

VALIDITY OF FIVE COMMON MANUAL NECK PAIN PROVOKING TESTS

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ABSTRACT. The purpose of the present study was to assess five manual tests for pain provocation of the neck to determine their suitability for epidemiological investigations. To 75 randomly selected men, five manual pain-provoking tests were applied in a single-blind design. Prevalence of reported neck dysfunction, sensitivity, specificity, and positive and negative predicted value for each test were calculated. 22 of the 75 reported present neck pain, while the remainder reported freedom from neck pain for at least one year. Palpation over the facet joints in the cervical spine was found to be the most appropriate screening test to corroborate the replies in self-reported questionnaires on dysfunctions of the neck. The outcome of this test was quite consistent with the reported neck pain. The test of the foramina intervertebralia and the upper limb tension test caused pain in almost all subjects with reported neck dysfunctions, though not causing referred pain in the arm as an indication of neurogenous tissue origin, as it was aimed to. Neither the neck rotation test nor the active flexion/extension test was sufficiently provocative to confirm the reported neck pain in these subjects, as both were insufficiently sensitive.

Key words: epidemiology, electricians, manual medicine, neck dysfunction, physical examination, sensitivity, specificity.

Cross-sectional studies on occupational musculoskeletal disorders are usually designed as self-reported questionnaire investigations.

Investigations on the agreement between self-reported dysfunctions and clinical examinations of the neck and shoulder area (1, 9, 12, 13) have produced diverging conclusions. There was disagreement between the reported neck and shoulder problems and the clinical findings in subjects with self-reported neck and shoulder dysfunctions (1, 9, 13). On the other hand, Persson & Kilbom (12) reported

correlation between the reported neck dysfunction and the physical examination of the neck.

The general purpose of the present study was to develop methods to confirm and make self-reported questionnaire investigations regarding musculoskeletal pain in the cervical area more substantial. One specific objective was to apply five manual pain-provoking tests for the neck to establish and reflect their validity and applicability in epidemiological surveys.

MATERIAL AND METHODS

Subjects

Seventy-five male electricians were randomly selected from a population of 3,144 electricians attending health check-ups at the Construction Industry's Organization for Work Environment, Safety and Health (Bygghälsan) in Stockholm, Sweden (4). Every electrician who consecutively visited the clinic on 12 different days within a month and fulfilled the criteria was included in the study.

The criteria for inclusion in the present study were: 1) to be of Swedish origin, and 2) to have reported pain in the neck during the preceding week or to have reported no pain in the neck either during the preceding week or within the last 12 months.

The subjects were selected for the study according to the inclusion criteria by the medical staff who carried out the health check investigation.

The health check included a self-administered questionnaire about musculoskeletal pain in the neck. The alternatives in the questionnaire were dichotomized (yes/no) to questions concerning any neck pain during the preceding, week and/or the last 12 months.

Twenty-two (29%) of the 75 participating individuals reported neck pain during the last few days and were considered as having ongoing neck trouble. Consequently 53 subjects (71%) who reported they were free from neck pain during the last few days as well as during the last 12 months were treated as controls. Subjects who reported neck pain during the last 12 months but not during the last week were not included as it seemed impossible to classify them correctly. All individuals who were invited and who fulfilled the criteria volunteered for the study.

In the investigation of all the 3,144 subjects, 62% reported that they had not suffered from any neck pain during the past 12 months (4).

