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Observational study

Chronic neck pain patients with traumatic or non-traumatic onset: Differences in characteristics. A cross-sectional study

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HIGHLIGHTS

- Traumatic chronic neck pain patients report worse on most outcomes.
- They perform worse in muscle function, extension, and pressure point threshold tests.
- They report worse on self-reported quality of life, function, and depression.
- Both groups present a wide variety and range of symptoms.

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ABSTRACT

Background and aims: Patients with chronic neck pain can present with disability, low quality of life, psychological factors and clinical symptoms. It is unclear whether patients with a traumatic onset differ from those with a non-traumatic onset, by having more complex and severe symptoms. The purpose of this study was to investigate the clinical presentation of chronic neck pain patients with and without traumatic onset by examining cervical mobility, sensorimotor function, cervical muscle performance and pressure pain threshold in addition to the following self-reported characteristics: quality of life, neck pain and function, kinesiophobia, depression, and pain bothersomeness.
Methods: This cross-sectional study included 200 participants with chronic neck pain: 120 with traumatic onset and 80 with non-traumatic onset. Participants were recruited from physiotherapy clinics in primary and secondary health care. For participants to be included, they were required to be at least 18 years of age, have had neck pain for at least 6 months, and experienced neck-related activity limitation as determined by a score of at least 10 on the Neck Disability Index. We conducted the following clinical tests of cervical range of motion, gaze stability, eye movement, cranio-cervical flexion, cervical extensors, and pressure pain threshold. The participants completed the following questionnaires: physical and mental component summary of the Short Form Health Survey, EuroQol-5D, Neck Disability Index, Patient-Specific Functional Scale, Pain Bothersomeness, Beck Depression Inventory-II, and TAMPA scale of kinesiophobia. The level of significance for all analyses was defined as $p < 0.01$. Differences between groups for the continuous data were determined using either a Student's *t*-test or Mann Whitney *U* test.

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Results: In both groups, the majority of the participants were female (approximately 75%). Age, educational level, working situation and sleeping patterns were similar in both groups. The traumatic group had symptoms for a shorter duration (88 vs. 138 months $p = 0.001$).
Participants in the traumatic group showed worse results on all measures compared with those in the non-traumatic group, significantly on neck muscle function (cervical extension mobility $p = 0.005$, craniocervical flexion test $p = 0.007$, cervical extensor test $p = 0.006$) and cervical pressure pain threshold bilateral ($p = 0.002/0.004$), as well on self-reported function (Neck Disability Index $p = 0.001$ and Patient-Specific Functional Scale $p = 0.007$), mental quality of life (mental component summary of the Short Form Health Survey $p = 0.004$ and EuroQol-5D $p = 0.001$) and depression (Beck Depression Inventory-II $p = 0.001$).
Conclusions: This study showed significant differences between chronic neck pain patients when differentiated into groups based on their onset of pain. However, no specific clinical test or self-reported characteristic could differentiate between the groups at an individual patient level.
Implications: Pressure pain threshold tests, cervical muscle performance tests and patient-reported characteristics about self-perceived function and psychological factors may assist in profiling chronic neck pain patients. The need for more intensive management of those with a traumatic onset compared with those with a non-traumatic onset should be examined further.

1. Introduction

Most adults experience neck pain during their lifetime. The 12-month prevalence of neck pain is 30–50%, with activity-limiting neck pain varying between 1.7% and 11.5% [1]. In Denmark, 21% of patients referred to physiotherapy in primary care have neck pain [2,3]. The cause of chronic neck pain can be traumatic (e.g. from a whiplash injury) or non-traumatic (e.g. work-related or degenerative). Regardless of the onset, chronic neck pain patients can present with a variety of symptoms including physical impairment, psychological distress, and social dysfunction [4–6].

