ORIGINAL ARTICLE

The role of physical examinations in studies of musculoskeletal disorders of the elbow

Ann Isabel Kryger, Christina Funch Lassen, Johan Hviid Andersen

Occup Environ Med 2007;**64**:776–781. doi: 10.1136/oem.2005.026260

See end of article for authors' affiliations

Correspondence to: Dr A I Kryger, Department of Occupational and Environmental Medicine, Copenhagen University Hospital, Bispebjerg, Bispebjerg Bakke 23, DK-2400 Bispebjerg, Denmark; akry@dadlnet.dk

Accepted 4 May 2007
Published Online First 23 May 2007

Objectives: To present data on pain and physical findings from the elbow region, and to discuss the role of diagnostic criteria in epidemiological studies of epicondylitis.
Methods: From a cohort of computer workers a subgroup of 1369 participants, who reported at least moderate pain in the neck and upper extremities, were invited to a standardised physical examination. Two independent physical examinations were performed—one blinded and one not blinded to the medical history. Information concerning musculoskeletal symptoms was obtained by a baseline questionnaire and a similar questionnaire completed on the day of examination.
Results: 349 participants met the authors' criteria for being an arm case and 249 were elbow cases. Among the 1369 participants the prevalence of at least mild palpation tenderness and indirect tenderness at the lateral epicondyle was 5.8%. The occurrence of physical findings increased markedly by level of pain score. Only about one half with physical findings fulfilled the authors' pain criteria for having lateral epicondylitis. A large part with physical findings reported no pain at all in the elbow in any of the two questionnaires, 28% and 22%, respectively. Inter-examiner reliability between blinded and not blinded examination was found to be low (kappa value (0.34–0.40)).
Conclusion: Very few with at least moderate pain in the elbow region met common specific criteria for lateral epicondylitis. The occurrence of physical findings increased markedly by level of pain score and the associations were strongest with pain intensity scores given just before the examination. Physical signs were commonly found in subjects with no pain complaints. No further impact was achieved if the physical examination was not blinded to the medical history. Furthermore, the authors propose that pain, clinical signs and disability are studied as separate outcomes, and that the diagnoses of lateral epicondylitis should be used only for cases with classical signs of inflammation reflected by severe pain, which for example conveys some disability.

Musculoskeletal symptoms of the neck and upper limb are common complaints among computer workers, and a large epidemiological literature exists on the relation between computer work and upper extremity symptoms and disorders.[1–6] Physical examination is a basic diagnostic tool but a considerable resource-demanding outcome measurement in some of these studies.[3 5 7] The examination is used primarily to identify the occurrence and severity of impairments and to diagnose clinically relevant conditions. To reduce subjective elements and in an attempt to reduce potential bias of the results, the examination is often blinded to information about the medical history.[3 6 8 9]

The results of an examination are however of limited value if the inter-examiner reliability is poor. This is particularly a problem for upper extremity disorders, where a clear-cut golden diagnostic standard is missing.[10–13] The diagnoses are mainly based on symptoms and physical findings, which may not necessarily be explained on the basis of the underlying pathophysiology. This means that the reliability of the individual test is crucial in terms of ensuring that we are in fact measuring the same phenomenon, because the true ''approach'' is difficult to define. In the epidemiological setting diagnoses are furthermore mainly based on symptoms recorded in questionnaires that are completed days or weeks before the physical examination, based on the assumption that pain level is relatively constant, but this does not necessary seem to be the case.[5] Moreover, the low prevalence and generally mild nature of upper extremity disorders in computer workers have been found to lead to unstable reliability of any physical examination.[10 11] In a study of reliability of physical examination among keyboard operators, Salerno *et al* reported that more reliable results could probably be achieved if the physical examination was not blinded to the medical history. A recent study of primary healthcare patients with neck and/or shoulder problems found that the history had no or only little impact on the reliability of the test, but the prevalence of the findings increased when history was known.[14]

Most often questionnaires are used as a screening method to identify the occurrence of musculoskeletal complaints and only a subgroup is invited to the physical examination.[3 4] In an ideal scenario, the selection criteria used to identify these participants should be sensitive enough to include the majority of possible musculoskeletal disorders, and should be specific enough to diagnose the relevant cases and reduce the number of resource-demanding physical investigations. In recent years there have been several attempts to standardise diagnostic criteria for work-related musculoskeletal disorders in epidemiological studies,[15 16] and lateral epicondylitis represents one of the conditions, where a reasonable consensus exists on the diagnostic criteria.[10]

In this paper, we present data from an epidemiological study: the NUDATA study (Neck and Upper limb Disorders Among Technical Assistants), which may contribute to the discussion and clarification of diagnostic criteria for studying epicondylitis in an epidemiological context.

