

Diagnostic distribution of non-traumatic upper limb disorders: vibrotactile sense in the evaluation of structured examination for optimal diagnostic criteria

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KEY WORDS

Diagnostic criteria; muscle connective tissue disorders; neuropathy; vibration perception threshold (VPT); upper limb disorders

SUMMARY

Background: Upper limb disorders (ULDs) are common, and so are the difficulties in specific diagnoses of these disorders. Prior studies have shed light on the nerves in the diagnostic approach beside disorders related to muscles, tendons and joints (MCDs). **Objective:** The study aimed to compare the distribution of upper limb disorders, and the vibration perception threshold (VPT) in different diagnostic groups according to 1) A-criteria: the SALTSA consensus criteria, including MCDs and four peripheral neuropathies, and 2) B-criteria: including MCDs and 10 different neuropathy diagnoses – re-defined in an attempt to refine diagnostic criteria of peripheral neuropathy in respect of different MCDs; and further to discuss the impact of the presented criteria. **Methods:** 161 patients – recruited from 21 general practitioners – were examined by the same examiner according to the two sets of diagnostic criteria. VPT measurements were conducted in all patients. **Results:** Three patients did not fulfill the criteria of any ULD diagnosis. A/B criteria were fulfilled for 181/183 upper limbs, respectively, out of which 29.3%/63.3% were neuropathy diagnoses alone, 23.8%/10.9% MCD alone, and 46.9%/25.7% were categorized as neuropathy in combination with MCD diagnoses. The overall agreement on presence of neuropathy was high (75%), but on focal level there was a large discrepancy. According to the A-criteria, patients with symptoms located at wrist and shoulder were primarily defined with wrist diagnoses, and only few had concomitant shoulder diagnoses. In contrast, the B-criteria primarily defined neuropathy located at the shoulder, often concomitantly with neuropathy of the radial and the median nerve at the elbow, but seldom at the wrist level. In MCDs defined by both sets of criteria – Rotator cuff syndrome and medial/lateral epicondylitis – the A-criteria defined more MCDs than the B-criteria, the B diagnoses typically constituted only a part of the A diagnoses and additionally defined neuropathy. The B-criteria showed more significant VPT findings than the A-criteria concerning the discrimination between limbs with and contralateral limbs without diagnoses as well as between diagnostic groups with and without neuropathy. **Conclusions:** The VPT findings suggest the B-criteria to be superior to A-criteria for differentiating between patients with and without neuropathy. This study shows that neuropathy is extensive in ULDs when specific diagnostic criteria are used. Additionally it suggests the importance of a critical revision of the current diagnostic criteria of upper limb neuropathy, and the differential diagnoses concerning the MCDs. Management and prevention is highly dependent on correct diagnoses.

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RIASSUNTO

«Distribuzione diagnostica delle patologie dell'arto superiore di origine non traumatica: la percezione vibrotattile nel contesto di un esame clinico strutturato volto a migliorare i criteri diagnostici». Le patologie dell'arto superiore sono assai comuni e di difficile classificazione diagnostica. In passato alcuni studi hanno considerato aspetti relativi alla funzione dei nervi nell'approccio diagnostico accanto alle alterazioni di muscoli, tendini e articolazioni. Questo studio si propone di confrontare la distribuzione delle patologie dell'arto superiore e dei risultati della misura della soglia di percezione delle vibrazioni (Vibration Perception Threshold -VPT) in differenti gruppi diagnostici in accordo con: 1) Criteri A, cioè i criteri del documento di consenso SALTSA, riguardanti le patologie di muscoli, tendini e articolazioni e quattro neuropatie periferiche e 2) Criteri B, che includono le patologie di muscoli, tendini e articolazioni e dieci differenti diagnosi di neuropatia - ridefinite nel tentativo di affinare i criteri diagnostici di neuropatia periferica rispetto alle diverse patologie di muscoli, tendini e articolazioni. In seconda istanza, lo studio si pone lo scopo di valutare i risultati dell'applicazione dei suddetti criteri. 161 pazienti, reclutati da 21 medici di medicina generale, sono stati studiati dallo stesso esaminatore in conformità con le due serie di criteri diagnostici. In tutti i pazienti è stata calcolata la soglia di percezione delle vibrazioni. Tre pazienti non soddisfacevano alcun criterio diagnostico indicativo di patologia degli arti superiori. I criteri A-B erano soddisfatti rispettivamente per 181-183 arti superiori, dei quali, sempre rispettivamente, il 29,3%-63,3% era relativo alla diagnosi di una neuropatia, il 23,8%-10,9% corrispondeva ad una patologia di muscoli, tendini e articolazioni, il 46,9%-25,7% è stato classificato come affetto da una patologia mista (neuropatia in combinazione con una patologia di pertinenza di muscoli, tendini e articolazioni). La concordanza generale riguardo alla presenza di neuropatia è stata alta (75%), ma, per quanto concerne le diagnosi specifiche, è emersa una notevole discrepanza adottando gli uni o gli altri criteri. Seguendo i criteri A i pazienti con sintomi localizzati a polso e spalle sono stati per lo più inquadrati con diagnosi di neuropatia localizzata al polso e solo a pochi è stata attribuita una concomitante diagnosi a livello della spalla. Al contrario, l'applicazione dei criteri B portava principalmente alla diagnosi di neuropatie localizzate alla spalla, spesso in associazione con neuropatie del nervo radiale e mediano al gomito, ma raramente a livello del polso. Per quanto riguarda le patologie di muscoli, tendini e articolazioni, definite da entrambe le serie di criteri (sindrome della cuffia dei rotatori e epicondilite mediale/laterale), l'applicazione dei criteri A portava all'identificazione di un maggior numero di casi rispetto all'utilizzo dei criteri B; i casi definiti applicando i criteri B costituivano solo una parte di quelli ottenuti applicando i criteri A e casi di neuropatie identificati in aggiunta. I criteri B hanno mostrato risultati più significativi di soglia di percezione delle vibrazioni rispetto ai criteri A per quanto riguarda la capacità di discriminazione tra arti con una diagnosi di neuropatia rispetto ai corrispondenti arti controlaterali senza neuropatia, come pure tra gruppi diagnostici con e senza neuropatia. I risultati relativi alla misura della soglia di percezione delle vibrazioni suggeriscono che i criteri B sono superiori ai criteri A nel differenziare i pazienti con e senza neuropatia. Questo studio dimostra che una neuropatia è largamente presente nelle patologie degli arti superiori nel caso in cui vengano utilizzati specifici criteri diagnostici. Inoltre sottolinea l'importanza di una revisione critica dei criteri correntemente utilizzati nella diagnosi di neuropatia dell'arto superiore e nella diagnosi differenziale nell'ambito delle malattie muscoloscheletriche. La gestione e la prevenzione di queste patologie dipendono fortemente da una corretta diagnosi.