A traumatic onset of neck pain may relate to a whiplash injury. Approximately 50% will have on-going symptoms after a whiplash injury for months or years after the injury [8], and 10–20% will have severe pain after 7 years [8,9]. These symptoms involve both physical and psychological changes [10–14]. Some of these symptoms may be due to central sensitisation mechanisms, a phenomenon seen mainly in traumatic neck patients [12,15]. Non-traumatic chronic neck pain patients can also present with varying symptoms in addition to pain such as functional limitations [16] and psychological changes [17–19].

Some former studies have shown that the presentation of several symptoms may be dependent upon the onset being traumatic or non-traumatic: sensory alterations [15,20], sensorimotor function [21], morphological changes [22], and specific psychological factors [23–25]; other studies have not found such group differences [26–28].

Furthermore, whiplash is a controversial diagnosis [29–32]. As a consequence, in a recent report from Canada, the term 'Whiplash' in Whiplash Associated Disorders (WAD) was replaced with 'Neck' (Neck and Associated Disorders-NAD) [33]. In other articles, WAD has been described as a medico-legal illusion [34] and a "man-made illness" [35]. In clinical practice and public debate, chronic neck pain patients with a traumatic onset or WAD are often considered more challenging regarding treatment than those with a non-traumatic onset [36–40]. WAD patients have sometimes experienced injustice from their employer, insurance company, or medical profession [29,41] and been labelled as malingerers [42]. Former studies have focused mainly on whiplash patients or compared this group with healthy controls. Knowledge is lacking about the specific characteristics, similarities and differences of the two groups of neck patients (traumatic/non-traumatic), as they present in clinical practice.

In summary, a variety of symptoms are reported in both the traumatic and non-traumatic groups, but it is unclear whether patients with neck pain following traumatic onset differ substantially from those with a non-traumatic onset.

The overall aim was to investigate differences between the two groups, which might justify more individualised management. The specific objectives of this study were to compare the clinical presentation of neck pain patients with a traumatic onset with those with a non-traumatic onset, by examining the following clinical characteristics: physical impairments including range of motion, sensorimotor function, muscle function and pressure pain threshold, in addition to the self-reported characteristics of quality of life, neck pain and function, kinesiophobia, depression, and pain bothersomeness.

2. Materials and methods

2.1. Study design and setting

This study is cross-sectional, using data originally collected as baseline data for a randomised parallel two-group trial [43,44]. The participants were recruited from both primary (eight physiotherapy clinics) and secondary health care locations (two spine centres, one municipal rehabilitation centre and one hospital neurological outpatient clinic) in Denmark. Patients were recruited from March 2012 to September 2014.

2.2. Study population

Participants were recruited by physiotherapists and informed about the study via in-clinic advertisements, by their treating clinician or at their first contact with the health care unit.

For patients to be eligible, they had to meet the following inclusion criteria: at least 18 years of age, neck pain for at least 6 months with either traumatic or non-traumatic onset, neck-related activity limitation determined by a score of at least 10 on the Neck Disability Index, diagnostic procedures completed (i.e. medical investigations, diagnostic imaging), in a stable social and/or working situation, and able to participate in an exercise programme. Participants could have pain from other body regions as long as the primary pain area was in the neck region. Exclusion criteria were radiculopathies (clinically tested by positive Spurling test, relief on cervical traction and positive plexus brachialis tests on the affected side) [45], currently undergoing experimental or progressive medical treatment, currently pregnant, and known current fractures or depression as determined by a Beck Depression Inventory score over 29 [46].

2.3. Procedures

The classification 'traumatic' versus 'non-traumatic' was based upon the participant's self-reported cause of their neck pain as traumatic or not. Trauma could relate to traffic accidents or other physically traumatic events.

The patients were tested by two trained assessors. The physical tests were performed in the same order for all participants, starting with the least physically demanding test. The self-reported questionnaires were completed during the same test session, after the physical tests. Before enrolling in the study, the participants signed an informed consent form.