Abbreviations: BEC, baseline elbow case; BLE, baseline lateral epicondylitis; CEC, current elbow case; CLE, baseline lateral epicondylitis; DASH, Disability of Arm, Shoulder and Hand questionnaire; NUDATA, Neck and Upper limb Disorders Among Technical Assistants study

METHODS

The material of the present study consists of a subgroup of 1650 participants from the NUDATA study population of computer workers. The subgroup was defined as those who were invited to a physical examination because of neck or arm pain (see below).

The NUDATA study is a one-year follow-up study on the relation between computer use and neck and upper limb musculoskeletal symptoms and disorders. The cohort was established in January 2000 and consists of all 9480 members of the Danish Association of Professional Technicians, who were educated technical assistants (n = 7252) and machine technicians (n = 2228). They were employed in 3527 public and private companies involved with computer-aided design, graphics/layout, word processing, data entry tasks and other non-computer office work tasks. The proportion of computer time in which they actively used the mouse and keyboard were 19.5 (SD 10.3) h/week and 11.4 (SD 8.8) h/week respectively. The cohort has been described in detail elsewhere.[4 6]

Baseline pain score

Information concerning musculoskeletal symptoms from the neck, shoulders, elbows, forearms and wrists/hands (nine regions) were obtained by a baseline questionnaire (''baseline pain score'') for each of the nine regions. Participants reported pain on an ordinal scale during the past seven days (no pain, very mild, mild, mild to moderate, moderate, moderate to severe, severe and very severe pain).

Physical examination

1650 participants, who indicated at least moderate pain in one or more regions (neck, shoulder, elbow, forearm and wrist/hand) during the previous seven days, were offered a standardised physical examination at their local occupational medicine department performed 2–3 weeks after baseline questionnaire completion. Participants were not eligible for examination if they had had an operation in the relevant region, if pain was caused by trauma, or if they suffered from medical conditions that might affect the present pain status. Nor were they invited if they returned the questionnaire more than two weeks after they had received it.

Eighty three per cent (n = 1369) accepted the invitation. The mean age of the participants was 42.2 (SD 8.4) years, and 77% were women. Among the participants, 242 reported that they suffered from at least moderate elbow pain and therefore met our criteria for being an elbow case. The remainder suffered either from none or only mild symptoms in the elbow and/or had symptoms from at least one of the other eight regions.

Just before the physical examination participants filled in a similar questionnaire as 2–3 weeks earlier, concerning actual pain in the nine regions during the past seven days (''current pain score''). The responses were registered on the same scale as aforementioned. The participants also completed the DASH (Disability of Arm, Shoulder and Hand) questionnaire at the day of examination. The DASH includes 30 responses on physical function and symptoms, and a raw score is transformed to a 0–100 scale, where 100 reflects severe upper-limb disability.[17]

Two teams with two physicians trained in occupational medicine (n = 4) performed the examinations according to a detailed clinical protocol with comprehensive descriptions of all procedures. The examiners were trained to use the clinical protocol, and common training sessions during the study were conducted to ensure the quality of the clinical data.

Two independent physical examinations were performed. In one examination, in which all 1369 participants were examined (blinded examination), the physician was blinded to the answers from the questionnaire and was not informed as to whether the subjects suffered from elbow pain or pain in one of the other regions. The examination was performed even if the day's pain intensity score was ''no pain''. All nine target regions were examined irrespective of regional case status. In this examination only questions related to whether a certain physical test was positive or not could be asked, and the examinee was not allowed to give any hints concerning symptoms/exposure to the examiner.

In the second examination, the non-blinded examination, which was performed about 5 min after the blinded examination, only participants who suffered from at least moderate pain in the elbow or forearm were examined. The examination included a structured interview concerning onset of symptoms, precise location of the worst pain, present pain status, medication, sick leave and medical treatment for the pain, followed by an examination of the elbow region and the adjacent forearm and shoulder region. During the interview the examiner could add questions as required. Both examiners were blinded to the answers of the DASH questionnaire and the questionnaire concerning current pain status. The duration of each examination was approximately 15–20 min.