The ages of the 75 subjects ranged between 18 and 64 years

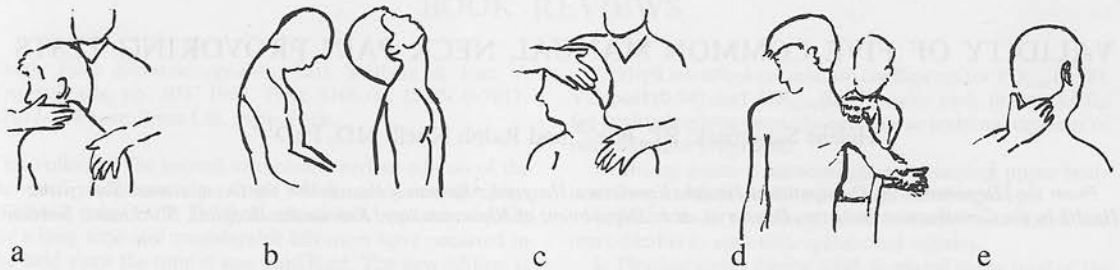


Fig. 1. Pain-provoking tests. (a) Active siderotation of the neck and upper thoracic spine with a passive manual stretch at the extreme position of siderotation. (b) Active flexion and extension of the neck and upper thoracic spine. (c) Test of foramina intervertebralia. (d) The upper limb tension test. (e) Palpation of the facet joints of the cervical spine.

(mean 35 years, SD 13 years). The ages of the 22 cases ranged from 18 to 59 years (mean 36 years, SD 13) and of the 53 controls between 18 and 64 (mean 34 years, SD 13 years).

Twenty-one of the 22 cases (95%) reported a history of periodic neck pain lasting from 6 months up to 17 years. One subject had had his neck pain for a few days only. None of the subjects was on sick-leave at the time of the investigation.

Manual tests

Five manual tests, operationally defined as pain-provoking tests in the present study, were applied. They were chosen because of their frequent use and general clinical application and because they are considered to provoke different anatomical pain-sensitive structures in the neck and shoulder area (3, 5, 7, 8, 10, 11, 16).

The following tests were applied, all with the subject in a sitting position:

(a) Active rotation of the neck and upper thoracic spine with a passive manual stretch performed by the examiner at the extreme position of rotation (Fig. 1a). Movements in the neck may provoke neck pain or radicular symptoms (3). Pain of muscular origin is considered to be produced by active movements and pain from articulations, capsules, and ligaments by passive movements (3, 5, 16). The entire cervical and the upper thoracic spine were side-rotated and thus structures within this region were included in the test.

(b) Active flexion and extension of the neck and upper thoracic spine to each individual's extreme position (Fig. 1b).

(c) A test for the foramina intervertebralia (Fig. 1c) was first described and also validated by Spurling & Scoville (14). They concluded that this test provokes pain from the nerve roots at the incidence of a cervical interspinal lesion. In the present study the test was performed with the subject's neck and head placed passively in dorsal flexion, rotated and laterally flexed to the same side, according to Kaltenborn (8).

(d) 'The upper limb tension test' (10) (Fig. 1d) was originally called 'the brachial plexus tension test'. However, studies have shown that the tension seems to appear in the nerve roots and the spinal nerves of the brachial plexus as well as in the brachial plexus itself (10). The test was performed with the arm in extension, external rotation and abduction in the glenohumeral joint and the elbow in extension, the forearm in supination and the wrist and fingers in extension. Neck flexion and contralateral neck lateral flexion may increase the provocation and was added.

(e) Palpation over the facet joints of the cervical spine (7) (Fig. 1e). The articulations were palpated 2 cm lateral to the

spinous processes of the cervical vertebrae. Besides the reaction from the facet joint structures, the intermediate structures—mostly the trapezius muscle and the cervical erector spinae—were also palpated during this manoeuvre and pain could be elicited from these structures as well (7).

Procedure

The five manual pain-provoking tests were performed by an experienced registered physiotherapist, not informed whether the subject had reported neck pain during the last few days or was free from neck pain the last few days and last 12 months. The subjects were told before the examination not to disclose to the examiner whether they had reported neck pain or not.

The subjects were instructed to answer 'yes' or 'no' after the performance of each test in answer to the question if pain had been elicited or not. Discomfort or unpleasantness were not considered to suffice for a positive answer. Solely a pain reaction yielded a positive result. If pain was provoked on one side of the body the result was regarded as positive. If pain was elicited by the test, the next question was whether the pain was local or if it was radiating.