2.4. Clinical tests (Table 1)

Cervical range of motion (ROM) was tested in flexion, extension and side-bending using an inclinometer. For rotation, a semi-circular goniometer was placed upon the patient's shoulder measuring cervical rotation in degrees to the nearest five degrees [48]. Sensorimotor function was tested with two neck–eye coordination tests: gaze stability (GS) testing the ability to keep the gaze fixed while moving the head; and the eye movement test (EMT) testing the ability to move the eyes while keeping the head still. GS and EMT were recorded as positive if the patient experienced dizziness or related symptoms. Cervical muscle function was tested with the cranio-cervical flexion test (CCFT), testing the activity of the deep cervical flexors [49]; and the cervical extensors test (CE), testing the activity of the cervical extensors during an isometric neck extension. The CCFT scores were divided into three categories: 22, 24 and 26+, as there were very few in the category 28 and 30. CE was grouped into four categories based upon quartiles of the data: 0–10 s (lower quartile) was categorised as poor, 11–38 s moderate (second quartile), 39–119 s good (third quartile), and 120 s was categorised as ideal (fourth quartile).

Pressure pain threshold (PPT) was tested bilaterally using an algometer (Wagner, FPX algometer, USA) on the anterior tibialis, the infraspinatus and on the facet joints at C5/6 level.

A detailed description of all the clinical tests chosen for the current study is provided in a publication investigating their intra- and intertest-retest reliability [48]. All tests showed satisfactory reliability.

2.5. Self-reported measures

The participants' demographic data including age, gender, type of onset (traumatic or non-traumatic), employment, educational status, and sleeping disturbances were recorded.

Quality of life was measured with the Physical Component Summary (PCS) and the Mental Component Summary (MCS) of the Short Form Health Survey (SF-36) and EuroQol-5D (EQ-5D) (Table 1) [50,51]. Self-reported neck pain and disability were measured with the Neck Disability Index (NDI) [52–54]. The Patient-Specific Functional Scale (PSFS) assessed individual functional status with three items chosen by the participant [52] and registered the participant's perceived functioning level [55–59]. The TAMPA Scale of Kinesiophobia (TSK) [60] examined fear of movement, injury or re-injury [61]. The Beck Depression Inventory was used for the measurement of depression (BDI-II) [46]. Pain Bothersomeness (PB) was assessed using a question that measures a participant's perceived impact of their pain on daily life, with a scale rating from 0 to 10 [62,63].

2.6. Study size and bias

The size of the population was determined by a power calculation of the accompanying randomised controlled trial. Potential sources of bias caused by mass significance were addressed by choosing a very conservative significance level ($p < 0.01$). The participants were stratified according to the onset being traumatic or non-traumatic. The assessors did not know the research questions for the study and were not blinded to the origin of the chronic neck pain (as they stratified the participants being traumatic or non-traumatic for the interventions).

2.7. Data analysis

All continuous data were checked for normality using Shapiro Wilks test and QQ plots. Differences between groups for the continuous data were determined using either a Student's *t*-test for normal data or Mann Whitney *U* test for non-normal data. For the ordinal data, a chi-square test was performed to determine differences between groups and if the minimum expected frequency was less than five in a cell, the Fisher's exact test was performed instead.

Due to the large number of comparisons, the level of significance for all analyses was defined as $p < 0.01$. All statistical analyses were performed using the Statistical Package for Social Sciences (version 22.0.0, IBM, New York, USA).

3. Results

3.1. Participants

Two hundred participants were included: 120 with traumatic onset and 80 with non-traumatic. In the traumatic group, 90 (75%) had experienced a traffic collision while 30 (25%) had trauma of another kind. In the traumatic and non-traumatic groups, the majority of the participants were female (approximately 75%) (see Table 2). The traumatic group had symptoms for a shorter duration (88 vs. 138 months $p = 0.001$).

3.2. Results of the clinical tests

All physical tests showed poorer results for the traumatic group (Table 3); there was a significantly decreased ROM on extension of the cervical spine and significantly lower PPT at left infraspinatus and cervical spine sites. In addition, the traumatic group had significantly lower scores on the CCFT and CE tests, indicating diminished function of the cervical flexors and extensors.

