Introduction

Upper-extremity musculoskeletal disorders (UEMSD) have been recognized to occur in relation to work for hundreds of years. They were described by Bernardini Ramazzini, an Italian physician and father of occupational medicine, in the 18th century, when he said the diseases: "… arise from three causes; first constant sitting, the perpetual motion of the hand in the same manner, and thirdly the attention and the application of the mind ..." (as quoted in Euro Review, Issue on Repetitive Strain Injuries, European Foundation for the Improvement of Living and Working Conditions, 1994).

Today, there is growing concern in Europe and elsewhere both about the effects of work-related upper-extremity musculoskeletal disorders (WRUEMSD) on the health and well-being of workers and about the economic and social impact of these conditions (1—4). Musculoskeletal disorders, in general, are considered a major cause of sickness absence, disability, and health care (5—7), and many studies have found high prevalences of musculoskeletal symptoms and disorders in a wide range of occupational groups. These studies have been described or systematically reviewed or both in many publications. [See, for example, the reports of Hagberg & Wegman (8), Armstrong (9), Hagberg et al (10), Gorden et al (11), Bernard (12), National Research Council (13), Punnett & Bergqvist (14).]

A variety of umbrella terms has been used in different countries to describe UEMSD thought to be related to repeated trauma. These include repetitive strain injury (RSI), occupational overuse syndrome (OOS), occupational cervicobrachial disorder (OCD), and cumulative trauma disorder (CTD). These terms assume a link between the clinical disorder(s) and the suspected causal factor or mechanism of injury. Like many researchers (1, 9, 12, 15), we use the term work-related to reflect the multifactorial nature of most UEMSD. According to the World Health Organization (WHO), work-related diseases are defined as multifactorial when the work environment and the performance of work contribute significantly, but as one of a number of factors, to the causation of disease (16). Although different abbreviations and acronyms are used to identify work-related upper-extremity musculoskeletal disorders (eg, WMSD, WRUED, WMD), we use WRUEMSD in this document in order to be as precise and descriptive as possible.

Despite the impressive number of studies on WRUEMSD, considerable uncertainty and even controversy still exist about the extent and etiology of these problems, the contribution of work and nonwork risk factors to their development and resolution, the criteria used to diagnose them, the outcomes of various treatment methods, and the appropriate strategies for intervention and prevention. Progress in advancing our understanding of these problems has been hampered by a number of things. These include (i) the acknowledged multifactorial nature of WRUEMSD, (ii) the uncertainty of pathophysiological mechanisms, and (iii) the methodological and practical challenges associated with epidemiologic research on WRUEMSD, the last on this list including the following:

- choice and use of different case definitions and diagnostic criteria for assessing health effects
- lack of "gold standards" for the clinical diagnosis of most UEMSD
- problems associated with the meaningful measurement of exposure
- inherent biases associated with different study designs and study populations
- inability or failure to control for known or suspected confounders
- unfortunate adversarial and acrimonious climate in some countries due, in large part, to issues surrounding compensation.

Although many hypotheses have been suggested in the last few decades about possible underlying mechanisms for the development of nonspecific musculoskeletal symptoms in particular and (chronic) pain in general, definitive knowledge is still lacking. One well-known potential mechanism at the muscular level is the Cinderella hypothesis, namely, that the lack of recovery from repeated recruitment of the same motor units is responsible for fatigue and complaints when the same movements and forces are asked for in a repetitive manner. Interested readers are referred to, for example, the reports of Hagberg & Wegman (8), Johansson & Sojka (17), Armstrong et al (9), Wright (18), Main & Watson (19), and Bushnell & Cobo-Castro (20).

Taken together, the aforementioned problems make it difficult to compare the results of different epidemiologic studies, surveillance systems, and registration databases. This difficulty hampers efforts to assess and compare the magnitude and nature of WRUEMSD within and across different countries, geographic areas, industries, workplaces, and occupational groups over time. Similarly, it impedes the ability to assess the effectiveness of different types of medical and workplace intervention.

Current problems

- **Too many definitions and concepts for WRUEMSD**
- **Lack of unequivocal criteria with which to establish UEMSD and decide on work-relatedness**
- **Uncertainty about pathophysiological mechanisms for UEMSD**

Purpose and target users of this document

The underlying purpose of this document is the prevention of WRUEMSD. Such prevention can take different forms (primary, secondary, and tertiary), occur at different levels [in the clinical setting (the micro level), in the workplace (the meso level), at the national level (the macro level)], and involve many types of activities. Information is the foundation upon which these prevention activities rely. This document seeks to facilitate a more uniform collection, recording, and reporting of information about WRUEMSD in the European Union (EU) by providing evidence- or consensus-based case definitions and criteria for identifying and classifying them. Because prevention is the main goal, the criteria provided by this document are not intended to be used for compensation purposes. The document is designed primarily for occupational health physicians who provide care for individual workers with health problems and who provide occupational health services to workers and employers in different companies. However, it may also be useful to other providers, including occupational health nurses, general practice and primary care physicians, physiotherapists, and ergonomists.

This document can be used at the aforementioned levels of prevention. A description of them follows.

