need to validate this procedure.

#### Further Studies

Further studies on the clinical usefulness of the simplified PD, its reliability, sensitivity, and specificity in discerning different kind of pain require larger patient samples. Such studies may also investigate the concordance in assessment of NP based on the PD with assessment based on other diagnostic methods such as the neurometer, MRI of the spine, and discography.

#### Conclusions and Clinical Implications

Our study indicates that the simplified PD can be used with good inter-examiner reliability, is easy to learn to use, and has a high sensitivity to assess NP in patients with discomfort in the neck/shoulder region. Our study also indicates that a majority of patients do not give a full report of their symptoms of discomfort when they first fill in the PD. Furthermore, findings in the physical examination indicating NP in the area of discomfort are very common.

The clinical implications of these conclusions include, first, the recommendation to use the simplified PD as a diagnostic method in the assessment of patients with discomfort in the neck/shoulder region with the understanding that the examiner should look for patterns of NP following

dermatomes, myotomes, and/or sclerotomes. Second, patients should be reminded to give a full account of their symptoms and be ensured that they will not be suspected of over-reporting. Third, the notion of psychogenic origin to musculoskeletal disorders in the neck/shoulder region should be questioned and maybe replaced by an assumption that most symptoms of discomfort have a neurogenic origin that can be assessed by a structured neurological examination and a simplified PD made by the patient.

If further studies can confirm the high sensitivity and also evaluate the specificity of the PD, this simple, inexpensive diagnostic tool can save time and increase accuracy in the challenging diagnostic process of pain and dysfunction facing many healthcare providers.

#### Acknowledgments

This study was supported by funds from Stockholm City council and Astra-Zeneca.

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## Appendix I. Questionnaire

Patient name \_\_\_\_\_ social security # \_\_\_\_\_  
 Address \_\_\_\_\_ telephone/fax: # \_\_\_\_\_  
 Examination date \_\_\_\_\_ Birth date \_\_\_\_\_ Sex (male/female) \_\_\_\_\_  
 Social status \_\_\_\_\_ Occupation \_\_\_\_\_  
 On sick leave since \_\_\_\_\_ Tobacco use (yes/no) \_\_\_\_\_  
 Referral from (name of family physician) \_\_\_\_\_

**History of neck/shoulder discomfort (write and/or circle the answer)**

1. Why do you seek help? \_\_\_\_\_
2. When did the discomfort you seek help for start? \_\_\_\_\_
3. a Was it an accident? \_\_\_\_\_ yes no  
b If yes, what happened? \_\_\_\_\_
4. How did the discomfort start? \_\_\_\_\_
5. Have you had similar discomfort before? \_\_\_\_\_ yes no
6. In what body part(s) do you experience discomfort? a. head right left  
b. neck right left  
c. shoulder right left  
d. arm right left  
e. hand/finger(s) right left  
f. Discomfort in some other part(s) of the body? \_\_\_\_\_
7. Do you experience constant discomfort day as night? \_\_\_\_\_ yes no
8. What increases your discomfort? a. sudden effort like coughing or laughing \_\_\_\_\_ yes no  
b. turning your head \_\_\_\_\_ yes no  
c. shoulder movement \_\_\_\_\_ yes no  
d. other \_\_\_\_\_
9. Do you experience relief from your discomfort by laying down? \_\_\_\_\_ yes no
10. What decreases your discomfort? \_\_\_\_\_
11. Is your discomfort associated with? a. wryneck \_\_\_\_\_ yes no  
b. headache \_\_\_\_\_ yes no  
c. dizziness \_\_\_\_\_ yes no  
d. tingling or numbness in lower arm \_\_\_\_\_ yes no  
e. tingling or numbness in hand/finger \_\_\_\_\_ yes no
12. Draw a stroke on the following lines to illustrate the last week's experience of:
  - a Pain  
no = 0 \_\_\_\_\_ 10 = worst conceivable
  - b Problem to sleep  
no = 0 \_\_\_\_\_ 10 = worst conceivable
  - c Problem to work. With what?  
no = 0 \_\_\_\_\_ 10 = worst conceivable
  - d Problem at leisure time. With what?  
no = 0 \_\_\_\_\_ 10 = worst conceivable
13. Quality of life? (assess by drawing a stroke on the following line)  
no = 0 \_\_\_\_\_ 10 = best conceivable
14. a Assessed by (e.g. family physician, orthopaedist): \_\_\_\_\_  
b With (e.g. blood test, radiology, EMG): \_\_\_\_\_  
c Have you received a trustworthy explanation to your discomfort? \_\_\_\_\_ yes no  
d Which explanation? \_\_\_\_\_
15. a Have you been X-rayed, if so what and when? \_\_\_\_\_  
b Do you bring X-ray replies? \_\_\_\_\_ yes no
16. a Treated by (e.g. physician, physiotherapist, alternative medicine): \_\_\_\_\_  
b With what? (e.g. ultrasound, electric current, hot bath): \_\_\_\_\_
17. Previous and other medical discomfort, e.g. operation/hospital stay/current disease: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
18. Current medication: \_\_\_\_\_
19. What is your greatest discomfort? \_\_\_\_\_  
\_\_\_\_\_
20. What do you believe is the reason for your discomfort? \_\_\_\_\_  
\_\_\_\_\_

Diagnosis: \_\_\_\_\_ code 1 2 3 4 5 with/without nerve dysfunction

## Appendix II. Technique of the Physical Examination

A general status was first considered while the patient undressed the upper body. Torticollis and, if so, the position of the head were noted. Problems in moving, antalgic positioning, mental or speech disorder, skin disease or other notable, physical or mental deficiency were noted. Patients were then examined in sitting position with undressed upper body and hands resting on their legs. All tests presented were measured subjectively, including angles where we had tested our measuring ability with a setsquare on some pilot patients. A positive observation indicating abnormality, yes or no, was first considered and then, if positive, right and/or left side was noted. Uncertain abnormality was considered as not positive. In some tests, the positive findings were graded. In this paper, graded findings are not presented. The 66 clinical tests were divided into the following 9 categories. The number of tests in each category is noted within parenthesis.