BACKGROUND

Upper Limb Disorders (ULDs) are common among patients in the primary and secondary health sector, among patients on sick leave/early-retirement, and among patients notifying work-related disorders (8, 13, 32, 36, 45), and cause substantial financial consequences (1, 9). ULD patients represent a challenge with respect to proper diagnosis and according to current estimates only a

quarter of patients are diagnostically classifiable (31), the rest may be undiagnosed or labeled with non-specific diagnostic acronyms e.g. *repetitive strain injury* (RSI), *cumulative trauma disorder*, and *overuse syndrome of the upper limb*. These unspecific designations signalize that the physical examination fails to identify well-described clinical conditions. Recently, to overcome this problem, an attempt has been made to look at case definition as a practical method in distinguishing groups of peo-

ple whose illnesses share the same causes or determinants of outcome (5). Thus the case definitions may be varying according to the purpose for which it is applied, and so far causality has been tested as risk factor profiles for different diagnostic categories of ULD according to a specific test scheme has been compared (40, 47). However, the underlying pathology is still an important factor by managing ULD and emphasizes the need for validation of specific diagnostic criteria.

Commonly associated symptoms such as pain, and numbness/tingling in ULD patients suggest involvement of the peripheral nerves. This is supported by studies finding an elevated vibration perception threshold (VPT) level among computer users with symptoms in the hand and forearm region (17), and in patients with RSI (11). In a former study we have compared VPT between a group of ULD patients with different diagnoses (24) defined from diagnostic criteria developed by a group of European experts (SALTSA) (41) and a control group. Patient groups defined with neuropathy demonstrated significantly higher VPT in the limb with diagnoses compared with the contralateral limb without diagnoses, while this was not the case for patients diagnosed with muscular- and connective-tissue disorders (MCD) only.

Other studies have demonstrated that in ULD patients a systematic and detailed physical examination can reliably disclose or exclude neurological patterns reflecting upper limb focal compression neuropathy with specific locations (18, 19) including neuropathy of the brachial plexus. The examination includes assessment of strength in representative muscles, sensory qualities in selected innervation territories, and nerve trunk mechanosensitivity at defined locations. Based on anatomy and pathophysiology, patterns of muscle weakness, abnormal sensibility and mechanical allodynia disclose neuropathies at specific locations. The ability of this examination to predict upper limb symptoms in a sample of patients in a secondary occupational medicine referral centre (18) suggests its diagnostic potential.

The SALTSA criteria do not include thoracic outlet syndrome (TOS) because it is difficult and controversial, and pronator teres is not included

because of low prevalence (41). The aforementioned studies have shown a huge number of neuropathies at the brachial plexus, demonstrated too in another study (33). Other studies have found neuropathy at other locations (12,28), thus it seems to be reasonable to question if the SALTSA criteria should be revised.

In the present study the SALTSA diagnostic criteria are revised according to the aforementioned studies (2, 19). E.g. criteria for 10 differentiated neuropathy diagnoses including proximal neuropathy at the brachial plexus are introduced. Also, the criteria of MCDs are adjusted in respect of the differentiated neuropathy diagnoses. Finally, we present VPT results of the same group of patients as presented in our previous study grouped by the SALTSA criteria (24), but now grouped according to the revised criteria in order to evaluate if these criteria more optimally separate patient with neuropathy and non-neuropathic diagnoses.

SUBJECTS AND METHODS

Subjects

The population included in this study has been described previously (24). In short, the inclusion criteria were: age 16-65 years and upper limb symptoms. The exclusion criteria were: history of acute trauma, pregnancy or alcoholism, and disorders predisposing to upper limb conditions, that is rheumatoid arthritis, cardiac diseases, hypothyroidism, diabetes mellitus, amyloidosis, polyneuropathy, and B₁₂ vitamin deficiency. A total of 277 patients were identified by 21 general practitioners (GPs) in the counties of Esbjerg and Varde, Denmark. Patients, who came to their GPs with upper limb symptoms, were examined and diagnosed as usual. The GPs were informed to recruit study-patients according to the inclusion and exclusion criteria. If the patients accepted participation they were transferred to this study. Among the 169 patients who agreed to participate, eight were subsequently excluded at symptom interview due to predisposing diseases (five) and acute trauma (three). The final study population included: 113 women,

median age 44 (range 19-64) years, median BMI 25 (range 18-47); and 48 men, median age 45 (range 28-65) years, median BMI 25 (range 18-36).

The period of data collection was September 2001 - January 2003. The study was approved by the Local Ethic Committee, and all participants signed informed consent.

Diagnostic criteria

All non neuropathy diagnoses in this context are denoted as MCDs. Based on the aforementioned diagnostic variables, differential diagnoses were specified for each patient according to two sets of diagnostic criteria:

A-criteria: are the set of criteria reported in our previous study in detail (24). In short: consensus criteria were applied that were considered to be the best documented and most widely accepted suggestion of reference criteria available (2,24) defined in "Criteria Document for Evaluation of the Work-Relatedness of Upper Extremity Musculoskeletal Disorders (SALTSA)"(41), and supplied with criteria for *myofascial pain syndrome* (22) and *frozen shoulder* (16). However, three diagnoses were omitted from the SALTSA criteria in this study: 1) The first criterion - "Radiating neck complaints" - as this diagnosis must be distinguished from osteoarthritis of the cervical spine, cervical syndrome

(nerve root compression), TOS, and shoulder tendinitis, and no criteria are set up for these disorders in the SALTSA criteria; 2) The 10th criterion for vibration induced neuropathy, because of missing information about moving 2 point discrimination (we were not able to do this examination, but only few patients fulfilled the criterion of preceding vibratory influence) ; and 3) The 12th criterion on nonspecific ULDs, as no case definition is available.

B-criteria: include 10 differentiated neuropathy criteria based on the results of prior studies (18,20) and specified in table 1. This approach assigned neuropathy by the B-criteria to the most proximal location. An additional distal neuropathy diagnosis demanded distal score deviations (from normal) in muscle strength, sensibility and mechanical allodynia to be at least as high as the proximal score deviations. Further, the B-criteria comprised criteria for ULDs not included in the A-criteria - root compression syndrome, trigger finger, Dupuytren's disease, ganglion, Kienboeck's disease, olecranon bursitis, shoulder neuritis, and Raynaud's phenomenon - but only few of these diagnoses were defined in patients in this study, thus the criteria are not shown here. The B-criteria also comprised MCD criteria defined in respect of neuropathic differential diagnostic considerations: *Rotator cuff syndrome* - The A-criteria diagnoses include biceps tendinitis in the rotator cuff diagnosis, however, these conditions are preferentially separated in diagnostic and

Table 1 - Diagnostic criteria of neuropathy defined by the B criteria

Neuropathy diagnoses by the B criteria	Symptoms	Muscle strength	Mechanical allodynia, MA sensibility changes, SC and other findings
Brachial plexus supraclavicular G54.0	Pain in neck, shoulder, arm, or hand <u>or</u> weakness in shoulder, arm or hand <u>or</u> sensory changes in shoulder, arm or hand	Reduced: Infraspinatus, Post. deltoid and Biceps Normal: FCR (unless more distal affection too)	MA: Max. pain at the Scalene Triangle SC: Deltoid region
Brachial plexus infraclavicular G54.0	Pain in neck, shoulder, arm, or hand <u>or</u> weakness in shoulder, arm or hand <u>or</u> sensory changes in shoulder, arm or hand	Reduced: Posterior del-toid, biceps, FCR, and one/more of the following: Triceps, ECRB, EPL; FPL, APB; Pectorals; FDP V, and ADM	MA: Max. pain at infraclavicular plexus SC: Deltoid region