Micro level: in the clinical setting with individual patients

The recognition of work-related disease and injury often begins in the physician's office, once patients decide to seek help for their symptoms, complaints, or functional limitations. Physicians rely on the anamnesis and the findings of the physical examination to begin to develop a differential or working diagnosis by integrating information about symptoms, signs, and risk factors (work and nonwork). Sometimes, additional consultation or specialized medical testing is needed to confirm or rule out specific diagnoses. Clearly, the clinical process is dynamic, and physicians use their best medical judgment in making a diagnosis. The information provided in this document is designed to help the physician with this process of recognizing and diagnosing WRUEMSD. It includes clinical diagnostic criteria based on symptoms commonly associated with different UEMSD, signs that may be elicited during the physical examination and information about the diagnostic value of these signs and other diagnostic tests, if available, and criteria for assessing the work-relatedness of these clinical disorders. The focus of this document is limited to the recognition and diagnosis of WRUEMSD; it does not contain information on treatment, prevention, or reintegration strategies.

Physicians can review the information in this document at any time. It may be especially helpful when they are required to register or report work-related disorders. Although the criteria proposed in this document do not diminish the importance of physicians' clinical judgment, adherence to these criteria when WRUEMSD are reported will enhance the usefulness of their reporting activities.

Meso level: in the workplace with groups of workers

Sometimes, information about WRUEMSD is solicited in a more active way to help identify existing or potential problems and risks in certain occupational groups or in particular workplaces. This activity can be initiated by occupational health professionals who provide prevention-oriented services to companies and groups of workers — perhaps at the request of employers or workers. Health or labor authorities may engage in or require occupational health surveillance for high-risk groups or when alerted to possible problems through other means. According to the International Labour Organization (21), occupational health surveillance includes both workers' health surveillance and the surveillance of the work environment. The primary purpose of occupational health surveillance is prevention. If surveillance activities suggest or identify a problem, action must follow. Workers' health surveillance for WRUEMSD or symptoms is especially important because these problems may not come to the attention of physicians or be captured by existing administrative databases for a variety of reasons (10). Thus relying on these sources of information may not provide the full picture of WRUEMSD in any workplace, occupation, industrial sector, geographic area, or time period.

Most workplace health surveillance activities for WRUEMSD are based on symptoms only, because the provision of medical examinations is neither realistic nor affordable. Thus this document provides surveillance case definitions and criteria based on symptoms alone. The criteria can serve as the basis for conducting interviews or using questionnaires to collect a common set of data elements on symptoms and work factors. Of course, if resources permit, medical examinations

might also be done, and this would provide additional information on diagnostic signs. Indeed, physical examinations may be particularly important for high-risk groups, as WRUEMSD may be more likely to occur in these workers.

It is important that the criteria be applied consistently and without deviation. This attention will enhance the validity of comparisons over time and across different workplaces, industrial sectors, occupations, and geographic areas. Once collected, the data can be used to help identify potential problem areas in the workplace and signal the need for more intense investigation or intervention. This document provides criteria that help assess the work-relatedness of UEMSD, but it is beyond its scope to provide detailed risk assessment methods or instruments for use in the active surveillance of the work *environment*.

Macro level: in the community, region or country

Health and labor authorities, researchers, and, perhaps, occupational health services may use existing records and data to help identify WRUEMSD patterns and potential problem jobs (10). These records and data include injury and illness reports, company dispensary logs, insurance records, absentee records, and other data often collected for administrative purposes. The collection and recording of a uniform set of data elements by physicians as the basis for reporting cases of WRUEMSD should facilitate these more passive surveillance activities and also provide more reliable data for epidemiologic research. If reporting physicians use the criteria consistently, users can have more confidence that the cases have been diagnosed and reported similarly. This consistency and confidence will help agencies more validly target workplaces and jobs most in need of assistance, which might include the initiation of more active surveillance activities. Moreover, it will enhance the validity of comparisons made over time and across jobs, workplaces, industries, and geographic areas.

Criteria for different levels

As depicted in table 1, the criteria used for the diagnosis of individual patients in the office setting includes both symptoms (ie, the nature of a patient's present complaints) and clinical signs (ie, positive findings, according to some definition, in a physical examination). Thus they are more extensive than the criteria used for workers' health surveillance workplace activities, which generally are based on symptoms only. Accurate diagnosis helps determine the most appropriate treatment and protects the patient from treatments that are ineffective, unwarranted, or unnecessarily invasive. In other words, specificity is more important than sensitivity at the micro level. Criteria based on symptoms alone will generally not provide the accuracy needed in this setting. The criteria are based on what the occupational or primary physicians can do in their own offices. In some cases, additional diagnostic testing or specialty consultation will be helpful. However, many UEMSD lack a "gold standard" for making or confirming a diagnosis; therefore, signs and symptoms are often the only tools available to physicians.

Because workers' health surveillance in the workplace does not focus on the diagnosis and treatment of

Table 1. Information ideally needed or available and the methods used in different settings for diagnosing work-related upper-extremity musculoskeletal disorders (WRUEMSD) (✓= criteria provided in this document)

	Purpose	Information needed	Methods
Micro Level	For diagnosing and managing WRUEMSD with individual persons in the clinical setting	✓ Symptoms ✓ Signs ✓ Work Factors • Other anamnestic data • Specialized testing or consultation, as necessary	• Anamnesis • Physical examination • Specialized testing, as necessary
Meso Level	For active occupational health surveillance in the workplace	✓ Symptoms ✓ Work factors ✓ Signs, if possible and desirable	• Questionnaires • Worker interviews • Checklists • Observation • Physical examinations • Specialized testing, as necessary
Macro Level	For passive occupational health surveillance using existing records	Diagnoses or diagnostic codes, ideally based on: ✓ Symptoms ✓ Signs • Other anamnestic data • Specialized testing or consultation, as necessary ✓ Work factors	• Review and analysis of (existing) records, databases, questionnaires

individual patients, case definitions and criteria are generally designed to capture most, if not all, persons with work-related musculoskeletal complaints. In this context, sensitivity becomes more important than specificity. Moreover, tools used to collect data for surveillance purposes must be practical, rapid, uniform, and easy to use (22). Thus the surveillance case definitions included in this report for use at the meso level are based on symptoms only. If physical examinations are offered, then the criteria on diagnostic signs can also be used. Surveillance data can suggest the need for further activity, including referring workers to physicians for clinical assessment.