The elbow region was defined distally as a transversal plane 5 cm below the olecranon and proximally as a transversal plane just proximal to the olecranon. The forearm region was defined proximally as a transversal plane 5 cm below the olecranon and distally as a transversal plane just proximal to the processus styloideus ulnae. The dorsal and volar side of the elbow and forearm were further subdivided into regions (fig 1). The surface of the regions was palpated systematically. Palpation tenderness was scored on a 0–3 scale (0 = none, 1 = mild without withdrawal; 2 = moderate with withdrawal, 3 = severe with jump sign). Palpation pressure was trained to be approximately 4 kg.

The examination also included an individual pressure pain threshold measured by means of Algometry (Somedic, Stockholm, Sweden). Pressure was applied with an increased

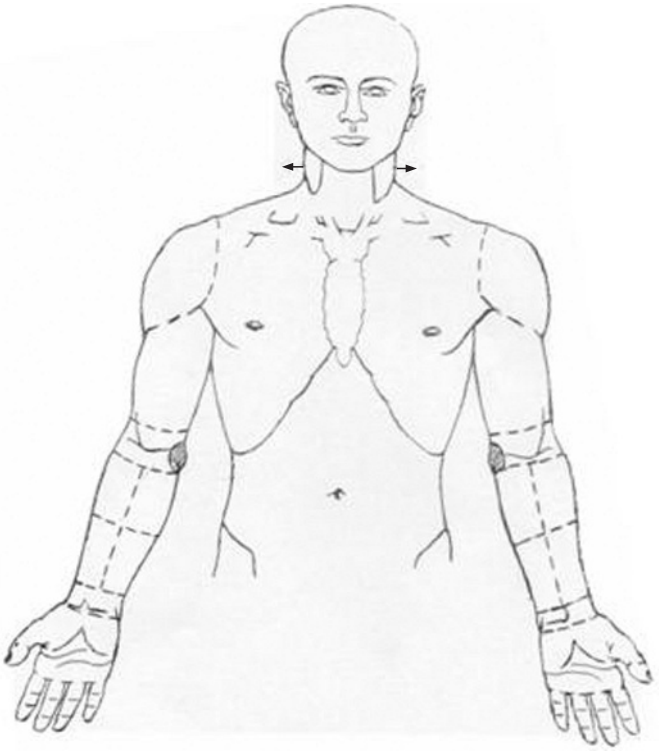

Figure 1 Subdivision of the forearm and elbow region.

rate of 50 kPa/s through a circular rubber-coated pressure head (area 1 cm^2). The mean values of measures on the tibia and vastus medialis muscle were thought to give an expression of the person's overall pain threshold, independent of elbow pain with pressure tenderness. Based on the mean values, and divided into gender, the 25% with the lowest pain pressure threshold was defined as having a ''low pain pressure threshold''.

Elbow outcomes

A history of at least moderate elbow pain combined with direct and indirect tenderness at the lateral epicondyle constituted sufficient criteria for lateral epicondylitis. This definition is similar to those used in most clinical practice and is consistent with accepted classification systems.[15 16]

Direct tenderness was considered positive if palpation on the lateral epicondyle or the adjacent tissue (up to 4 cm distal to the epicondyle) elicited any degree of palpation tenderness. Indirect tenderness was examined by resisted dorsal flexion of the wrist with the elbow stretched and was considered positive if exacerbation of pain was located in the specified area.

A baseline elbow case (BEC) was defined as subjects who reported at least moderate pain in the elbow in the baseline pain score, and a current elbow case (CEC) as subjects who reported at least moderate pain in the current pain score. The clinical diagnoses considered are (1) baseline lateral epicondylitis (BLE), defined as at least moderate pain in the elbow at the baseline pain score combined with direct and indirect tenderness, and (2) current lateral epicondylitis (CLE), defined as at least moderate pain in the elbow at the current pain score, combined with direct and indirect tenderness.

STATISTICAL ANALYSES

The associations between physical signs of lateral epicondylitis and baseline pain level and current pain level were tested in a logistic regression model with physical signs of lateral epicondylitis as the dependent variable. The model included pain level, divided into four categories: no pain, minor pain (categories very mild, mild and mild to moderate collapsed), moderate pain (moderate and moderate to severe pain), and severe pain (severe and very severe pain) and treated as dummy variables. The model further included gender, pain pressure threshold, age, body mass index (BMI), negative affectivity and a variable for each of the two clinical teams.