(continued)

Table 1 - (continued) Diagnostic criteria of neuropathy defined by the B criteria

Neuropathy diagnoses by the B criteria	Symptoms	Muscle strength	Mechanical allodynia, MA sensibility changes, SC and other findings
Suprascapular nerve G56.8	Pain in the back of the shoulder <u>or</u> weakness in shoulder	Reduced: Infraspinatus Normal: Posterior Deltoid and Biceps	MA: At Scapular incisure (Min. 5 VAS score)
Axillary nerve G56.8	Pain in the shoulder region (posterior deltoid) <u>or</u> weakness in the shoulder	Reduced: Post. deltoid (anterior and medial too)	MA: Quadrilateral space SC: Deltoid region
Radial nerve triceps arcade G56.3	Pain in lateral upper arm or weakness by elbow extension <u>or</u> sensory changes at 1 st dorsal web	Reduced: Triceps, ECRB, and EPL Normal: Infraclavicular plexus ***	MA: At Triceps Arcade SC: 1 st dorsal web
*Radial nerve PIN G56.3	Pain proximal in lateral part of forearm on the extensor side, and lateral in elbow <u>or</u> weakness by wrist or finger extension <u>and</u> no sensory changes	Reduced: ECU Normal: Triceps, ECRB and EPL ***	MA: At Frohse's Arcade, 3-4 fingers distal to lateral epicondyle SC: No sensory changes
Median nerve elbow level G56.1	Pain in medial elbow region and flexor side of the forearm <u>or</u> weakness in pinche grip <u>or</u> sensory changes in 2 nd and 3 rd finger volar side	Reduced: FCR and FPL Normal: Infraclavicular plexus ***	MA: Medial upper arm, at Lacertus Fibrosus, Pronator Teres or the Superficialis Arcade SC: 2 nd and 3 rd finger
*Median nerve CTS G56.1	Pain or sensory changes in hand or fingers which wake up the patient in the night and disappear by shaking the hand	Reduced: APB Normal: FCR and FPL***	MA: At carpal tunnel SC: 2 nd and 3 rd finger. Phalen positive
*Ulnar nerve elbow level G56.2	Sensory changes of the 5 th finger <u>or</u> pain and tenderness in medial elbow and distally <u>or</u> weakness of the hand in general	Reduced: FDP V and ADM Normal: Pectorals	MA: At sulcus SC: 5 th finger tip volar Tinel positive
*Ulnar nerve Guyon's canal G56.2	5 th finger sensory changes <u>or</u> weakness of the hand in general <u>or</u> pain in 5 th finger or hypothener	Reduced: ADM Normal: FDP V	MA: Guyon's canal SC: 5 th and ulnar part of 4 th finger

* These diagnoses are defined too in the A criteria (41), and here modified according to the B criteria, ** Time rule for symptoms as defined by the A criteria⁴¹. *** Unless neuropathy is defined at a more proximal level too.

SC: Sensibility changes are defined by: light touch and pinprick with values ≤ 8 , or hyper excitability, or abnormal vibratory findings by tuning fork 256Hz. MA: Mechanical allodynia at 3 Kp: positive VAS scores are defined as abnormal, but pure motor nerves demand a minimum score of 5. Reduced strength: Scores > 0

therapeutic use, and so in this study according to the B criteria. Additionally the assumption that a rotator cuff diagnosis may occur simultaneously with neuropathy of the brachial plexus implies sensory changes to be permitted in these cases; *Medial/lateral epicondylitis*: more “restrictive” criteria are included in the B-criteria to make a clearer distinction between these diagnosis and neuropathy at elbow level; *De Quervain’s syndrome*: Finkelstein’ test is the ultimate diagnostic test; *Osteoarthritis of distal limb*: clinical findings of swelling and tenderness are demanded as well as the restricted movements demanded according to the A-criteria; *Frozen shoulder*: clinical findings of disturbed rhythm and restriction of movement in the frontal plane are demanded in addition to the diagnostic criteria defined in the A-criteria document. Additionally *disorders of the forearm were included* (table 3), but in the present study only a few of these were found, and the criteria are not presented. Limbs defined with ulnar neuropathy at the elbow *and* wrist level are presented separately, although the A-criteria (41) prescribes a pooling of these. ICD codes (10th revision, 2nd edition, 1992) were used.

Examination of study patients

Patients were reexamined, preferable within a week of consulting their GPs. Anamnestic information was collected via an interview questionnaire followed by a clinical examination comprising all the following tests in both upper limbs:

1) Manual muscle strength test of 17 upper limb muscles were performed according to modified standard techniques (20, 21, 26, 43, 44)

2) Mechanical allodynia (MA) along the nerve bundles (7, 14, 15, 19, 37) was examined with the examiner’s thumb exerting a pressure of 3 Kp (frequently recalibrated) at 10 locations of compression neuropathy (table 1). The subjects scored perceived pain on a visual analogue scale (VAS) (0=no pain, 10=maximal pain),

3) Sensibility was examined by light touch and pinprick (42) (table 1) in five homonymously innervated regions corresponding to the peripheral nerves. The subjects scored the sensibility results on a VAS (10=normal sensibility, 0=no sensibility).

Additionally perception of vibration was examined at the second and fifth fingertips with a tuning fork 256hz and by vibrometry.

4) Active and passive limb movements were examined with patients in a standing position in front of the examiner (table 2 and SALTSA) (41),

5) A total of 29 specific standardized tests such as Phalen’s and Finkelstein’s test were performed as prescribed (table 2 and SALTSA)(41),

6) Specific diagnostic tests concerning inspection and palpation of tendons and muscles were performed according to the clinical examinations included in the A (16, 22, 41) and B criteria (table 2 and SALTSA) (41).

Diagnostic interpretation

Clinical testing was conducted by one examiner (author, LHL) following a scheme and testing all separate clinical signs occurring in all the diagnoses in the test panel comprising 119 test results on each side. All patients were tested by all clinical tests in both limbs, and on another day the diagnostic interpretation was made according to a route diagram showing the findings fulfilling the criteria.

Vibrometry testing

The VPT was determined with a Somedic vibrometer testing at a fixed frequency of 100Hz (11, 17, 24, 35) for the three sensory nerves innervating the hand, the median nerve between the first and the second metacarpals at the palm, the ulnar nerve at the dorsum of the fifth metacarpal bone, and the radial nerve dorsally at the at the second metacarpal bone. For more details see (24).

STATISTICS

The statistical package of EPI-data (version 2.0) was used for double registration and checking of the database, and SPSS (version 11.0) was used for further statistical analyses.