At the macro level, occupational health surveillance activities are more passive in nature. They entail the use of existing records to identify or monitor worker health problems. Existing records, such as insurance records, physician reports, and company records, may provide some information about health outcomes. Information on work factors is generally not available in existing records. The information provided in this document may help classify data found in existing records in the short-term. A long-term goal is to facilitate more uniform reporting, collection, and recording of information in existing databases.

Purpose and use of the document

- **Prevention: by facilitating more uniform collection, recording, and reporting of information about WRUEMSD in the European Union**
- **For both active and passive surveillance activities**
- **Targeted for use by (occupational health) physicians and other health care providers**
- **Not designed for use in determining compensation**

Contents and use of this document

The document is based on the following 2-step procedure for diagnosing and conducting surveillance for WRUEMSD: (i) establishing the clinical diagnosis and (ii) assessing the work-relatedness of the diagnosis. To help users with the 1st step, the document provides case definitions and diagnostic criteria. Once the diagnosis is made, the user can consult the criteria on region-specific work factors for help in making a determination of work-relatedness. Like the Swedish National Board of Occupational Safety and Health (23) and the proposed 3-zone model for action of Buckle & Devereux (24), this report uses a "traffic light model" to help the user determine whether the disorder is work-related (red light), possibly work-related (yellow light), or most likely *not* work-related (green light).

The document addresses 11 specific UEMSD and nonspecific UEMSD, referred to in this document as nonspecific UEMSD**.** The methods used to develop this document are detailed later in this section.

Specific Disorders

The following 11 more or less specific disorders and complaints are included in this document:

1. Radiating neck complaints
2. Rotator cuff syndrome
3. Epicondylitis - lateral and medial
4. Ulnar nerve compression at the elbow: cubital tunnel syndrome
5. Radial nerve compression: radial tunnel syndrome
6. Flexor-extensor peritendinitis or tenosynovitis of the forearm-wrist region
7. De Quervain's disease
8. Carpal tunnel syndrome
9. Ulnar nerve compression at the wrist: Guyon canal syndrome
10. Raynaud's phenomenon (vibration white finger) and peripheral neuropathy associated with hand-arm vibration
11. Osteoarthrosis of the distal upper-extremity joints.

Clearly, this is not a list of every specific UEMSD. For example, the document does not include sections on osteoarthrosis of the cervical spine, cervical radiculopathy, osteoarthrosis of the glenohumeral joint, frozen shoulder, thoracic outlet syndrome, pronator teres syndrome, or trigger finger. These disorders are not included because of very low prevalences (eg, pronator teres syndrome), the relationship to work is not yet clear (eg, osteoarthrosis of the cervical spine and glenohumeral joint, cervical radiculopathy), or because the diagnosis is difficult or controversial (thoracic outlet syndrome). However, these and other UEMSD could be addressed in future studies of this kind.

For each of these specific disorders, the document has the following sections:

- description and clinical features of the disorder
- information on the differential diagnosis specific to other UEMSD
- information on test properties
- examples of case definitions and criteria proposed or used in different epidemiologic and clinical studies — based on symptoms only and on symptoms plus signs (The examples were chosen to reflect case definitions and criteria used by researchers in different countries or were included because of their frequent citation in the literature.)
- proposed case definitions based on symptoms only and on symptoms and signs

- proposed criteria based on symptoms only and on symptoms and signs
- references.

Temporal criteria are included in each proposed case definition and its accompanying diagnostic criteria. The rationale for these temporal characteristics is described later in this document.

The strength of the evidence used to develop the case definitions and criteria for these disorders varies. For some disorders, such as carpal tunnel syndrome, the symptoms and signs included as criteria in this document have been well characterized, and their diagnostic value has been studied. For other disorders, such as osteoarthrosis and forearm tendinitis, the diagnostic value of symptoms and signs has not been subject to rigorous evaluation. Criteria are included because of their general acceptance and wide use in clinical practice and their common inclusion in medical textbooks. Some criteria, such as those for radial nerve compression at the elbow and ulnar nerve compression at the wrist (Guyon's canal), have been derived primarily from clinical studies and case series. Their value for the health surveillance of active workers in occupational settings is less certain. For the 11 listed disorders, the criteria that have been evaluated clinically to some extent or are well-accepted by the medical community include those for rotator cuff syndrome, epicondylitis, cubital tunnel syndrome, de Quervain's disease, carpal tunnel syndrome, and hand-arm vibration syndrome. The criteria found for the remaining disorders (ie, radiating neck complaints, radial tunnel syndrome, flexor-extensor peritendinitis-tenosynovitis, Guyon canal syndrome, and osteoarthrosis) can be considered scientifically weaker. Moreover, the case definitions and criteria proposed for active surveillance — that is, criteria based solely on symptoms — are, by definition, considerably weaker than the criteria that can be applied when physical examinations are possible. The existence of clinical signs increases diagnostic certainty.