The reliability of the physical examinations were assessed by calculating kappa values for lateral elbow tenderness (0, 1), lateral elbow pain on resisted wrist extension (0, 1), and the combination of the two findings, where there was both elbow tenderness and pain on resisted extension (0, 1). The reliability was tested only among participants who suffered from at least moderate pain in the elbow or forearm (n = 349).

The Kappa statistic is a measure for testing whether agreement exceeds chance levels.[18] Values of kappa greater than 0.75 were considered excellent, values between 0.40 and 0.75 were fair to good, and values less than 0.40 represented poor agreement beyond chance.[19] Symmetry tests were performed with McNemar χ^2 statistics.

RESULTS

242 participants reported more than moderate pain in the elbow in the baseline questionnaire, while only 97 of these complained of the same degree of pain at the day of examination (table 1).

Thus, 60% had recovered from their moderate to severe pain at the day of examination. The majority of participants remained at the same symptom level (63%) when including participants with no symptoms. A higher proportion improved rather than worsened in elbow pain—19.0% and 14.0% respectively. The weighted kappa coefficient was 0.46 (95% CI 0.42 to 0.50) comparing the self-completed questionnaire at baseline and the self-administered questionnaire on the examination day regarding pain.

Physical examination

1369 people participated in the blinded examination, and among these 242 participants were baseline elbow cases (fig 2). The prevalence of participants with at least mild palpation tenderness and indirect tenderness at the right lateral epicondyle was 5.8% (n = 79) (fig 2). Physical signs were found in 24.7% of those who stated that they suffered from moderate to severe pain on the examination day (fig 2). This frequency was reduced to 16.9% when we used the questionnaire completed 14 days earlier. In the group with no pain, physical signs were found in 2.4% and 2.2% participants, respectively. Participants with moderate to severe pain in both questionnaires revealed increased prevalence of physical signs of lateral epicondylitis, from 21.7% to 60.0%.

About one half (n = 41) with physical findings reported more than moderate pain in the elbow in the baseline screening questionnaire, and thereby met our criteria for being a BEC, whereas only one third (n = 24) with physical findings experienced moderate to severe symptoms on the day of the examination, and thereby fulfilled the criteria for being a CEC (fig 2). A large part with physical findings reported no pain at all in the elbow in any of the questionnaires, 28% and 22% respectively.

We found indirect tenderness on resisted wrist extension among 101 subjects (7.5%), but 15% and 28% respectively reported no pain at all in the elbow or forearm at both pain scores (fig 2).

The number of participants with physical signs of lateral epicondylitis increased markedly by level of pain score (table 2).

This was seen for baseline pain and current pain as well, but the associations were strongest in the questionnaire completed just before the examination (current pain). None of the covariates—age, gender, low pain pressure threshold, team membership, BMI and negative affectivity—was significantly

Table 1 Frequency of elbow symptoms at baseline and on the day of examination

	Current pain score, number with symptoms (%)					
Baseline pain score	**No symptoms (0)**	**Mild symptoms (1–3)**	**Moderate symptoms (4–5)**	**Severe symptoms (6–7)**	**Total**	**Missing data**
No symptoms (0)	Stable 669 (48.9%)	Worsened 162 (11.8%)	Worsened 9 (0.7%)	Worsened 1 (0.1%)	866 (63.3%)	25 (1.8%)
Mild symptoms (1–3)	Resolved 89 (6.5%)	Stable 135 (9.9%)	Worsened 13 (1.0%)	Worsened 0	242 (17.7%)	5 (0.4%)
Moderate symptoms (4–5)	Resolved 32 (2.3%)	Improved 122 (8.9%)	Stable 46 (3.6%)	Worsened 5 (0.4%)	209 (15.3%)	4 (0.3%)
Severe symptoms (6–7)	Resolved 3 (0.2 %)	Improved 8 (0.6%)	Improved 14/ (1.0%)	Stable 8 (0.6%)	33 (2.4%)	0
Total	803 (58.7%)	432 (31.6%)	83 (6.1%)	14 (1.0%)	1369	37 (2.7%)
Missing data	10	5	1	0	19	3 (0.2%)