**Cervical ROM (range of motion) (6).** Active, extension, ventral and lateral flexion and rotation to each side of the head until pain or stiffness stopped the movement, was observed while standing in front of the patient. Normal movement was defined in accordance with the limits suggested by Viikari-Juntura [23] ventral flexion and extension 30°, lateral flexion to each side 20°, rotation to each side 60° or more. Inhibited movement was considered positive.

**Shoulder tests (2).** Active abduction to 180° and adduction to 30° with thumb pointing upwards were tested subjectively, standing in front of the patient. Inhibited motion and/or distinct pain within the given range were considered positive and the area of pain was noted. Isometric contraction of shoulder muscles was tried with the examiner standing behind the patient with hands on the patients arms held in 90° flexion in the elbow and the thumb pointing upwards. While giving resistance to both arms, the examiner would ask the patient to exert force bilaterally in one of eight directions at the time: lower arm up, down, external rotation, internal rotation, upper-arm abduction, flexion, extension, and adduction. Distinct pain was considered positive.

**Tenderness (20).** With the examiner standing behind the patient, a mild to moderate pressure with one or two fingers was exerted on 20 different areas; spinal processes C1–3, C4–7, T1–3, T4–7,

paraspinal joints C1–3, C4–7, T1–3, T4–7, neck muscles, brachial plexus, scapula, paraspinal muscles, shoulder, upper arm, lateral and medial epicondyle, lower arm, tenar, middle hand, and hypotenar. Distinct pain was considered positive.

**Hypotrophy (8)** was assessed in the 8 areas; chin, neck, neck-shoulder, shoulder, upper arm, lower arm, hand, and chest. Clear hypotrophy was considered positive.

### Neurological Tests

**Sensibility to pain (10)** was tested in the 10 indicator areas for dermatomes shown in Figure A1. The testing was done with two pinwheels drawn slowly, with no pressure other than their own weight, bilaterally, simultaneously, over each indicator area. The patient was asked if he/she experienced a difference from side to side or from chin to foot. Hypo- and/or hypersensibility in an area was considered positive.

**Strength (7)** was tested in 7 movements, representing myotomes. The testing was done with the examiner standing behind the patient and asking him/her to resist force from the examiners hand in the following movements; head flexion C2(–3), head lateral flexion C3(–4), shoulder elevation C4(–5), arm abduction C5(–6), elbow flexion C(5–)6, elbow extension C(6–)7, and little finger

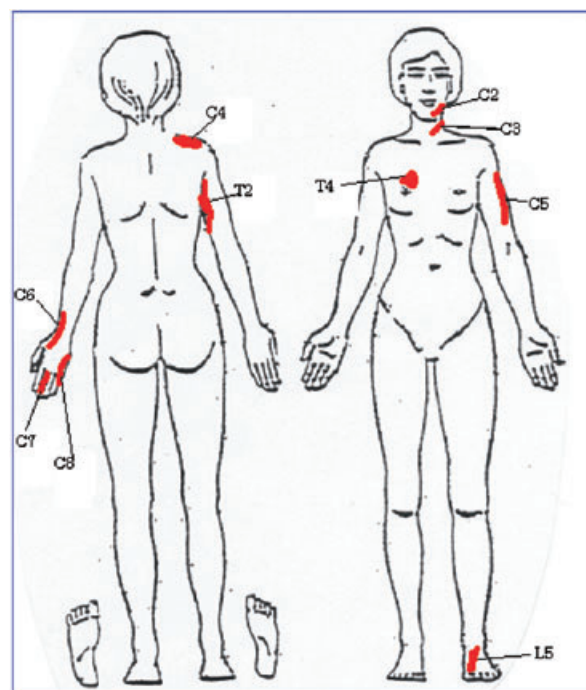


Figure A1 Indicator areas for dermatomes.

hook C(7–)8. Except for head movements, all tests were done simultaneously on both sides. Force was applied for about 5 s per test. Decreased strength was considered positive.

**Reflexes (5)** were tested on 5 tendon insertions, representing different levels of innervation; suprapinatus C4–5, biceps C5–6, brachioradialis C6–7, triceps C7–8, and the Babinski reflex. The testing was done one side at a time with a reflex hammer. Asymmetry or a weak or strong reaction was considered positive.

**Nerve stretch (3)** was performed for the median, radial, and ulnar nerve using one arm at a time as described by Magee [29]. However, we performed the test with the patient sitting and not lying

down as described by Magee. Pain response in the arm and brachial plexus was considered positive.

**Neck compression/traction (5).** Compression and traction of the neck was done with the examiner standing behind the patient with hands on top of the patients head and exerting increased pressure, with the head in different positions, respectively, lifting the head with hands underneath each maxilla and with thumbs on the back of the head as suggested by Viikari-Juntura [23]. If the patient expressed pain, further compression/traction was immediately stopped and the test considered positive. Relief at traction of the head was considered positive. Pain and/or relief were specified as to side and area.