3.3. Results of the self-reported measures

The traumatic group scored worse on all questionnaires, significantly on SF-36 MCS, EQ-5D, NDI, BDI-II and PSFS. Scores on the SF-36-PCS, TSK and Pain Bothersomeness showed no statistical significance although TSK scores were high (37 or more) in both groups (Table 4).

4. Discussion

In this cross-sectional study investigating the differences in clinical presentation between chronic neck pain patients who had a traumatic versus non-traumatic onset, we found that the traumatic group was worse on most variables and significantly worse on cervical extension ROM, cervical PPT, muscle function, quality of life, self-reported mental function, and depression.

4.1. Cervical function: ROM and CCFT, CE

The significantly worse results for the traumatic group on cervical extension ROM, CCFT and CE are in line with previous studies demonstrating reduced ROM in traumatic neck pain patients compared with non-traumatic [21,62], and decreased strength and

Table 1
List of self-reported measures and clinical tests.

Name	Questionnaire description
SF-36	The Short Form 36 (SF-36) Health Survey is a generic questionnaire, measuring functioning and well-being with strong reliability and validity documentation for both general and disease-specific populations. SF-36 measures eight health-related quality of life domains: physical functioning (PF), role limitation – physical, bodily pain (BP), general health (GH), vitality (VT), social functioning (SF), role limitation – emotional (RE) and mental health (MH). Domain scores range from 0 to 100, where higher scores represent better health status. Scores from the eight domains aggregate into two summary measures: physical component summary (PCS) and mental component summary (MCS). MCS and PCS are transformed into t-scores with a mean of 50 and SD of 10.
EQ-5D	The Euro-QoI five dimensions questionnaire (EQ-5D) captures the patient's perceived state of health, with predefined end-points (range 0–100): high value is good health and low value is bad health. Each dimension has three levels: no problems, some problems, extreme problems. Total scores range from 1 to −1. The EQ visual analogue scale (EQ VAS) is a vertical 10 cm rating scale, with the end points labeled best imaginable health state at the top and worst imaginable health state at the bottom, having numeric values of 100 and 0, respectively. The reliability of the EQ-5D is high, 0.86–0.90.
NDI	The Neck Disability Index (NDI) tests neck pain and neck disability related to daily activities (range 0–50), with higher scores representing greater perceived disability. Each dimension is rated from no disability (0) to total disability (5). The overall score (out of 50) is calculated by summing the responses to each individual item. The test-retest correlations that have been reported range from 0.90 to 0.93, with reported Cronbach's Alpha ranging from 0.74 to 0.93.
PSFS	The Pain-Specific Functional Scale (PSFS) tests for change in self-reported function, comprising three patient-rated important activities based on the perceived level of difficulty (range 0–10 scale), with lower scores representing better function. The test-retest reliability coefficient is consistent with that reported for persons with low back pain. There is excellent reliability and validity comparable to the Neck Disability Index, and good sensitivity to change.
TSK	The TAMPA scale of kinesiophobia (TSK) tests for fear avoidance behavior with a 17-item measure of the fear of movement, injury and re-injury (range 17–68) with a score above 37 indicating a high degree of kinesiophobia. Responses are indicated on a four-point Likert scale, ranging from 1 (strongly disagree) to 4 (strongly agree). A total score is calculated. The TSK demonstrates adequate internal consistency (Cronbach's Alpha ranges from 0.70 to 0.81) and good test-retest reliability ($r = 0.78$). The instrument shows acceptable concurrent validity, with TSK scores correlating with other self-report measures of pain-related fear (r values range from 0.54 to 0.60).