The VPT mean values for the right and the left limbs were compared by the non-parametric Wilcoxon rank test, and comparison of VPT be-

Table 2 - Diagnostic criteria of MCDs defined by the B criteria

Diagnosis	Symptoms	Clinical findings
*Rotator cuff syndrome M75.1	Intermittent pain in the shoulder region <u>and</u> pain is worsened by active elevation movement of the upper arm <u>and</u> no paraesthesia (<i>except when concomitant neuropathy of the plexus is defined</i>)	Shoulder abduction against resistance causes local pain <u>and</u> external rotation of shoulder causes local pain <u>and</u> local palpation tenderness at supra/infraspinatus tendon <u>and</u> rhythm of movement affected (+pain arch)
Biceps tendonitis M75.2	Intermittent pain in the shoulder region <u>and</u> pain is worsened by active elevation movement of the upper arm <u>and</u> no paraesthesia (<i>except when concomitant neuropathy of the plexus is defined</i>)	Supination against resistance with flexed elbows causes pain at biceps tendon <u>and</u> elbow flexion against resistance causes pain at biceps tendon <u>and</u> local soreness and swelling at biceps tendon
*Frozen shoulder M75.0	Active as well as passive movements restricted and preceded by unilateral pain in deltoid region	Shoulder movements reduced according to rhythm and extent in frontal plane <u>and</u> passive movements limited at abduction and outward rotation
Osteoarthritis shoulder M19.8	Intermittent pain, at or around the acromio clavicular joint <u>or</u> stiffness in movements after a resting period	Palpation tenderness <u>and</u> swelling <u>and</u> pain on active movement in shoulder : abduction of upper limb from 90°- 180°
*Medial Epicondylitis M77.0	Activity related pain located directly around the medial epicondyle	No weakness of FPL and FCR (<i>except when concomitant neuropathy is defined at elbow level</i>) <u>and</u> palpation soreness at the top of the epicondyle
*Lateral Epicondylitis M77.1	Activity related pain located directly around the lateral epicondyle	No weakness of ECU (<i>except when concomitant neuropathy is defined at elbow level</i>) <u>and</u> distinct palpation pain located distally to the lateral epicondyle <u>and</u> wrist extension against resistance causes distinct pain distally to the lateral epicondyle

* These MCDs are also defined – but with other criteria definitions - according to the A criteria

tween different independent groups by the non-parametric Mann-Whitney rank test. Frequency tables were drawn to show the diagnostic distribution according to both sets of criteria. Significance was set at the $p < 0.05$ level.

RESULTS

Diagnostic distribution

The distribution of the total number of diagnoses in limbs for the 161 patients divided in unilateral and bilateral diagnostic groups is shown in

table 3. Several diagnoses may have been identified in each limb. The columns of “total” are showing the total number of diagnoses in the total number of limbs examined. All diagnoses are arranged according to localization from proximal to distal, and MCDs preceding neuropathy diagnoses.

98.1% of all patients fulfilled criteria of an ULD diagnoses according to at least one set of criteria (91.9% according to the A-criteria and 93.2% according to the B-criteria). 181 limbs were defined with diagnoses according to the A-criteria, 183 according to the B-criteria. According to the A/B-criteria 29.3%/63.3% of these were categorized with *neuropathy*, 23.8%/10.9% with *MCD*, and

Table 3 - Distribution of diagnoses in patients with uni- and bilateral diagnoses according to the A and B criteria

Diagnoses	ICD-code	A diagnoses (Patients N)				B diagnoses (Patients N)				Agreement between A and B diagnoses (Total)
		Unilateral N=115	Bilateral N=33		Total	Unilateral N=117	Bilateral N=33		Total	
			Right	Left			Right	Left		
Root compression syndrome	M50.1	-	-	-	-	-	1	0	0	1
Myofascial pain syndrome, shoulder (A)	M53.1	12	11	11	34	-	-	-	-	-
Myofascial pain syndrome, neck (A)	M53.1	7	10	10	27	-	-	-	-	-
Rotator cuff syndrome (2)	M75.1/.2	42	4	6	52	15	2	4	21	19
Biceps tendinitis	M75.2	-	-	-	-	15	1	2	18	-
Frozen shoulder (A)	M75.0	4	1	1	6	5	1	0	6	5
Osteoarthritis, shoulder	M19.8	-	-	-	-	3	1	1	5	-
Medial epicondylitis (3)	M77.0	8	0	2	10	0	1	2	3	3
Lateral epicondylitis (3)	M77.1	27	5	4	36	5	1	2	8	7
Bursitis olecranon	M70.2	-	-	-	-	1	1	0	2	-
Flexor peritendinitis/tenosynovitis of forearm/wrist (6) (6)	M70.0/70.8	1	0	0	1	-	-	-	-	-
FCR-tenosynovitis	M70.8	-	-	-	-	0	0	0	0	-
Tenosynovitis of the flexors	M70.0	-	-	-	-	0	0	0	0	-
Closed compartmentsyndrom	M70.8	-	-	-	-	2	0	0	2	-
Extensor peritendinitis/tenosynovitis of forearm/wrist (6) (6) region (6)	M70.0/70.8	3	0	0	3	-	-	-	-	-
Intersection syndrome	M70.8	-	-	-	-	0	0	0	0	-
Tenosynovitis crepitans	M70.0	-	-	-	-	1	0	0	1	-
Synovitis of the wrist	M70.0	-	-	-	-	1	0	0	1	-
De Quervain's syndrome (7)	M65.4	9	0	2	11	8	0	1	9	9
Osteoarthritis of distal upper extremity (11)	M15.1/18.9	1	2	1	4	1	1	1	3	2
Trigger finger	M65.3	-	-	-	-	1	0	2	3	-
Dupuytren's disease	M72.0	-	-	-	-	0	0	1	1	-
Ganglion	M67.4	-	-	-	-	2	1	1	4	-
Kienboeck's disease	M93.1	-	-	-	-	0	0	0	0	-
Raynaud's phenomenon (10)	T75.2	1	0	0	1	-	-	-	-	-
Raynaud's phenomenon (not vibration induced)	I73.1	-	-	-	-	1	0	0	1	-
Neuropathy, brachial plexus, supraclavicular affection	G54.0	-	-	-	-	20	7	9	36	-
Neuropathy, brachial plexus, infraclavicular affection	G54.0	-	-	-	-	84	25	22	131	-
Neuropathy, suprascapular nerve	G56.8	-	-	-	-	31	14	15	60	-
Neuropathy, axillary nerve	G56.8	-	-	-	-	22	11	8	41	-
Neuropathy, radial nerve, Triceps arcade	G56.3	-	-	-	-	20	8	6	34	-

(continued)

Table 3 - (continued) Distribution of diagnoses in patients with uni- and bilateral diagnoses according to the A and B criteria

Diagnoses	ICD-code	A diagnoses (Patients N)				B diagnoses (Patients N)				Agreement between A and B diagnoses (Total)
		Unilateral N=115	Bilateral N=33		Total	Unilateral N=117	Bilateral N=33		Total	
			Right	Left			Right	Left		
Neuropathy, radial nerve, radial tunnel (5)	G56.3	28	5	3	36	25	7	7	39	17
Neuropathy, median nerve, elbow level	G56.1	-	-	-	-	40	12	9	61	-
Neuropathy, median nerve, CTS (8)	G56.0	65	25	27	117	3	4	2	9	9
Neuropathy, ulnar nerve, elbow level (4)	G56.2	18	9	8	35	9	1	1	11	7
Neuropathy, ulnar nerve, Guyon's canal (9)	G56.2	42	22	15	79	1	1	0	2	1
Total number of diagnoses		268	94	90	452	317	100	96	513	79

Total number of limbs with diagnoses according to the A/B criteria: 181/183;

* Total number of patients examined: 98. () A criteria; numbers assigned in the SALTSA criteria document

46.9%/25.7% with *neuropathy and MCD*, respectively.