Nonspecific upper-extremity musculoskeletal disorders

For most cases, upper-extremity musculoskeletal complaints cannot be classified into specific diagnostic categories. The complaints may reflect mild early cases of specific disease, symptoms compatible with multiple diagnoses, or chronic pain processes that do not fit nicely into any accepted diagnostic category. A variety of terms has been applied to these nonspecific UEMSD, including repetitive strain injuries, cumulative trauma disorders, occupational overuse syndrome, and others.

Although there is growing concern about the prevalence of these disorders, little is known about their epidemiology, etiology, pathomechanisms, symptomatology, diagnosis, clinical course, prognostic factors, and treatment or intervention outcomes. Some studies have focused on nonspecific complaints (25—28), but most clinical studies have focused on specific disorders. Most occupational studies of upper-extremity pain or symptoms have been cross-sectional in nature, and they have not included a follow-up. Thus the evidence for developing valid and reliable case definitions and diagnostic criteria for nonspecific UEMSD is lacking.

However, this document provides guidance to physicians and others who frequently encounter these nonspecific disorders in their clinical practice or in the workplace. It suggests the structured collection of a common set of data elements. Information about the nature, location, and onset of symptoms will help advance the clinical understanding of nonspecific UEMSD and facilitate research into this important occupational health problem.

Criteria for work-relatedness by body region

After the 12 UEMSD sections, the document describes a 4-step process for determining the level of work-relatedness of the UEMSD (eg, probable, possible, most likely not). The first step concerns the important question of the temporal relationship between the exposure and the development of the UEMSD.

The 2nd step of this process is described in the section on criteria for determining work-relatedness. This section addresses risk factors according to the region of the upper extremity affected. To clarify and help standardize what the different regions mean, the document includes definitions of the upper-extremity body regions using precise anatomic landmarks and a graphic body chart. The work factors commonly associated with UEMSD are categorized into the following 4 main regions of the upper body: neck, shoulder-upper arm, elbow-forearm, and wrist-hand. The work risk factors include physical factors such as posture, force, movement, and vibration and nonphysical factors that may increase risk, such as work organizational factors, including work:rest ratios, and other work environment characteristics, such as psychological demands and social support.

Knowledge of the relationship between these work factors and UEMSD comes primarily from epidemiologic studies on groups of workers and laboratory studies on humans and animals in experimental conditions. The criteria for work-relatedness in this document are based on the best available evidence from the literature or on the consensus of expert groups. Because they have generally been derived from studies on groups of workers, the criteria are, perhaps, the most valid when used for workers' health surveillance activities at the meso and macro levels. However, they are also informative and

helpful when determining work-relatedness at the micro level with individual patients.

Clearly, a variety of confounding and mediating factors may affect the development of UEMSD in individual persons. These include personal characteristics, such as age, gender, life-style and familial risk factors, medical anamnesis, and nonoccupational exposures (which are addressed in step 3). For example, osteoarthrosis increases with age, smoking may increase the risk of Raynaud's disease in workers exposed to hand-arm vibration, carpal tunnel syndrome is more common in women and in persons with diabetes mellitus, and certain HLA (human leucocytlocus A) antigens may predispose persons to repeating tenosynovitis. These "red flags" must be always considered when WRUEMSD is diagnosed in the clinical setting. Similarly, workplace conditions, exposures, practices, and techniques are important and may vary among individual persons — even those from the same workplace. However, the general criteria included in this section will help the physician assess work-relatedness with individual patients, and the region-specific work risk factors will guide inquiry with both individual workers and groups of workers. Finally, in step 4, rules for making decisions are provided to establish the probability of work-relatedness.

Appendices

The appendices include descriptions and photographs of the provocative tests included in the criteria (appendix A), a glossary of anatomic terms and acronyms used throughout the document (appendix B), a tabular summary of the evidence on work factors per region (appendix C), a list of codes of the International Classification of Diseases (ICD) for the disorders (appendix D), and a quick-scan to decide what case definitions have to be checked (appendix E).

Contents of the document

Case definitions and criteria for:
- **Eleven specific UEMSD**
- **Nonspecific UEMSD**
- **Temporal criteria**
- **Definitions of upper-extremity body regions**
- **Four-step process to establish the work-relatedness of UEMSD**

Project methods

Supervising group

An international group of experts was assembled to provide advice and guidance on the project. (See the cover page.) The group included experts in WRUEMSD, with specific expertise in:

- occupational medicine
- ergonomics
- exposure assessment
- epidemiology.

This supervising group met 3 times during the course of the project. The group (i) provided advice on which disorders to include in the document and the type of information about each disorder, (ii) assisted in the search for relevant grey literature by identifying individuals and organizations doing work in this area, and (iii) critiqued the first drafts of this report and participated in the final consensus workshop.

Literature study

Scientific and grey literature was sampled to gather as much literature as possible on the existing case definitions, criteria, and guidelines used in Europe, as well as on the most current information on occupational risk factors.