BDI-II	The Beck Depression Inventory for the measurement of depression (BDI-II) is a 21-item measure of depressive symptoms, including items assessing both cognitive and somatic complaints associated with depression. Each item represents a symptom of belief that is rated by four statements, ranked from 0 to 3 in terms of intensity. The participants mark the statement that best describes their feelings the previous week. All the scores are added into one score, ranging from 0 to 63. A total score less than 14 indicates minimal or no depression, 14–19 mild depression, 20–28 moderate depression, and >28 severe depression. A Danish version of the BDI has been validated and used in a Danish setting. The BDI has shown high validity and reliability in measuring depressive symptoms, and has shown acceptable test–retest reliability ($r = 0.79$) in a non-clinical population and out-patient population.
PB	Pain Bothersomeness (PB) is a numerical rating scale (range 0–10), with higher scores representing greater pain bothersomeness. Participants register how bothered they are about their pain on a scale from 0 (not bothered) to 10 (extremely bothered) during the previous 24 h.
ROM	Cervical Range Of Movement (ROM) is measured in degrees with a bubble inclinometer for flexion/extension and lateral flexion that measures to the nearest five degrees using custom-designed equipment for rotation.
GS	The Gaze Stability Test (GS) assesses changed neuromuscular control of the neck with cervical rotation to both sides and in flexion and extension while keeping the gaze fixed on one point. The test is recorded as positive when symptoms such as dizziness, nausea or changes in vision or an inability to maintain focus are provoked.
EMT	To test change in head and eye coordination, the Eye Movement Test was used (EMT). This was tested in both neutral and in relative 45° neck rotation, using the elements of the smooth pursuit neck torsion test from Tjell. The test is recorded as positive when symptoms such as dizziness, nausea or changes in vision or an inability to move the eyes smoothly are provoked.
CCFT	The Cranio-Cervical Flexion Test for the deep cervical flexors was measured with a biopressure feedback transducer (range 22–30 mmHg). The test was performed with the participants in a supine position using a biopressure feedback device, where patients were asked to execute a high cervical flexion without the use of the superficial anterior cervical muscles with the biopressure device under the upper cervical spine. The test was progressive with an increase of 2 mmHg for every level. The outcome was measured as the level where the participant activated the superficial cervical flexors or otherwise compensated.
CE	The Cervical Extensors Test (CE) was designed to target the deep extensors, the multifidus and semispinalis cervicis. This test measured the time taken to keep the head steady, while lying in a prone position, with the head over the edge of the table. The outcome was measured in seconds. The test was interrupted if the patient left the position or had a score of 120 seconds. Apart from the reliability study mentioned, there is not at present a standard test for evaluating the function of the deep cervical extensors.
PPT	Mechanical allodynia was measured with the Pressure Pain Threshold (PPT) transducer on both sides of the tibialis anterior, infraspinatus and C5/6 level.