Diagnoses defined by only one set of criteria or for which there was a poor concordance between the numbers defined by the two sets of criteria are presented in tables 4 and 5.

Diagnoses few in number defined by the A- and/or B-criteria (i.e.: flexor peritendinitis/tenosynovitis of forearm/wrist, FCR-tenosynovitis, tenosynovitis of the flexors, closed compartmentsyndrom, extensor peritendinitis/tenosynovitis of forearm/wrist region, intersection syndrome, tenosynovitis crepitans, synovitis of the wrist, De Quervain's syndrome, Raynaud's phenomenon, Raynaud's phenomenon - not vibration induced, osteoarthritis of distal upper extremity, root compression syndrome, trigger finger, Dupuytren's disease, ganglion, Kienboeck's disease, and olecranon bursitis), and diagnoses few in number and with a high agreement between A- and B-criteria (frozen shoulder and de Quervain's syndrome) - are pooled in the group of "other diagnoses" in the tables 4 and 5.

In table 4 the 8 main columns represent the specific diagnoses fulfilling the A-criteria, either defined only by the A-criteria (myofascial pain syndrome) or for which there was a poor agreement

between the two sets of criteria (Rotator cuff syndrome, medial and lateral epicondylitis, neuropathy at the radial tunnel, CTS, and neuropathy of the ulnar nerve at the elbow and at Guyon's canal) taking the A-criteria as the point of departure. Each main column - representing the number of each of these diagnoses found by the A-criteria - is divided into two sub columns, the first sub column representing the number of concomitant diagnoses according to the A-criteria, and the second sub column representing the number of corresponding diagnoses (to the main column diagnosis) according to the B-criteria. An example: *Lateral epicondylitis*: The fourth main column represents lateral epicondylitis (n=36, cell shaded), and the concomitant-diagnoses by the A-criteria are found in the first sub column, showing that 21 of these additionally were diagnosed with radial tunnel neuropathy and 22 with CTS according to the A-criteria. The second sub column shows the corresponding diagnoses (to the 36 lateral epicondylitis) defined by the B-criteria. According to the B-criteria there was only agreement in 7 of the 36 cases of lateral epicondylitis defined by the A-criteria, and the B criteria was mainly defining *neuropathy* at the brachial plexus (infraclavicular, N=23), and at the radial tunnel (N=17).

Table 4 - Diagnoses based on the A criteria and the corresponding diagnoses according to the B criteria

Diagnoses by the A criteria	Myofascial pain syndrome shoulder & neck N=48		Rotator cuff syndrome N=54		Medial epicondylitis N=10		Lateral epicondylitis N=36		Neuropathy radial tunnel N=36		Neuropathy CTS canal N=117		Neuropathy ulnar nerve elbow N=35		Neuropathy ulnar nerve Guyon's N=79	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
Myofascial pain syndrome, shoulder	34*	-	13*	-	1*	-	3*	-	6*	-	26*	-	7*	-	18*	-
Myofascial pain syndrome, neck	27*	-	4*	-	1*	-	2*	-	3*	-	20*	-	5*	-	12*	-
Rotator cuff syndrome	14	7	52	19	2	2	5	1	5	1	28	13	7	2	19	7
Biceps tendinitis	-	4	-	14	-	2	-	1	-	1	-	12	-	2	-	6
Medial epicondylitis	1	1	2	1	10	3	6	1	8	3	9	3	2	0	4	1
Lateral epicondylitis	4	2	5	1	6	0	36	7	21	3	22	4	7	1	16	3
Neuropathy, brachial plexus, supra-clavicular	-	15	-	8	-	2	-	6	-	6	-	31	-	9	-	20
Neuropathy, brachial plexus, infra-clavicular	-	35	-	34	-	8	-	23	-	27	-	100	-	32	-	69
Neuropathy, suprascapular n.	-	17	-	14	-	2	-	9	-	9	-	48	-	3	-	32
Neuropathy, axillary n.	-	13	-	11	-	2	-	7	-	5	-	33	-	9	-	26
Neuropathy, radial n., triceps arcade	-	10	-	11	-	2	-	10	-	9	-	27	-	8	-	18
Neuropathy, radial n., radial tunnel	7	8	5	5	8	2	21	17	36	17	25	26	9	8	18	18
Neuropathy, median n., elbow level	-	19	-	16	-	6	-	12	-	15	-	50	-	15	-	30
Neuropathy, median n., CTS	33	3	28	0	9	0	22	1	25	2	117	9	32	2	67	5
Neuropathy, ulnar n., elbow level	11	1	7	1	2	2	7	4	9	4	32	8	35	7	28	6
Neuropathy, ulnar n., Guyon's canal	23	0	19	0	4	0	16	0	18	0	67	2	28	1	79	1
Other diagnoses	5	8	10	13	1	5	6	11	8	8	14	18	5	5	14	14
No diagnoses	0	6	0	5	0	0	0	2	0	2	0	4	0	2	0	3

* Total number of examined patients: 98. Total number of examined patients for all other diagnoses: 161

Shaded cells represent the main column diagnosis

- Not applicable

Table 5 - Diagnoses based on the B criteria and the corresponding diagnoses according to the A criteria