In order to make the guidelines as evidence-based as possible, literature searches were conducted using the Medline, EMBASE, NIOSHTIC, PsychINFO, SPORTSDiscus, and Ergonomic Abstracts databases. The initial search was limited to articles published during 1995—1998, because the National Institute for Occupational and Safety (NIOSH) in the United States had recently published a comprehensive review of prior literature (12) and a report prepared for the Dutch Ministry of Social Affairs and Employment on guidelines for diagnosing WRUEMSD was also based on a systematic review of the literature (29). Key words (singly or in combination) included upper limb, upper extremity, arm, elbow, wrist, finger, neck, shoulder, musculoskeletal, repetitive strain injury, cervicobrachial, cervicothoracic, glenohumeral, thoracic outlet syndrome, rotator cuff, periarthritis, humeroscapularis, referred, symptoms. The yield was over 9500 references. The search was narrowed to approximately 1500 references with the following key words (singly or in combination): occupational, disorder, work-related, diagnosis, and syndrome. Further narrowing to 165 references was accomplished with the following key words: criteria, guideline, case definition, surveillance, consensus, evidence-based, epidemiology, exposure, work factors, and dose-response. A second search was done using the key words musculoskeletal disorders and psychosocial. Additional searches were done on specific clinical diagnoses, including epicondylitis, elbow, ulnar nerve compression, radial nerve compression, Raynaud's phenomenon, hand-arm vibration syndrome, and stenosing tenosynovitis. The titles and abstracts resulting from these searches were

reviewed, and relevant references were retrieved. Additional references from earlier periods were also collected via the snowball method and reviewed.

The project team systematically abstracted information on prevalence, risk ratios, case definitions, diagnostic criteria, diagnostic testing, work factors, psychosocial factors, and nonwork factors from these articles. To ensure that the 2 researchers (JS, KR) responsible for reviewing the literature were abstracting similar information, 5 articles on nonspecific disorders were randomly selected and abstracted by both. The results were compared, and minor differences in abstracting technique were corrected.

Grey literature was collected by contacting approximately 75 persons active in fields concerning musculoskeletal disorders and by contacting national institutes for occupational health throughout the European Union. Approximately 22 persons responded to this inquiry and provided approximately 43 pieces of grey literature, including reports, conference papers and abstracts, doctoral theses, and guidelines.

Because of the paucity of data in the literature about the clinical diagnosis of nonspecific WRUEMSD and their associated work factors, the authors of this report conducted a questionnaire survey of all members of an organization for repetitive strain injury in The Netherlands. As described later in this document, these data, along with available literature, were used to develop both the guidelines for the nonspecific UEMSD category included in this report and the associated work-factor criteria.

Workshop

Finally, a workshop was held to develop a consensus on the document. In addition to the project staff, 29 persons from 14 European countries (Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, The Netherlands, Norway, Portugal, Sweden, and the United Kingdom) participated in the 2-day workshop. These persons were invited for one of the following reasons: (i) they were expert members from the supervising group, (ii) they had expertise or experience with WRUEMSD, or (iii) they had the potential to influence the practice of occupational health physicians in their countries. These persons represented government, academia, health services, industry, and trade unions.

Project methods

- **Supervising group of European experts**
- **Literature search (scientific and grey)**
- **Survey of members of an organization for repetitive strain injury**
- **Workshop**

Description and rationale of the temporal criteria used in this document

Case definitions used in epidemiologic studies of work-related upper-extremity musculoskeletal disorder(s) (WRUEMSD) often include elements of time frame (eg, symptoms ever, within the last 12 months, within the last 7 days), frequency (eg, symptoms at least once a month or >3 times within the past year), duration (symptoms lasting >7 days), severity (symptoms of moderate intensity, symptoms that interfere with work, home or social activities), or a combination of these. Clearly, the definition used will affect the prevalence of WRUEMSD found in any study or investigation (30).

Clinical studies sometimes report how long patients experience symptoms before consulting a physician. Sports medicine literature often refers to the phasing of tendinitis. The phases reflect symptom severity and the temporal occurrence in relation to certain activities (eg, training). However, very few clinical studies report the frequency or duration of symptoms as part of their case definitions. This practice has implications for diagnoses. A physician's diagnosis may be different for the patient who comes to the office with mild symptoms shortly after the symptoms begin than for the patient who waits many months and seeks help when the symptoms become severe.

We have developed temporal criteria for the WRUEMSD addressed in this document. The following basic assumptions underlie these criteria:

- The criteria should be useful at different levels — in the clinical setting with individual patients (current cases) and in the workplace for screening and surveillance activities (current and past or recovered cases).
- For workplace-based prevention, the criteria should facilitate the capture of *possible* cases and cases with mild symptoms so that intervention strategies can be implemented in a timely manner. They should not restrict cases only to those with the most severe symptoms, longest duration, or highest frequency.
- At the same time, the criteria should be strict enough to differentiate normal and transient aches and pains from symptoms suggestive of specific (and non-specific) disorders of the upper extremities. This stipulation is especially important for muscle and tendon symptoms, which are common.
- Unless symptoms are present at the time of the examination or have been present regularly in the immediate past, people are unlikely to exhibit clinical signs in a physical examination.
- Entrapment neuropathies often have cyclical symptoms (31). Therefore, the duration criteria should allow enough time to recognize the intermittent occurrence of neurological symptoms.

Using these basic assumptions and in an attempt to be as consistent as possible with the widely used questionnaires used to study work-related musculoskeletal disorders [eg, the Nordic questionnaire (32)], we have used several temporal elements for the symptom-related time rule presented in this document. They include a timeframe (symptoms now, within the past week, or within the last 12 months), an element of frequency (on at least 4 days during the last 7 days), and an element of duration (during at least 1 week). We believe this combination of elements is strict enough to differentiate common aches and pain from true UEMSD, but inclusive enough to identify persons in the early phase of the disorder.