endurance of the neck flexors, as well as decreased strength of the extensor muscles in those with traumatic onset. It could be speculated that our findings of decreased function of the cervical extensors in traumatic neck pain could be explained by fatty infiltration in the extensor muscles, which was previously found in the extensor muscles of patients with chronic neck pain due to WAD, but not in those with insidious neck pain [64].

4.2. Central sensitisation

The result of significantly poorer performance on muscle function in the traumatic neck pain patients could also be explained by mechanisms of central sensitisation. A systematic review concluded that central sensitisation does not appear to be a major feature in non-traumatic neck pain, whereas it is seen in patients with traumatic chronic neck pain [65,66]. Central sensitisation may be related to change in motor control and changes in ROM caused by peripheral nociceptive processes [67,68]. Even though the participants in our study had a mean duration of symptoms of 7 years, changed motor control and ROM were more evident in the traumatic group compared with the non-traumatic group. The higher score in the traumatic group on depression and SF-36 MCS, indicating possible psychological mechanisms, may have been causing the ongoing perception of pain, and potentially feeding both the central sensitisation and peripheral processes [16]. However, processes that underlie the persistence of pain in chronic neck patients are still unclear [69].

4.3. Patho-anatomical changes

The significantly poorer results in the traumatic group may also relate to more severe lesions of the cervical spine due to trauma. Patients with a traumatic onset can have a variety of lesions in the cervical spine [70]. A systematic review, looking at cervical spinal injuries, concluded that it was reasonable to assume that non-fatal road traffic traumas may result in patho-anatomical lesions similar to those in fatal road traffic traumas [71]. But, there is still no consensus on the degree of patho-anatomical changes and their possible influences on symptoms. The impact of such lesions on

Table 2
Demographic data for participants in traumatic and non-traumatic groups.

Measure	Traumatic	Non-traumatic	*p*-value
Sex			
Male/female (%)	32/88 (27/73)	19/61 (24/76)	0.64
Age			
Mean age in years ± SD	43.5 ± 11.4	47.5 ± 11.3	0.015
Duration pain			
Mean in months ± SD	88 ± 89	138 ± 113	0.001*
Education level n (%)			
Academic	13(11%)	08(10%)	
Skilled	97(81%)	66(83%)	0.96
Unskilled or no education	10(8%)	06(8%)	
Working situation n (%)			
Unemployed	09(8%)	07(9%)	
Working part-time	36(30%)	14(18%)	
Working full-time	29(24%)	34(43%)	
Retired	09(8%)	09(11%)	
Early retirement	12(10%)	03(4%)	
Sick leave	16(13%)	09(11%)	0.60
Student	09(8%)	04(5%)	
Sleep disturbances			
Sleeping undisturbed	40(33%)	26(33%)	
Disturbed ≤ 3× per night	61(51%)	34(42%)	0.25
Disturbed > 3× per night	19(16%)	20(25%)	

SD = Standard Deviation.
* *p*-value < 0.01.

muscle performance and cervical mobility is therefore an area for further research.

4.4. Changes in pressure pain threshold

We measured a consistently lower PPT in the traumatic group at the cervical spine C5/6 level and for the left infraspinatus muscle, but not for the tibialis anterior. This differs from a study of healthy controls, chronic WAD and idiopathic neck patients [20] that showed lower PPT for the WAD group at the tibialis anterior, but not for the cervical spine muscles while the infraspinatus site was not tested. This divergence from the results in the current study may be explained by the fact that their participants had shorter duration of symptoms (idiopathic group 3 months until 3 years, WAD group 3 months until 2 years) compared with our group (mean duration symptoms non-traumatic group 11.5 years months and traumatic group 9.5 years).

4.5. Self-reported health and depression

The self-reported health results of the traumatic group showing worse scores on the SF36-MCS, EQ-5D and BDI-II are in-line with those of Guez [72], a study including 4415 participants in north Sweden, who found that those with neck trauma perceived their health to be worse than those with a non-traumatic origin. The self-reported psychological changes of our participants mirrored former studies that showed traumatic patients rating themselves as being more forgetful and less able to concentrate [25], as well as scoring higher on depression [20,73] than non-traumatic neck patients.

Depression appears to be an important influencing factor to perceived health and quality of life [74] and is seen in patients with chronic pain and traumatic neck pain [75,76]. Depression is, as such, one of the characteristics of chronic neck pain patients. However, the exclusion in our study of those with severe depression (BDI-II > 29) was based upon the fact that pain patients with severe depression have poor response to treatment [74] and might

Table 3
Results of clinical tests for participants in traumatic and non-traumatic groups.