The subjects with ongoing neck pain filled in, after the testing, an outline sketch of a human to mark the extension of the pain in general, not only pain elicited on the test occasion.

Statistical analysis

To analyse each test, five '2 × 2' contingency tables were set up according to Fletcher et al. (6). The outcome of each test was related to reported neck pain and the sensitivity and the specificity of each test was calculated.

The sensitivity of a test is the proportion of subjects reporting the dysfunction and also having a positive outcome of the test. The specificity of a test is the proportion of subjects without the reported dysfunction who have a negative outcome of the test. A highly sensitive test yields few false-negatives, and a highly specific test is one with few false-positives (6). The procedure of calculating the sensitivity and specificity is visualized in Fig. 2.

The likelihood that a person with a positive value has the investigated disease or dysfunction or that a person with a negative test has not got the disease or the dysfunction, the positive or a negative predictive value, was calculated for each of the five tests. The predictive value (PV) of a test is

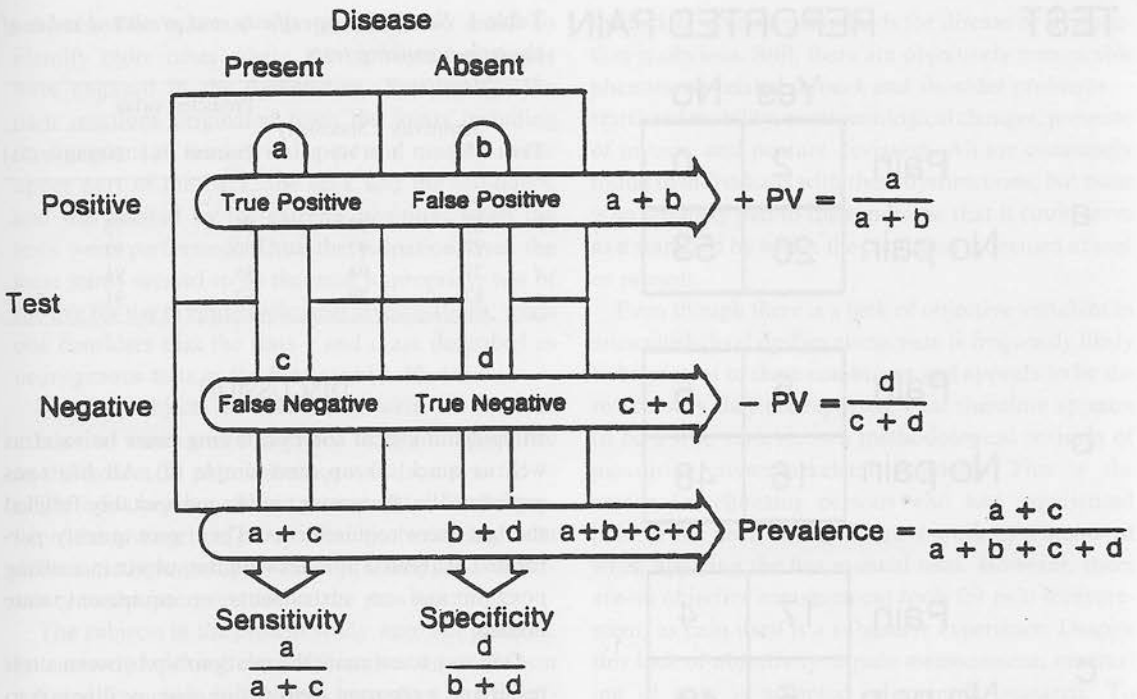


Fig. 2. The definitions and relationships between a diagnostic test and the actual presence of a dysfunction (5). PV = predicted value. Modified after Fletcher et al. (6).

determined by the value of the sensitivity and specificity of the test and also by the prevalence of the dysfunction within the group investigated. In Fig. 2 it is demonstrated how the calculations of a positive (+PV) and a negative predictive (-PV) value are carried out.

RESULTS

The distribution of the outcome of each test is illustrated in Fig. 3.