We have used the same temporal criteria for all the disorders included in this document. Because the evidence for these temporal criteria is sparse, it was not possible to develop different criteria for the different categories (tendon-muscle versus entrapment neuropathies) or types of disorders addressed in this document. As more evidence becomes available on the temporal nature of symptoms, the criteria in this document may require future revision.

The following criteria can be used to identify both current and past cases. The 1st is the most useful in the clinical setting, where physicians encounter symptomatic patients and have the opportunity to do a physical examination. The 2nd is more useful in the context of surveillance for WRUEMSD in the workplace. Because intervention and prevention are the primary reasons for monitoring workers' health, the use of both criteria together facilitates the identification of current cases and cases that have occurred in the past year — thus providing a more complete picture of potential problems in the workplace.

Temporal criteria

- **Symptoms present now or on at least 4 days during the last 7 days**

OR

- **Symptoms present on at least 4 days during at least 1 week in the last 12 months**

Definitions of the upper-extremity body regions

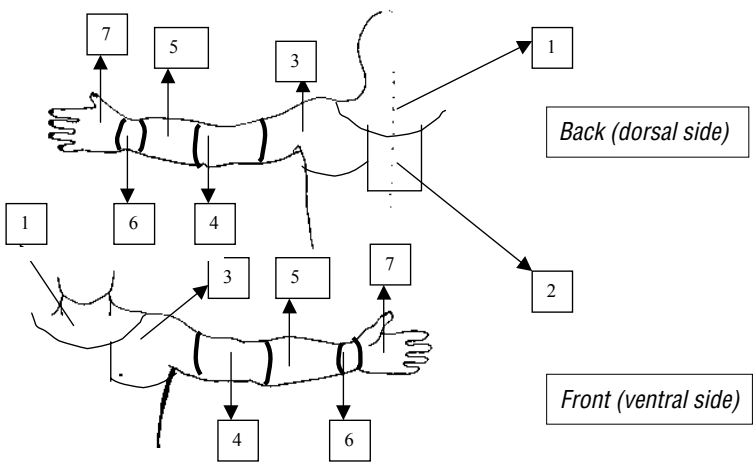
The Nordic questionnaire (32) defined 5 upper-body regions (ie, neck, upper back, shoulders, elbows, and wrists-hands) without covering the whole upper extremity.

The goal for the present criteria document on upper-extremity disorders differs from the goal of the developers of the Nordic questionnaire because their goal was to develop and test standardized questionnaires on general, low-back and neck-shoulder complaints. In addition, the Nordic questionnaire intentionally defined only regions from the back aspect of the body, and the authors acknowledged the gap for disorders located in the frontal part of the shoulder or on the flexor side of the upper limbs (32).

The Medical Research Council (MRC) in the United Kingdom is preparing 7 definitions of upper-limb areas and will differentiate between the neck, shoulder, elbow, forearm, wrist, and 2 parts of the hands (MRC, personal communication, 1999).

The present criteria document presents a categorization of the upper-extremity body regions that might be used to cluster upper-extremity complaints and register them in a common way across studies and examiners. As defined, the regions have logical or functional boundaries and are practical in terms of symptoms arising in some specific disorders. To be as complete as possible, and to acknowledge the anatomic landmarks and joints in the upper extremity, 7 regions have been defined for this criteria document. These regions are the neck, the upper back, the shoulder, the elbow, the forearm, the wrist, and the hand.

Definitions of the 7 upper-extremity regions are given hereafter. The body chart in which the regions are marked is also shown.



1 Neck: The neck region is defined caudally by the line that crosses the Th4 junction in the middle and laterally at the acromioclavicular joints. The cranial border is the skin at the top of the head.

2 Upper back: The upper-back region is defined cranially by the line that crosses the Th4 junction in the middle and laterally by the medial borders of the scapula bones. The caudal border is the line that crosses at about Th10.

3 Shoulder: The shoulder region is defined distally as the transversal plane off the middle of the humeral bone. The dorsal borders are from the line between the acromioclavicular joint to the medial border of the scapula and the line that crosses the inferior angle of the scapula. Ventrally, the line between the sternal end of the clavicula to about 5 cm below the axilla on the chest wall is the border. The scapula is included totally in this region.

4 Elbow: The elbow region is defined from the line running between the lateral and medial epicondyles and transversally approximately 5 cm distal and proximally to the middle of the humeral bone.

5 Forearm: The forearm region is defined proximally as a transversal plane at 5 cm below the olecranon and distally as a transversal plane off just proximally from the processus styloideus ulnae.

6 Wrist: The wrist region is proximally defined as a transversal plane off just proximally from the processus styloideus ulnae, and the distal boundary as a transversal plane from the base of the fifth metacarpal bone.

7 Hand: The hand region is proximally defined as a transversal plane from the base of the fifth metacarpal bone, and distally by the fingertips of all digits.

Definitions for the following upper-extremity body regions

- **Neck**
- **Upper back**
- **Shoulder**
- **Elbow**
- **Forearm**
- **Wrist**
- **Hand**

Case definitions and criteria for upper-extremity musculoskeletal disorders

How to use criteria for specific upper-extremity musculoskeletal disorders

In daily clinical practice, musculoskeletal disorders are diagnosed after the anamnesis reveals characteristic symptoms reported by the patient, and the physical examination elicits positive findings upon inspection, palpation, and provocative testing. Sometimes, consultation with a specialist and further diagnostic testing are needed to confirm the working diagnosis.