Diagnoses by the B criteria	Rotator cuff syndrome+ biceps tendinitis N=29		Medial epicondylitis N=3		Lateral epicondylitis N=8		Neuropathy-brachial plexus N=139		Neuropathy radial n. triceps arcade N=34		Neuropathy radial tunnel N=39		Neuropathy median nerve elbow N=61		Neuropathy ulnar nerve elbow N=11	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
	Myofascial pain syndrome, shoulder	8*	-	1*	-	2*	-	30*	-	9*	-	6*	-	16*	-	0
Myofascial pain syndrome, neck	4*	-	1*	-	1*	-	20*	-	6*	-	5*	-	13*	-	1*	-
Rotator cuff syndrome	25	21	1	1	1	1	36	14	11	3	5	2	16	8	1	1
Biceps tendinitis	-	18	-	1	-	1	-	11	-	3	-	1	-	4	-	1
Medial epicondylitis	2	1	3	3	0	0	9	3	2	0	2	0	6	1	2	0
Lateral epicondylitis	1	1	1	0	7	8	24	4	10	4	17	4	12	4	4	0
Neuropathy, brachial plexus, supra-clavicular	-	5	-	1	-	2	-	36	-	9	-	10	-	13	-	3
Neuropathy, brachial plexus, infra-clavicular	-	16	-	2	-	4	-	131	-	30	-	28	-	53	-	8
Neuropathy, suprascapular n.	-	6	-	1	-	3	-	56	-	15	-	11	-	21	-	2
Neuropathy, auricular n.	-	2	-	0	-	0	-	9	-	1	-	1	-	3	-	0
Neuropathy, radial n., triceps arcade	-	4	-	0	-	4	-	31	-	34	-	14	-	24	-	4
Neuropathy, radial n., radial tunnel	1	2	3	0	3	4	28	29	9	14	17	39	15	24	4	4
Neuropathy, median n., elbow level	-	9	-	1	-	4	-	54	-	24	-	24	-	61	-	7
Neuropathy, median n., CTS	18	0	3	0	4	1	106	9	27	6	26	5	50	5	8	1
Neuropathy, ulnar n., elbow level	3	1	0	0	1	0	32	8	8	4	8	4	15	7	7	11
Neuropathy, ulnar n., Guyon's canal	10	0	1	0	3	0	71	2	18	0	18	0	30	0	6	0
Other diagnoses	6	7	1	3	0	1	17	24	8	8	8	7	10	12	1	3
No diagnoses	2	0	0	0	0	0	9	0	1	0	1	0	2	0	1	0

* Total number of examined patients: 98. Total number of examined patients for all other diagnoses: 161

Shaded cells represent the main column diagnosis

- Not applicable

In table 5 the eight main columns represent diagnoses defined by the B-criteria (neuropathy of the brachial plexus, the radial nerve at the triceps arcade and the median nerve at the elbow), and diagnoses with poor agreement between the two sets of criteria (Rotator cuff syndrome + biceps tendinitis, medial epicondylitis, lateral epicondylitis, neuropathy at the radial tunnel, and neuropathy of the ulnar nerve at the elbow) with the B criteria diagnoses as departure point. The second sub column represents the number of main and concomitant diagnoses according to the B-criteria. A total of 8 limbs with *lateral epicondylitis* was found (cell shaded) according to the B-criteria, and concomitant diagnoses were neuropathies of the brachial plexus, and of the radial and median nerve at elbow level (third main column, second sub column). The first sub column shows the corresponding diagnoses according to the A-criteria with agreement in 7 cases, and concomitant diagnoses defined by the A-criteria were neuropathies of the radial nerve at elbow level, the ulnar nerve at the elbow/Guyon's canal, and CTS.

There was a big difference in numbers of diagnoses according to the 10 diagnoses defined by both the A- and B-criteria with agreement in total only in 79 diagnoses (table 3, total columns). In MCD conditions disagreement mainly concerned the rotator cuff syndrome and lateral/medial epicondylitis. In 55.8% of the rotator cuff diagnoses defined by the A criteria (table 4) concomitant CTS and a few ulnar nerve neuropathy at Guyon's canal were defined by the A-criteria. Of the 29 limbs with rotator cuff and/or biceps tendinitis defined by the B criteria, 72.4% were defined concomitantly with neuropathy in the upper limb (69.0% localized proximally). All medial epicondylitis defined by the A-criteria were defined concomitantly with neuropathy, mainly CTS, and additionally with a high proportion of lateral epicondylitis. Corresponding diagnoses defined by the B-criteria were medial epicondylitis, and an overall agreement on neuropathy. Lateral epicondylitis has been described in the aforementioned example.

The myofascial pain syndrome was only defined by the A-criteria. A high fraction of these patients were defined with bilateral diagnoses, and a high

fraction of these with the same myofascial pain syndrome on both sides (54.5%). In 98 patients, 48 limbs with shoulder and/or neck myofascial pain syndrome were defined (in 13 limbs both shoulder and neck) with a concomitant high number of neuropathy at wrist level according to the A-criteria (N=35, 72.9%) (table 4). The corresponding diagnosis defined by the B-criteria were mainly neuropathy of the brachial plexus (N=38, 79.2%). 64.3% of two-sided myofascial pain syndromes were additionally defined with two-sided CTS according to the A criteria, and 50% with neuropathy of the brachial plexus by the B-criteria.

The difference in findings of neuropathy was big in the 4 diagnoses defined by both sets of criteria with only 34 diagnoses in common of a total of 267 A and 475 B neuropathy diagnoses. However, the B-criteria in comparison with the A-criteria additionally defined criteria of neuropathy at 6 locations including the brachial plexus, and proximal findings of neuropathy by the B-criteria matched distal findings by the A-criteria. Thus the overall agreement on presence of neuropathy was found in 129 (75.0%) of a total of 172 limbs defined with neuropathy by one or both sets of criteria. A high fraction of bilateral diagnoses with the same diagnoses on both sides was found in patients with CTS (80.9%) and ulnar nerve neuropathy at the elbow (58.8%) and Guyon's canal (70.3%) defined by the A-criteria. In diagnoses defined by the B-criteria most neuropathy conditions occurred in a high fraction on both sides in patients with bilateral diagnoses: brachial plexus total 73.9%; axillary nerve 63.2%; radial nerve Triceps arcade 57.1%, and radial tunnel 42.9, median nerve elbow 47.6; and CTS 66.6%.

In a total of 139 limbs defined with brachial plexus neuropathy according to the B-criteria (36 supraclavicular and 131 infraclavicular), a total of 120 limbs (86.3%) with corresponding neuropathy diagnoses were found by the A-criteria. These were mainly located at the wrist (76.3% CTS, and 51.1% neuropathy at Guyon's canal) and to a lesser extent at the radial and ulnar nerves at the elbow (table 5).

Out of a total of 129 limbs with wrist neuropathy defined by the A-criteria (117 with CTS and 79 Guyon's canal syndrome) 112 presented with

shoulder symptoms too, however, only 28 (25%) were defined with concomitant MCD shoulder diagnoses according to the A-criteria. The corresponding number of shoulder diagnoses according to the B-criteria was 108 limbs (96.4%) defined with neuropathy. Reversely out of 149 limbs defined with shoulder neuropathies (plexus and proximal nerves) defined by the B-criteria, 122 (81.9%) presented wrist and hand symptoms too, but only 10 (8.2%) of these were concomitantly defined with neuropathy at wrist and/or hand (the total number of wrist diagnoses, N=21 (17.2%)). The corresponding findings by the A-criteria were 108 limbs (88.5%) defined with neuropathy at the wrist (the total number of wrist diagnoses, N=109 (89.3%)).