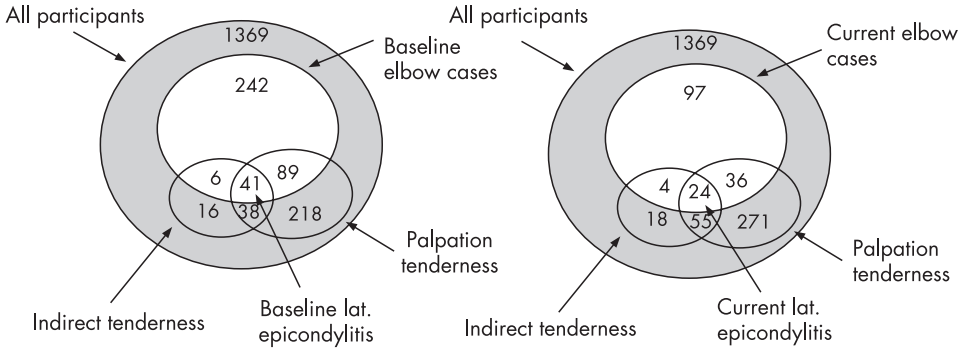

Figure 2 Distribution of physical signs in relation to baseline pain score and current pain score.

associated with physical signs of lateral epicondylitis, when adjustment for the effects of symptoms were made.

Using the physical signs as the ''gold standard'' the ability of the screening questionnaire (at least moderate pain at the baseline pain score) to classify subjects correctly was assessed by sensitivity, specificity; positive and negative predictive values (table 3).

There was a low sensitivity for the questionnaire in identifying subjects with physical signs of lateral epicondylitis (many ''false negatives''). The specificity of the questionnaire was fairly good (84%).

The non-blinded examination identified 21% subjects among participants with physical findings, but only about one third experienced more than moderate pain in the elbow on the examination day, and thereby met the criteria for being a CLE case; the majority stated none or mild symptoms.

The prevalence of participants with indirect tenderness in the non-blinded examination was 5.7% (n = 75), but it is worth noting that a large proportion of these participants (22.7%, n = 17) reported no pain or only very mild pain in the elbow in the current pain score questionnaire.

Disability

The mean DASH score was 23 (SD 15.3) among all participants with physical signs of epicondylitis, representing a mild degree of disability. Participants with moderate to severe pain had a slightly higher DASH score compared to participants with mild symptoms.

Reliability

Observed agreement between blinded and non-blinded examination was between 68% and 85% (table 4). After accounting for chance agreement, however, inter-examiner reliability was found to be low (kappa range 0.34–0.40). The poorest agreement was found for the diagnosis, but the reliability of reporting pain at the lateral elbow on resisted wrist extension was also low.

DISCUSSION

The main finding of the study was that in this very large cohort of computer workers very few subjects met commonly accepted specific criteria for lateral epicondylitis. The occurrence of clinical findings increased markedly by level of pain score, and the associations were strongest with pain scores in the questionnaire completed just before the examination. At baseline a pain score of at least moderate pain in the elbow identified only half of all clinical cases, and clinical signs were commonly found in subjects with no pain complaints. No further impact was achieved if the clinical examination was not blinded to the medical history.

In epidemiological settings the diagnosis of lateral epicondylitis often requires a combination of baseline self-reported complaints and clinical signs.[3 9 15 16] However the level of complaints required to qualify for a diagnosis should be examined as well as, in the case of epicondylitis and other upper extremity disorders, whether it would be more correct to use the current pain score in case definition.

Criteria for complaints of at least moderate pain within the last seven days used in this study were based on a consideration of what would be a reasonable indication of symptoms to define an epicondylitis. The argument was that ''no pain'' or ''mild pain'' within the last seven days does not indicate a disorder of clinical significance. However, the exact number of days with pain and the severity of pain required to meet diagnostic criteria for epicondylitis is debatable.

In general, we consider clinical findings as signs of tissue lesion or injury, and we probably all agree that clinical signs without any complaints do not meet criteria of an elbow

Table 2 Unadjusted and adjusted odds ratio with 95% confidence intervals for physical signs of lateral epicondylitis in relation to pain score at baseline and day of examination, age, gender, low pain pressure threshold and team membership, BMI and negative affectivity