Variable	Traumatic (*n* = 120)	Non-traumatic (*n* = 80)	*p*-value
Range of motion	**Degrees Mean ± SD**	**Degrees Mean ± SD**	
Cerv.Fl	37.9 ± 15.8	42.9 ± 13.7	0.022
Cerv.Ex	41.2 ± 20.3	48.6 ± 16.2	0.005*
Cerv.RotL	56.3 ± 17.6	60.9 ± 14.0	0.039
Cerv.RotR	59.1 ± 15.4	61.8 ± 14.8	0.220
Cerv.SBL	31.1 ± 10.0	31.7 ± 10.0	0.688
Cerv.SBR	33.6 ± 12.9	34.8 ± 10.8	0.482
Pressure pain threshold	**Kgf Median ± IQR**	**Kgf Median ± IQR**	
PPT TAR	2.6 ± 2.3	2.8 ± 3.0	0.157
PPT TAL	2.3 ± 2.0	2.8 ± 3.5	0.027
PPT ISR	1.6 ± 1.5	2.4 ± 1.9	0.014
PPT ISL	1.5 ± 1.6	2.0 ± 1.9	0.008*
PPT CvR	0.8 ± 1.4	1.4 ± 1.2	0.002*
PPT CvL	0.9 ± 1.2	1.3 ± 1.6	0.004*
Gaze stability	**Abnormal *n* (%)**	**Abnormal *n* (%)**	
GS L	64 (53%)	30 (37%)	0.179
GS R	55 (46%)	29 (36%)	0.028
GS E	59 (49%)	29 (36%)	0.149
GS F	48 (40%)	24 (30%)	0.071
Eye movement test	**Abnormal *n* (%)**	**Abnormal *n* (%)**	
EMT	43 (36%)	24 (30%)	0.392
EMT R	53 (44%)	26 (34%)	0.098
EMT L	51 (42%)	24 (30%)	0.074
Cranio Cerv. Fl. Pressure	***n* (%)**	***n* (%)**	
CCFT 22 mmHg	92 (77%)	53 (66%)	
CCFT 24 mmHg	23 (19%)	13 (16%)	0.007*
CCFT 26–30 mmHg	5 (4%)	14 (18%)	
Cervical ext. duration			
CE 0–10 s	22(18%)	10(12%)	
CE 11–38 s	40(33%)	15(19%)	0.006*
CE 39 –119 s	16(13%)	12(15%)	
CE 120 s	42(35%)	43(53%)	

SD = standard deviation; IQR = inter quartile rate (25–75%); Cerv.Fl. = cervical flexion; Cerv.Ex = cervical extension; Cerv.RotL = cervical rotation left; Cerv.RotR = cervical rotation right; Cerv.SBL = cervical sidebending left; Cerv.SBR = cervical sidebending right; PPT TAR = pressure pain threshold tibialis anterior right; PPT TAL = pressure pain threshold tibialis anterior left; PPT ISR = pressure pain threshold infraspinatus right; PPT ISL = pressure pain threshold infraspinatus left; PPT CvR = pressure pain threshold cervical right; PPT CvL = pressure pain threshold cervical left; GS L = Gaze stability left; GS R = gaze stability right; GS F = Gaze stability flexion; GS E = Gaze stability extension; EMT = eye movement test; EMT R = eye movement test right rotation; EMT L = eye movement test left rotation; CCFT = Cranio-cervical flexion test; CE = cervical extensors test.
* *p*-value < 0.01.

Table 4
Results of self-reported questionnaires for participants in traumatic and non-traumatic groups.

Measure	Traumatic (*n* = 120) Mean ± SD	Non-traumatic (*n* = 80) Mean ± SD	*p*-value (*t*-test)
SF-36-PCS	35.0 ± 7.1	36.1 ± 8.2	0.309
SF-36-MCS	44.7 ± 11.2	49.0 ± 9.5	0.004*
EQ-5D	0.66 ± 0.18	0.75 ± 0.12	0.001*
NDI	22.8 ± 7.3	19.0 ± 7.7	0.001*
BDI-II	15.9 ± 8.8	10.1 ± 7.8	0.000*
PB	05.7 ± 2.1	05.0 ± 2.3	0.016
PSFS	03.1 ± 1.6	**0**3.7 ± 1.6	0.007*
TSK	38.5 ± 7.2	36.8 ± 6.2	0.196

SD = standard deviation; SF-36-PCS = short form 36 physical component sum; SF-36-MCS = short form 36 mental component sum; EQ-5D = EuroQol-5 dimensions; NDI = Neck Disability Index; BDI-II = beck depression inventory-II; PB = pain bothersomeness; PSFS = patient specific functional scale; TSK = Tampa scale of kinesiophobia.
* *p*-value < 0.01.

need treatment for depression before physiotherapy treatment can have any effect.