VPT comparison between limbs in patients

The data were divided into *limb with* and *without diagnoses* for patients with unilateral diagnoses and into right and left limb for patients with bilateral diagnoses or no differential diagnoses and presented for each of the three nerves separately. Comparing VPT in limbs with unilateral diagnoses and contralateral limbs without, significant higher VPT values were recorded for all three nerves for the neuropathy diagnostic groups defined by the B-criteria (figure 1 – right column) but not for the median nerve for the neuropathy group defined by the A-criteria. Although, significance was recorded in all three nerves in the group of “*neuropathy and MCD*” according to the A-criteria (figure 1 – left column). No such difference was seen for the MCD groups. The VPT in bilateral diagnostic groups defined by the A-criteria were compared between right and left limb and no significant differences were found (data shown previously, for more detail see 24). Correspondingly, no differences were found for the B-criteria. This was also true for the group without differential diagnoses in both limbs.

VPT comparison between diagnostic groups

VPT was compared between groups of unilateral diagnoses. For the B-criteria there was a significant

difference in VPT between diagnosed limbs of the groups with *neuropathy* compared with *MCD* for the ulnar and the radial nerves (figure 1 – right column), while for the A-criteria only one significant difference was found between the groups of *MCD* and *neuropathy and MCD* in limbs with diagnoses for the radial nerve (figure 1 – left column). Grouping the two groups of neuropathy and comparing with the MCD group did not change the picture of significance for any of the diagnostic criteria. For the non-diagnosed limbs no differences in VPT were found between any of the diagnostic groups.

DISCUSSION

In the present study of a sample of non-traumatic ULD patients from the primary health sector, the majority of limbs were diagnosed with *neuropathy* or *neuropathy and MCD* and only a few with *MCD* alone. One may question the high number of neuropathy defined, however, the majority of patients reported symptoms reflecting paraesthesia of numbness and tingling (75.2%) in one or both upper limbs. The study group which chose participation in this study may not be representative for the entire group of ULD patients, but still represents a common group consulting the GPs, and they typically reported that they did not consult their GP, until the problem was rather severe and effecting their daily working or family life.

ULDs in this context primarily seem to be characterized as conditions encompassing a neurogenous component and which was more frequent according to the B-criteria than the A-criteria. The A-criteria primarily defined neuropathy at the wrist. In contrast the B criteria primarily defined proximal neuropathy of the brachial plexus at an infraclavicular level commonly combined with peripheral symptoms and findings mainly localized at the elbow level.

The diagnostic criteria of ULD preferentially should be able to discriminate between MCD and neuropathic conditions, mirrored by the VPT results differentiating between groups. There was a high grade of similarity between the patterns of

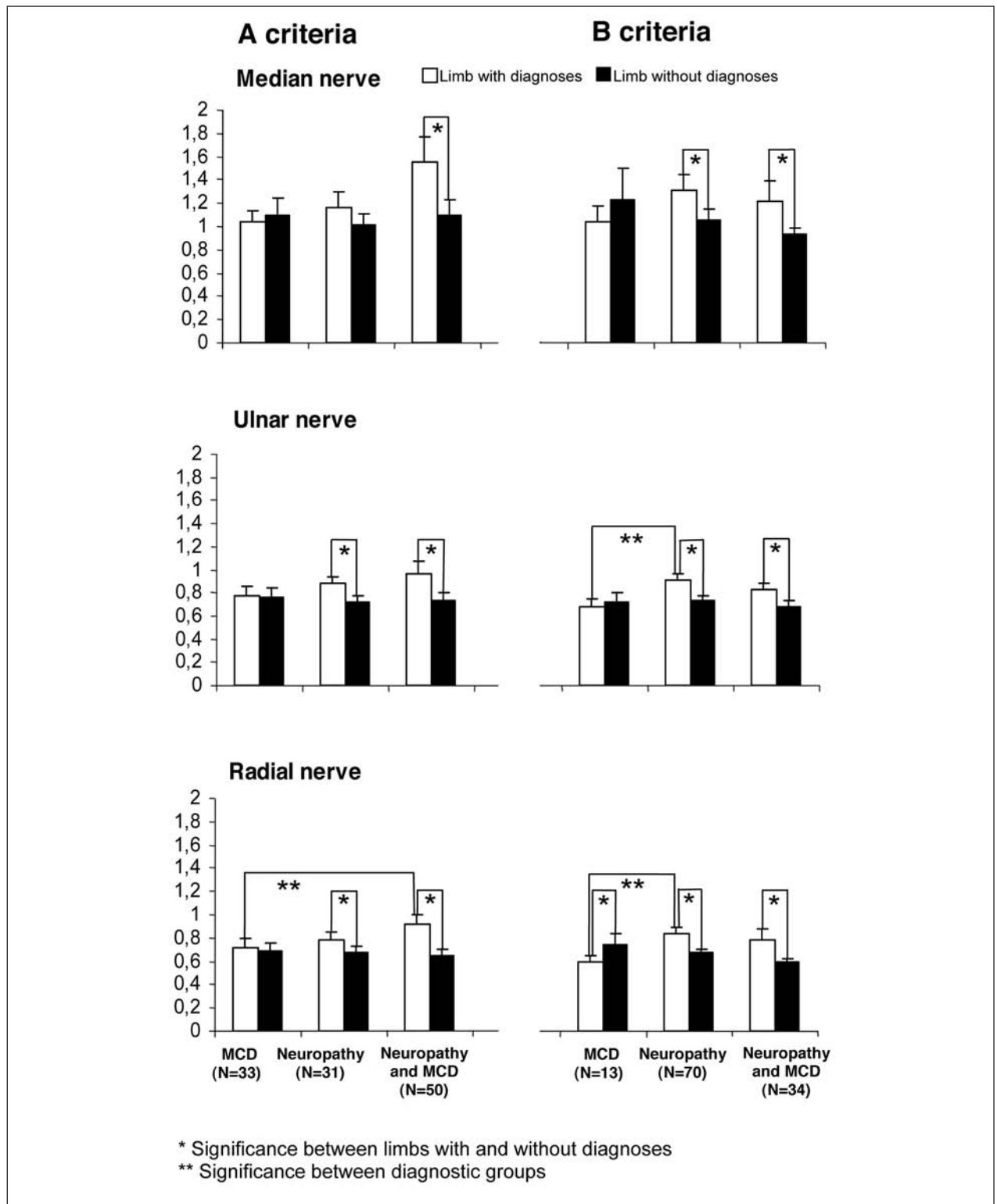


Figure 1 -VPT in patients divided into various diagnostic groups according to A- and B-criteria (mean values with SEM given as bars). The data on the A-criteria (left column) have been re-drawn from a part of figure 3 in our previous publication (24)

VPT means in all diagnostic groups according to the two sets of diagnostic criteria, which might be expected as there was an overall agreement on neuropathy in 75% of limbs defined with neuropathy diagnoses by the two sets of criteria. However, comparing the A- and the B-criteria, the B-criteria were found to discriminate somewhat better than the A criteria between groups of neuropathy and MCD according to VPT responses. Thus, in unilateral diagnoses including neuropathy more significant findings were reported between limbs with and contralateral without diagnoses. Therefore, the B-criteria are superior to the A-criteria in this context.