	Physical signs of lateral epicondylitis (n = 79)			Physical signs of lateral epicondylitis (n = 79)	
	Crude OR	OR_{adj} (95% CI)		Crude OR	OR_{adj} (95% CI)
Basaeline pain score			Current pain score		
No pain (0)	1	1	No pain (0)	1	1
Minor pain (1)	2.6 (1.3 to 5.2)	2.7 (1.3 to 5.3)	Minor pain (1)	4.1 (2.3 to 7.3)	3.9 (2.2 to 6.9)
Moderate pain (2)	7.2 (4.1 to 12.9)	7.0 (3.9 to 12.6)	Moderate pain (2)	11.2 (5.5 to 22.8)	10.3 (5.0 to 21.0)
Severe pain (3)	15.1 (6.2 to 36.4)	15.5 (6.3 to 38.5)	Severe pain (3)	43.6 (13.8 to 137.3)	38.6 (11.9 to 122.1)
Age (10 year increment)	1.2 (1.0 to 1.6)	1.3 (1.0 to 1.7)	Age (10 year increment)	1.2 (1.0 to 1.6)	1.4 (0.9 to 2.3)
Female gender	1.2 (0.7 to 2.1)	0.9 (0.5 to 1.6)	Female gender	1.2 (0.7 to 2.1)	1.2 (0.9 to 1.6)
Low pain pressure threshold	1.6 (1.0 to 2.6)	1.3 (0.8 to 2.2)	Low pain pressure threshold	1.6 (1.0 to 2.6)	1.0 (0.6 to 1.9)
Team membership	1.8 (1.1 to 2.9)	1.3 (0.8 to 2.2)	Team membership	1.8 (1.1 to 2.9)	1.3 (0.7 to 2.1)

Table 3 Sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) of the screening baseline questionnaire and physical signs of epicondylitis

	+ Physical signs of epicondylitis	− Physical signs of epicondylitis	Total	
At least moderate pain (4–7)	41 (51.9%)	201 (15.6%)	242	PPV = 17.7%
No pain-mild pain (0–3)	38 (48.1%)	1088 (84.4%)	1227	NPV = 82.3%
Total	79	1289	1369	

diagnosis. Should subjects with mild pain and clinical signs have a diagnosis? Using clinical signs as the ''gold standard'' and as signs of tissue lesion, the general answer is ''yes'' (and at least when as much as one quarter of subjects with clinical findings scored mild pain). However, there is no ''gold standard'' for the diagnosis of lateral epicondylitis, although there is a better consensus on the criteria for this diagnosis compared with other upper extremity disorders.[10]

Most epidemiological studies on epicondylitis have used criteria including palpation tenderness and epicondylar pain provoked by resisted extension of the wrist with the elbow extended.[10 16] However, in the criteria document proposed by Sluiter *et al* the criterion of direct tenderness was not required. The clinical findings are however to a great extent dependent on the eyes and palpitating fingers of the individual examiner. Do we in fact share the same opinions about the delimitation of anatomic regions, the procedures to apply and how we induce pain by resisted movements, and subsequently on the relevant pain localisation? To heighten reproducibility between examiners and minimise the misclassification of clinical signs, this study benefited from a large number of subjects examined by two teams of trained physicians. Furthermore, the elbow region was subdivided into minor well-defined regions, and the reaction to palpation was scored on a 0–3 scale. Also, the subjects were examined blinded as well as non-blinded. Nevertheless, the reliability was poor even for the indirect tenderness. Walker-Bone *et al*[12] reported better inter-observer reliability for the elbow tests (with kappa range from 0.52–0.64), but for upper limb disorders in general reliability was poor. This is in agreement with other studies.[11 13] Salerno *et al* proposed that more reliable results could probably be achieved if the clinical examination was not blinded to the medical history. The present study does not confirm this hypothesis. Only about one third of the subjects with clinical findings experienced more than moderate pain on the day of examination, and would thereby (if we used the current pain score) have fulfilled the diagnostic criteria of being an epicondylitis case. Kappa values are sensitive to high or low prevalence,[20] which was of minor concern in this study, where the tables were quite symmetric. The two examinations were performed in separate rooms and the two doctors did not discuss examination issues, and so we consider them as independent medical examinations.

The aetiology of lateral epicondylitis is still poorly understood, but there is a general agreement that the extensor carpi radialis brevis muscle and its origin are involved in its pathogenesis.[21] Histopathological studies have provided conflicting results, but most authors consider the pain to be the result of a degenerative process with or without inflammation.[21 22] However, mechanistic studies are rare and most often include patients with chronic symptoms lasting for 2–3 years. In such cases, it is difficult to determine whether the changes reflect primary pathology or a secondary phenomenon.