Sixteen of the electricians not reporting pain (31%) reported pain in the tests, reflecting false-positive answers (Fig. 3). Six of them stated pain in 2 of the tests and 1 of the subjects in 3. In all, 23 pain-reactions in the 53 controls were noted during the testing.

Altogether, 20 of the subjects who reported ongoing neck pain reacted positively in at least one of the five tests. Thus 2 persons who reported ongoing neck pain had negative reactions to all five tests.

In tests *a* and *b*, 20 (91%) and 16 (73%) respectively of the electricians reporting pain dysfunction did not react with pain when tested; the results of these tests made these subjects false-negatives regarding neck disorder in relation to the two tests (Fig. 3).

Nine of the electricians (41%), who reported neck

pain did not react with a pain reaction during tests *c*, *d*, or *e*. Five of them had a negative reaction on 2 of these 3 tests, and 4 on just one of these tests.

Tests *c*, *d* and *e* yielded high values of sensitivity and specificity (Table I). The palpation of the facet joints (*e*) had the highest sensitivity, 82%, and the upper limb tension test (*d*) the highest specificity, 94%. Test *b* had the lowest sensitivity, 27%, but a high specificity, 90%. Tests *c*, *d* and *e* had a sensitivity of 77%, 77%, and 82%, respectively. However, it should be noted that the reactions to the test of the foramen intervertebrale (*c*) and the upper limb tension test (*d*) were not radiating as sensations from neurogenous tissues often appear. Only in one individual did pain radiate in the left arm and during the upper limb tension test.

The highest predictive value of a positive test was the upper limb tension test (*d*), with 85%, and as in second place, the foramen intervertebrale test (*c*) with 80%. The predictive value of a negative result was yielded by the palpation test (*e*), the foramen intervertebrale test (*c*), and the upper limb tension test (*d*), with a value of 91%.

The spatial distribution of the pain provoked by the

TEST REPORTED PAIN

		Yes	No
a	Pain	2	0
	No pain	20	53

b	Pain	6	5
	No pain	16	48

c	Pain	17	4
	No pain	5	49

d	Pain	17	3
	No pain	5	50

e	Pain	18	11
	No pain	4	42

Fig. 3. "2x2" contingency table visualizing the number of negative/positive reactions in each test. The order corresponds to the order of the tests described in Fig. 1.

testing, in both subjects and controls, was located in the neck and shoulder area, i.e. the same area as the cases described and marked on the outline sketch of the human as being the usual pain site. If the subject experienced his usual pain in both the neck and the shoulder area and also in the arms or in one arm, the site of the pain when provoked by the testing was still in the neck and shoulder area.

Table I. Sensitivity, specificity and predicted value of the pain-provoking tests

Test	Sensitivity (%)	Specificity (%)	Predicted value	
			Positive (%)	Negative (%)
a	—	—	—	—
b	27	90	55	75
c	77	92	80	91
d	77	94	85	91
e	82	79	62	91

DISCUSSION

In epidemiological surveys, testing must be valid as well as quick, cheap, and simple (2). All five tests performed in the present study indisputably fulfilled the last three requirements. They were quickly performed in about 3 minutes with the subject in a sitting position and no instruments or equipment were needed.

One way to estimate the relationship between a test result and a reported dysfunction, pain or illness is to calculate the mathematical relations of these variables as done in the present study. To interpret the collected data, all four cells in the '2x2' contingency table must be filled in order to give useful information (6). Thus this method of calculation would not be appropriate if the tests were either the perfect instruments or entirely inappropriate in this respect. In the present study this method was suitable at least for the tests *b*, *c*, *d* and *e*. The *a* test had three of the four fields filled in the '2x2' contingency table and only 2 of the subjects who reported present neck pain reacted with pain in this test. None of the individuals who reported absence of neck pain had pain elicited by test *a*. This accorded the test a very low sensitivity and a calculation could not be carried out because of the zero in one field (Fig. 3). A similar result appeared in test *b*. All four cells in the table were filled, but still the sensitivity was low (27%). The low sensitivity in the first two tests makes them inappropriate to reveal, reproduce and predict neck dysfunctions reported in questionnaires.