In order to facilitate more uniform collection, recording, and reporting of information about WRUEMSD in the upper extremities, physicians are encouraged to practice their normal clinical routines but to check the criteria presented in this document to see if the requirements for the case definitions are met.

Case definitions

Two case definitions are prepared for each specific UEMSD, one with symptoms only and the other with both symptoms and signs. The 1st (on symptoms only) is probably most useful in worker health surveillance activities, while the 2nd (on symptoms and signs) is probably best applied in a clinical context when a physical examination is possible. Both case definitions include temporal criteria. The codes of the 10th revision of the International Classification of Diseases (ICD-10) for each specific UEMSD are presented in appendix D. The diagrams provide a visual aid to the decision process that occurs when the criteria are applied to the case definitions.

Criteria in diagrams

The criteria presented in the diagrams provide a structure to the diagnostic process as it takes place in the clinical situation. Heuristics give direction in the differential diagnosis process and are unconsciously present in patient contact and therapy sessions. During and after the anamnesis, many disorders are excluded immediately. The few disorders that remain possible should be checked.

Symptom case definition in the diagrams

Complaints in a certain body region form the entry point of each diagram for the symptom case definition, which is the first indicator that could lead to a diagnosis. The symptom criteria should be checked one by one. Failure to meet any part of the criteria will lead to a rejection of the specific disorder in question. After rejection, the other possible disorders listed in the diagrams (by number) should be checked. For some disorders, the symptoms may be present, but the temporal criteria may not be met. In such cases, the symptoms still suggest the disorder, and the disorder can be considered a "latent case". If some of the criteria are met, the complaints may be nonspecific and therefore considered a "deviant case".

A summary of the decision process for case definitions based on symptoms only follows:

1. Diagrams are examined for symptoms in a certain body region.
2. Criteria are checked.
3. Other listed possibilities are checked if the disorder is rejected.

   or
4. Symptom case is considered present and is registered or a physical examination may follow (dependent on the goal of the examination (micro, meso, or macro level) when the criteria are met.

Sign case definition in the diagrams

When the criteria for the symptom case definition are met, a physical examination may reveal positive signs that fulfill the sign case definition for that disorder. A "symptom case" is the entry marker to the flow diagram for this 2nd case definition. However, positive tests are generally found for patients whose symptoms are present at the time of examination or in the immediate past. These patients can be considered "current cases". Signs will not generally be present in "past cases". Thus

the 1st part of the time rule must be obeyed if a patient is to be considered a "current case". When a patient is a "past case", the label "symptom case" remains.

A summary of the decision process for case definitions based on symptoms and signs follows:

1. Diagrams are examined for the symptom case of the disorder in question.
2. Adherence to time rule is checked for the patient.
3. Criteria for physical examination tests are checked.
4. Decision is kept as "symptom case" and is registered as such when the sign criteria are not met.

   or
5. Sign case is considered present and is registered when the sign criteria are met.

Appendix E has been constructed so that the user can do a quick scan to decide which case definitions to consult when a patient complains of a specific upper body region.

1. Radiating neck complaints

Description of disorder and clinical features

Textbooks [eg, that of Kelly et al (33)] and the literature describe radiating neck complaints as mostly nonradicular complaints originating from structures in or around the cervical spine. Symptoms are found not only in the neck region, but also in one or more regions of the upper extremity as well. Because the cervical nerve roots are bound above and below by the 2 vertebra pedicles of the uncovertebral and zygapophyseal joints, involvement of these joints is considered the most common cause of nerve root irritation that leads to cervicobrachial neuralgia and, thus, to cervicobrachial pain. Whereas cervical nerve-root irritation causes well-localized areas of pain, more poorly defined areas of referred pain arise from irritation of deep connective tissue, structures, muscle, joint, bone, or disc.

With age, the intervertebral discs lose height. The result is increased pressure on the uncovertebral and zygapophyseal joints, which then are converted to joints that are load bearing, a function for which they are not designed (33).

Nonradiating neck pain is often called tension neck syndrome (TNS). TNS is not a specific disorder. It might be "defined", however, as a complex of nonspecific symptoms in which myofascial and tendinomyogen complaints dominate and which is centered around the neck-shoulder line (8, 9, 34). In this document, symptoms and signs that might be categorized as TNS will be dealt with in the section of nonspecific UEMSD.

Radiating neck pain of nonradicular origin has been found in over 25% of 440 patients with neck-shoulder complaints by Rekola et al (35) and in 86% of 517 patients by Borghouts et al (36).

Table 2. Test properties [sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV)] of self-administered examinations of 18 signs in the upper extremity with the medical examination as the criterion for radiating neck complaints, according to Toomingas (38).

	Test properties			
Test	Sensitivity	Specificity	PPV	NPV
Neck rotation range	0.20	0.98	0.14	0.99
Neck flexion-extension range	0.44	0.95	0.13	0.99
Neck tenderness	0.55	0.86	0.39	0.92
Trapezius tenderness	0.83	0.65	0.29	0.96

Differential diagnosis of radiating neck complaints and other upper-extremity musculoskeletal disorders

The disorder must be distinguished from osteoarthrosis of the cervical spine, cervical syndrome (ie, nerve root compression by herniated vertebral disc), thoracic outlet syndrome, and shoulder tendinitis (29 pp 61—67, 37].