Epicondylitis probably includes people with pain and degeneration at one end of the spectrum, and people with minor pain without any pathology at the other end. Perhaps the condition should be referred to as lateral epicondylalgia as proposed by Hager.[23] If the relatively arbitrary cut points on tenderness and pain on resisted extension exist, it is all termed lateral epicondylitis. If however we found an association between clinical signs and epicondylar pain, the overlap is too small to account for a distinctive diagnosis. Pain can be present without any clinical sign, and subjects may meet clinical criteria without experiencing any pain at all.

Most of the participants in epidemiological studies such as the NUDATA study go to work and are not disabled, which was also reflected by the low score on the DASH questionnaire, where mean scores corresponded to ''very mild disability'' or ''mild disability''. By performing several measurements in elucidating pain level, clinical findings and the ways in which ordinary daily activities are affected, a more thorough picture is painted of what elbow pain—with or without palpation tenderness, with or without disability—might be and means in terms of importance and impact for the individual worker. Performing epidemiological studies among healthy people has several drawbacks. Labelling otherwise neglected minor aches and pain as potential disorders or even diseases could eventually produce suffering, worrying and anxiety. Studies on one-year prevalence of pain reports—for example, from the use of the Nordic Questionnaire—often show prevalence of 40–70% of pain in loosely defined regions, but is that of any relevance with respect to what this minor pain means for doing

Table 4 Inter-rater agreement of physical signs between blinded and non-blinded examiner (n = 339–349)

	Examiner		Non-blind			Observed/expected agreement %	Kappa (SE)	Symmetry test (exact McNemar) p value
			Negative	Positive	Total			
Lateral elbow tenderness	Blind	Negative	128	59	187			
		Positive	49	103	152	68.1/50.2	0.36 (0.05)	0.39
		Total	177	162	339			
Lateral elbow pain on resisted extension	Blind	Negative	255	31	286			
		Positive	25	28	53	83.5/72.4	0.40 (0.05)	0.50
		Total	280	59	349			
Lateral elbow tenderness and indirect tenderness	Blind	Negative	273	30	303			
		Positive	22	24	46	85.1/75.4	0.39 (0.05)	0.33
		Total	295	54	349			

Policy implication

For the purpose of elucidating risk factors in epidemiological studies we propose that pain, clinical signs and disability are studied as separate outcomes and that the diagnoses of lateral epicondylitis should be used solely to cases with classical signs of inflammation reflected by severe pain and disability.

Main messages

- Very few with at least moderate pain in the elbow region met common specific criteria for lateral epicondylitis.
- The occurrence of physical findings increased markedly by level of pain score.
- Physical signs were commonly found in subjects with no pain complaints.

one's work, or performing everyday ordinary activities? That ought to be the question, but there is a lack of studies of this kind. In this study the clinical examinations were unreliable and this poses the question of whether one should include such clinical examinations at all in epidemiological studies. From a standard viewpoint on validity and reliability the answer is no, but from a clinical viewpoint the examinations did at least add to our own medical impression that the participants did not suffer from lateral epicondylitis in the way we have been taught in medical school and occasionally see in medical practice. This wisdom is of course of a casuistic nature, but it nevertheless adds further understanding than just computerised diagnostics based on a questionnaire.

For the purpose of elucidating risk factors in epidemiological studies we propose that pain, clinical signs and disability are studied as separate outcomes, and that diagnoses of lateral epicondylitis should be used solely in cases with classical signs of inflammation reflected by severe pain, which for example conveys some disability. Furthermore, it might be fruitful to combine pain, clinical signs, and aspects of disability, and make subgroup analyses in order to enlighten prognosis of the different degrees and perhaps types of elbow pain.

Authors' affiliations
A I Kryger, Department of Occupational and Environmental Medicine, Copenhagen University Hospital, Bispebjerg, Denmark
A I Kryger, C F Lassen, Department of Occupational Medicine, Copenhagen University Hospital, Glostrup, Denmark
C F Lassen, Danish Cancer Society, Institute for Epidemiological Cancer Research, Copenhagen, Denmark
J H Andersen, Department of Occupational Medicine, Herning Hospital, Herning, Denmark

Funding: The study was supported by grants from the Danish Medical Research Council; Contract grant number: nr 9801292, Danish Ministry of Employment, via National Work Environment Authority; Contract grant number: nr 220000010486.

Competing interests: None declared.