4.6. Strength and limitations of the study

There are several strengths to our study. We included a large number of participants and recruited the participants from different clinical settings across Denmark. The testing of the outcome measurements was performed by only two assessors: one was the main author of the related reliability study and was, therefore, experienced and rigorous with the test procedures; the other performed the tests on a monthly basis and maintained a close familiarity with the procedures during the whole period.

Despite recruiting from different centres, data collection was performed with the same test equipment. The built environment was similar across the settings used for the data collection.

Our study also had some limitations. While recruitment of the participants was based on well-defined inclusion and exclusion criteria, the clinical tests and questionnaires to include participants were performed by different physiotherapists at different centres and this may have introduced some variability due to potential cluster effects. Some of this variability may have been minimised due to all physiotherapists being trained in the procedures by the same instructor, but other cluster effects may have been present.

The classification of neck pain into traumatic or non-traumatic onset was based on the participant's own perception. This judgement may contain some imprecision as the pain onset could have been trauma-related, but the patient did not recognise this, or the neck pain was incorrectly ascribed to trauma. It is unknown whether the recall of trauma is related to the present severity of the condition and future studies should examine this.

This study was conducted using data collected as part of a randomised controlled trial. The inclusion criteria for the trial related to the duration of pain (more than 6 months), the severity of symptoms (NDI $\geq$ 10), and the willingness and ability to take part in an exercise programme, all of which may have influenced the results of this study. As the classification of neck pain into traumatic or non-traumatic onset was based on patient self-report, these inclusion criteria for the trial were unlikely to have influenced the comparative results.

4.7. Implications

There are several potential implications of our study. Chronic neck pain patients ought to be given proper attention in primary and secondary care as they are affected by their symptoms. Those with a traumatic onset may need more attention, presenting similar symptoms but at a worse level. The notion that the traumatic group, being a group with merely psychological problems was not confirmed, as there were no distinctive psychological test results or self-reported characteristics of this group compared with those with non-traumatic onset. Screening of different physical functions, particularly muscle-function and PPT may assist in profiling the patient. The question as to whether this would assist in clinical decision-making needs additional investigation. Both groups had high scores on the kinesiophobia scale (traumatic mean 38.5, SD 7.2; non-traumatic mean 36.8, SD 6.2), indicating a high degree of kinesiophobia. This should lead to a focus on addressing kinesiophobia in the management of chronic neck pain patients, regardless of the cause of onset. Clinicians should also consider addressing factors such as quality of life, self-perceived level of function and depression in chronic neck pain patients. Further research should focus on the results of treatments directed at these characteristics.

In summary, patients referred to physiotherapy with traumatic and non-traumatic chronic neck pain shared common clinical characteristics, but objectively measured physical impairments as well as self-reported health impairments were more severe in the traumatic group. However, both groups had a high degree of kinesiophobia. Our results showed more severe symptoms in the traumatic patients as a group, but these results cannot influence individual patient clinical decisions on their own. Further studies should explore the effect of different management strategies on the varying symptoms of both groups.

5. Conclusions

This study found that patients with chronic neck pain with a traumatic onset in general were worse than those with pain from a non-traumatic origin on both the physical tests and self-reported health characteristics. There were no exclusive characteristics for either group, and both groups presented a large variety of signs and symptoms.

Ethical issues

The trial was registered in www.ClinicalTrials.gov (NCT01431261). The Regional Scientific Ethics Committee of Southern Denmark approved the study (S-20100069). The study fulfilled recommendations of the Declaration of Helsinki 2008 [47].

Conflict of interest

The authors declare that they have no competing interests. The Nordic Institute of Chiropractic and Clinical Biomechanics and AK's position at the University of Southern Denmark are financially supported by the Danish Chiropractic Fund for Research and Postgraduate Education.

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