Rotator cuff syndrome

Almost all limbs defined with a rotator cuff syndrome by the B-criteria were defined with the same diagnosis according to the A-criteria, which further in total defined this diagnosis more than twice the B-criteria. This can be explained by the fact that the same elements of symptoms and clinical findings are represented in the two sets of diagnostic criteria, but more criteria have to be fulfilled according to the B-criteria which were defined in order to differentiate between neuropathy of the brachial plexus and a rotator cuff syndrome, and also to handle a potential simultaneous occurrence of the two conditions. Thus, according to the B-criteria, a rotator cuff syndrome may occur in common with paraesthesia in the shoulder region such as occurs with axillary nerve neuropathy, a symptom found in all infraclavicular brachial plexus affections according to the B-criteria definition. According to the A-criteria definition, such patients are ultimately excluded from getting a diagnosis of the shoulder, as paraesthesia in the shoulder region precludes a rotator cuff diagnosis, and no shoulder neuropathies are defined by the A-criteria. Thus although presenting with relevant shoulder symptoms, allowing the suggestion of a shoulder disorder, these patients were typically defined with distal neuropathy like CTS and Guyon's canal syndrome by the A criteria, while they were mainly defined with neuropathy of the brachial plexus by the B-criteria. These findings point out the need of case definitions considering symptoms and find-

ings of MCDs of the shoulder as well as neuropathy at a proximal level.

Medial/lateral epicondylitis

Each set of criteria rarely defined medial epicondylitis, yet three times as frequent by the A-criteria, mainly due to more restrictive B-criteria. The overall agreement on *neuropathy* between the two sets of criteria signals that both MCD and neuropathy diagnoses should be considered seriously in patients with symptoms of the medial elbow region.

According to the A-criteria, lateral epicondylitis was commonly defined, and for the same reasons as mentioned for medial epicondylitis defined by the A criteria, only a few of these (19.4%) were defined by the B-criteria. More than half of the 36 limbs with lateral epicondylitis defined by the A-criteria were concomitantly defined with a radial tunnel syndrome, which was also commonly defined by the B-criteria in addition to neuropathy of the brachial plexus. Lateral epicondylitis and radial tunnel syndrome frequently occurring in combination are confirmed by other studies (29, 39) and also in association with neuropathy of the brachial plexus (30). As for medial epicondylitis the differential diagnostic between these conditions is an important issue in diagnosing and proper treatment of lateral elbow conditions, thus case definitions of MCD and neuropathy in the elbow region should be resumed according to this.

Myofascial pain syndrome

In a high proportion of defined myofascial pain syndromes, neuropathy was defined at wrist level too by the A-criteria, and at the brachial plexus according to the B-criteria, and furthermore these diagnoses were also defined in a high fraction on both sides (with the same diagnosis). This may suggest myofascial pain syndrome and neuropathy of the brachial plexus or proximal upper limb nerves to reflect similar conditions. Former research has assumed diagnoses of myofascial pain syndrome, relying on positive trigger point findings with a dubious validity, to be rather conditions of neuropathy (38).

Neuropathy

There was a high overall agreement on neuropathy defined in limbs by the A- and B-criteria, however, a big difference was found between specific locations of neuropathy. This is mainly due to the differentiation of neuropathies into 10 diagnostic entities by the B-criteria compared with only four according to the A criteria. Additionally the B criteria are more demanding than the A criteria, in the sense that more clinical findings have to be fulfilled to define the specific diagnoses. The A-criteria typically operate with or while the B-criteria operate with and in combining the diagnostic findings.

Although CTS is generally considered to be the most common compression neuropathy, the frequency of CTS defined by the A-criteria was high compared to findings of other studies (4, 8). Definition of CTS, however, relies on one abnormal manual clinical test only according to the A-criteria, and either one of the symptoms anaesthesia and pain. In the present study a positive Phalen's test/Tinel's test/carpal compression test or reduced strength of APB/atrophy were common clinical findings leading to the definition of CTS, but former studies have found a limited value of these clinical tests relative to classification based on symptoms alone (6, 23, 25). Likewise, inclusion in the A-criteria of only one clinical finding in the definition of neuropathy at Guyon's canal may explain the surprisingly high number of these, and calls for further validation of the suggested A-criteria. The reliability and validity of these clinical findings has to be high, otherwise the result may be misclassification, in worst case leading to spurious and erroneous treatment of the condition.

A surprisingly high incidence of ulnar neuropathy at the elbow defined by the A-criteria was found too, while the B-criteria assigned most of these to the brachial plexus and the median nerve at the elbow and only a few to the ulnar nerve. Differential diagnostic between median and ulnar neuropathy at elbow level, and proximal neuropathy of the brachial plexus at infraclavicular level might call for further investigation.

The fact that only a few patients with wrist neuropathy and concomitant shoulder symptoms were

defined with a shoulder diagnosis, according to the A criteria, represents a diagnostic concern. According to the reverse double crush syndrome theory (3), neuropathic shoulder symptoms might be connected with a distal neuropathy like CTS. However, studies have found that with simultaneous CTS and TOS, distal decompression will but rarely relieve symptoms caused by proximal neuropathies (27, 30), while TOS release will relieve distal symptoms in about half of the cases, rather supporting the theory on double crush and thus a primary proximal neuropathy.

In limbs defined with wrist diagnoses according to the A-criteria, the B-criteria mainly defined neuropathy of the brachial plexus, and only few neuropathies at wrist level. A low frequency of distal neuropathies as by the B-criteria is in accordance with a former study (33) but is lower than in most studies (30). This may suggest the B-criteria to be too restrictive and tending to hide distal diagnoses behind a convincing proximal diagnosis. According to the double crush theory (10, 27, 30, 34, 46), however, symptoms of distal neuropathy can be related to proximal neuropathy, and peripheral neuropathy may be found in up to 44% of TOS (48). Thus this study seems to show an over representation of wrist diagnoses by the A criteria. On the other hand the B criteria may be too restrictive and exclude distal neuropathy.

CONCLUSION

The two sets of criteria tend to agree on the presence of neuropathy. Comparison of diagnostic groups, and limbs with and without diagnoses according to the A- and B-criteria, respectively, showed the B-criteria to discriminate better between groups of neuropathy and MCD and between limbs according to the VPT results. This suggests that a validation of differentiated neuropathy criteria including definitions of proximal neuropathy, like the ones presented in the B-criteria, should be considered and subjected to further research in order to attain consensus. Brachial plexus neuropathy is still a controversial diagnosis even in the sense of TOS, but the substantial num-

ber of findings in this and a previous study (33), and the high number of myofascial pain syndrome diagnoses that may be related to neuropathy (38) justifies to re-consider this diagnosis seriously.

Additionally, differential diagnostic criteria between neuropathy and MCD should be reconsidered seriously. Management and prevention is highly dependent on correct diagnoses into such major groups.

NO POTENTIAL CONFLICT OF INTEREST RELEVANT TO THIS ARTICLE WAS REPORTED

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