REFERENCES

1 **Jensen C**. Development of neck and hand-wrist symptoms in relation to duration of computer use at work. *Scand J Work Environ Health* 2003;**29**:197–205.
2 **Nakazawa T**, Okubo Y, Suwazono Y, *et al*. Association between duration of daily VDT use and subjective symptoms. *Am J Ind Med* 2002;**42**:421–6.
3 **Gerr F**, Marcus M, Ensor C, *et al*. A prospective study of computer users: I. Study design and incidence of musculoskeletal symptoms and disorders. *Am J Ind Med* 2002;**41**:221–35.
4 **Kryger AI**, Andersen JH, Lassen CF, *et al*. Does computer usage pose an occupational hazard for forearm pain: from the NUDATA study. *Occup Environ Med* 2003;**60**:e14.
5 **Brandt LPA**, Andersen JH, Lassen CF, *et al*. Neck and shoulder symptoms and disorders among Danish computer workers. *Scand J Work Environ Health* 2004;**30**:399–409.
6 **Lassen CF**, Mikkelsen S, Kryger AI, *et al*. Elbow and wrist/hand symptoms among 6943 computer operators: a 1-year follow-up study. *Am J Ind Med* 2004;**46**:521–33.
7 **Salerno DF**, Franzblau A, Amstrong TJ, *et al*. Test-retest reliability of the upper extremity questionnaire among keyboard operators. *Am J Ind Med* 2001;**40**:655–66.
8 **Andersen JH**, Gaardboe O. Musculoskeletal disorders of the neck and upper limb among sewing machine operators: a clinical investigation. *Am J Ind Med* 1993;**24**:689–700.
9 **Kaergaard A**, Andersen JH. Musculoskeletal disorders of the neck and shoulders in female sewing machine operators: prevalence, incidence, and prognosis. *Occup Environ Med* 2002;**57**:528–34.
10 **Walker-Bone KE**, Palmer KT, Reading I, *et al*. Criteria for assessing pain and nonarticular soft-tissue rheumatic disorders of the neck and upper limb. *Arthritis Rheum* 2003;**33**:168–84.
11 **Salerno DF**, Franzblau A, Werner RA, *et al*. Reliability of physical examination of the upper extremity among keyboard operators. *Am J Ind Med* 2000;**37**:423–30.
12 **Walker-Bone K**, Byng P, Linaker C, *et al*. Reliability of the Southampton examination schedule for diagnosis of the upper limb disorders in the general population. *Ann Rheum Dis* 2002;**61**:1103–6.
13 **Marx RG**, Bombardier C, Wright JG. What do we know about the reliability and validity of physical examination test used to examine the upper extremity. *J Hand Surg*, 1999;**24A**:185–93.
14 **Bertilson BC**, Grunnesjö M, Stender L-E. Reliability of clinical test in assessment of patients with neck/shoulder problems: impact of history. *Spine* 2003;**28**:2222–31.
15 **Sluiter JK**, Rest KM, Frings-Dresen MH. Criteria document for evaluating the work-relatedness of upper-extremity musculoskeletal disorders. *Scand J Work Environ Health* 2001;**27**(Suppl 1):1–102.
16 **Harrington JM**, Carter JT, Birrell L, *et al*. Suveillance case definitions for work related upper limb pain syndromes. *Occup Environ Med* 1998;**55**:264–71.
17 **McConnell S**, Beaton DE, Bombardier C. *The DASH Outcome Measure User's Manual*. Toronto, Ontario: Institute for Work & Health, 1999.
18 **Cohen J**. A coefficient of agreement for nominal scales. *Educ Psychol* 1960;**20**:37–46.
19 **Fleiss JL**. *Statistical methods for rates and proportions*, Second edition. New York: John Wiley and Sons, 1981.
20 **Feinstein AR**, Cicchetti DV. High agreement but low kappa: the problems of two paradoxes. *J Clin Epidemiol* 1990;**43**:543–9.
21 **Ljung B-O**, Lieber RL, Fridén J. Wrist extensor muscle pathology in lateral epicondylitis. *J Hand Surg* 1999;**24B**:177–83.
22 **Jensen B**, Savnik A, Bliddal H, *et al*. *Ugeskrift for Læger* 2001;**163**:1417–21.
23 **Hager E**. *Lateral epicondylalgia (tennis elbow). A diagnostic and therapeutic challenge*, Thesis.Department of Physiology II, Karolinska Institutet, Stockholm, Sverige.