Radiating pain, indicating a neurogenous dysfunction, was rare in the study population according to the outcome of the tests. Although tests *c* and *d* are intended to provoke the nerve roots, the spinal nerves and/or the brachial plexus, the local pain-sensitive musculoskeletal structures reacted instead. In test *c*, no radicular pain at all was elicited, but local pain occurred in the musculoskeletal tissues in 21

subjects. The material was probably too small to identify more cases where the neurogenous tissues were engaged in the dysfunction. Presumably, the pain reactions originated from the joints including the ligaments of the cervical spine and muscles in the upper part of the back, the neck and the shoulders, and was elicited by the extreme positions when the tests were performed. Thus the palpation over the facet joints seemed to be the most appropriate test of the five for use in epidemiological investigations, when one considers that the tests *c* and *d* are described as neurogenous tests in the literature (8, 10, 14).

All the subjects in this study were of Swedish extraction which was considered to be of importance as differences in pain tolerance—real or asserted—might exist between ethnic groups (15, 17). To perform the testing in a group of subjects coming from different ethnic groups would probably add uncertainty to the interpretation of the pain reactions.

The subjects in the present study were not patients, but actively working men, although a third of them suffered from pain in the neck according to the self-reports. One can assume that individuals seeking medical care and being on sick-leave would have more pronounced pain and dysfunction. The outcome of the tests would probably be different in a population of patients attending medical treatment and being sick-listed, than in the subjects in this study. Tests *a* and *b* might yield higher values of sensitivity and generate pain-reactions to a greater extent in a population of patients, rather than in the subjects of this investigation. In the clinical setting when performing these tests on patients undergoing treatment for musculoskeletal neck dysfunctions, experience has shown consistently positive reactions to all these tests.

The design and interpretation of clinical tests regarding musculoskeletal dysfunctions are usually based on functional anatomy. Clinical testing of musculoskeletal and nerve tissues is intended to compress or place mechanical load on a certain structure in order to provoke pain. This is to identify which structure is affected and thus establish the exact diagnosis (3, 8). Each of the tests in this study had been chosen because it was intended to provoke a specific anatomical structure in the neck and shoulder area. However, neither the validity nor the reliability of the tests generally have been investigated before, due primarily to the lack of appropriate methods, and especially to difficulties in validation. This is a general problem regarding musculoskeletal dysfunctions and

the lack of objective standards for disease or dysfunction is obvious. Still, there are objectively measurable phenomena related to neck and shoulder problems—restricted mobility, roentgenological changes, presence of myosis, and posture deviation. All are commonly found in individuals with these dysfunctions, but none is so uniquely tied to the syndrome that it could serve as a standard by which the condition is deemed absent or present.

Even though there is a lack of objective variables in musculoskeletal dysfunctions, pain is frequently likely to be present in these conditions and appears to be the reason why they are reported. Pain therefore appears to be a true variable in a methodological revision of measuring musculoskeletal problems. This is the reason for choosing persons who had experienced pain in the neck during the past week as a standard when applying the five manual tests. However, there are no objective measurement tools for pain measurement, as pain itself is a subjective experience. Despite this lack of objectivity in pain measurement, measuring of pain is accepted in scientific research. To simplify pain measurement in the present study and to make it easier for the subjects to accomplish, the answers regarding pain on testing were dichotomized to "yes" or "no". Reported neck pain and pain elicited by the tests performed corroborated the results.

CONCLUSIONS

All five tests fulfilled the requirement for epidemiological test batteries, as they were easy to perform, quick and cheap. Palpation over the facet joints was the most appropriate test. The tests of cervical spine rotation and of cervical flexion/extension were not sufficiently sensitive and whereas the test of the foramina intervertebralia and the upper limb tension test caused pain in musculoskeletal structures, they were intended to provoke pain from neurogenous tissues.

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