Information on test properties

Although not in an original study on test properties, but informative in this context, Toomingas (38) assessed the relation between subjective cervical complaints and objective findings. He calculated test properties (sensitivity, specificity, positive predictive value, and negative predictive value) of self-administered examinations of 18 signs in the upper extremity with the medical examination as criterion. Over 500 examinations were compared. The subjects came from the Stockholm MUSIC I study population. The tests compared were the neck rotation range, the neck flexion-extension range, and palpation of neck tenderness and trapezius tenderness (table 2).

Also relevant in this context is the study on interexaminer reliability that was done in an evaluation of the protocol used by the British Medical Research Council (MRC) (39). Of 56 hospital outpatients with rheumatic and orthopedic complaints, 31 pairs (62 limbs) of between-observer data and 12 pairs (24 limbs) of within-observer data were formed. Physical examinations were performed by trained research nurses or rheumatologists. The mean differences for measurements of neck movements was small within-observers (between 0.4—3.3 degrees) and between observers (differences 0—5.3 degrees). The diagnostic conclusions were perfect (100%) for the within and between-observer ratings for the only neck diagnosis made (cervical syndrome). The sensitivity and specificity of this examination schedule (gold standard in rheumatologists' opinions) for the two observers were 60% and 73% and 60% and 69%, respectively.

Westaway et al (40) evaluated the test-retest reliability of self-reported neck complaints for 31 consecutive physician-referred patients with neck pain. The 72-hour intraclass correlation was 0.81 for the severity of pain.

Viikari-Juntura et al (41) evaluated the predictive validity of symptoms and signs in the neck and shoulder with regard to sick leaves in a prospective study of 474 patients seeking medical advice from occupational health professionals. More than half of the subjects (64%) reported pain in the neck or shoulder upon rotation of the head, and 13% of the subjects reported pain in the upper limb upon rotation of the head. Cervical rotation leading to pain in the upper limb was the test that remained a significant predictive value in the multivariate analyses.

Examples of the case definitions and criteria proposed or used in different studies

Definitions based on symptoms

Although not for "radiating neck pain", the practice guidelines for occupational medicine by Harris et al (42) provided the following diagnostic criterion for regional neck pain (ICD-9 723.1,3,5,7,8,9): diffuse pain.

Definitions based on symptoms and signs

Veierstedt & Westgaard (43) used the following "diagnostic" criteria for trapezius myalgia: neck and shoulder pain that lasts >2 weeks and is of a degree making it difficult to continue work, plus at least 1 tender or trigger point present on palpation.

In a case-rerferent study of 142 male electricians and 139 female laundry workers, Norlander et al (44) evaluated whether mobility in the cervicothoracic motion segment could be seen as an indicative factor of musculoskeletal neck-shoulder pain. Cases were defined as >7 days of complaints in the neck or shoulder region or both according to the Nordic questionnaire. Positive signs were based on cervical flexion, and the relative flexion mobility was used as a sign according to the cervicothoracic ratio (a calculated ratio based on absolute values of skin distraction between C7 and T5). The results showed that an invariable inverse C7-T1 function had an increased relative risk of developing >7 days of neck-shoulder pain.

In the protocol used by the British MRC (39), developed through a Delphi process, the following diagnostic criteria are used for cervical syndrome: neck pain and one of the following neck movements (cut-points) restricted: right or left rotation (<80 degrees), flexion (<60 degrees), extension (<75 degrees), or lateral flexion (<45 degrees).

Proposed case definitions

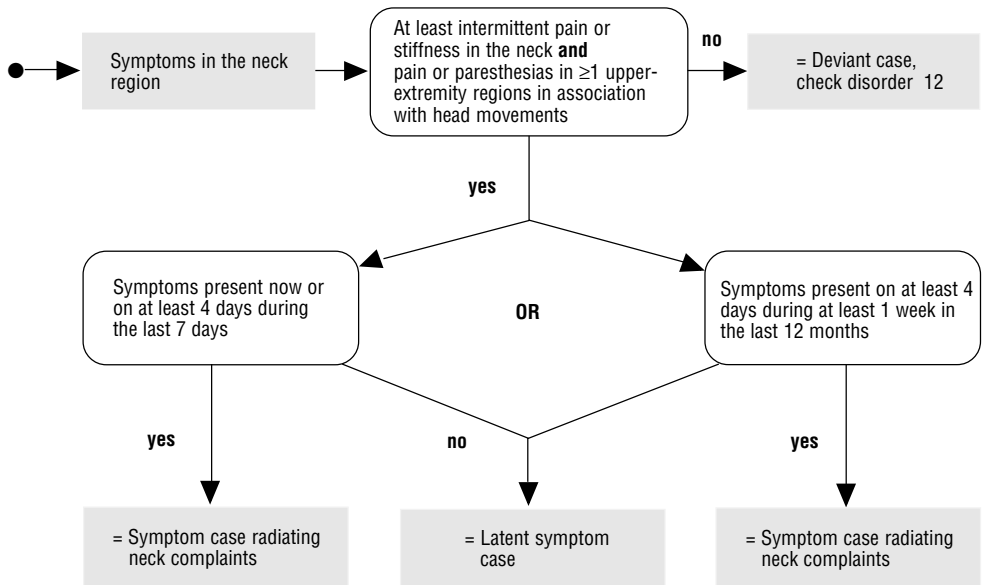
Because not many studies have described the symptoms belonging to radiating neck complaints, the symptoms for this criteria document are based on textbooks and common clinical practice. A positive test during the examination of the cervical spine is included. The study of Viikari-Juntura (41) could be used to add the appropriate sign to the symptoms. A time criterion is also included on the basis of the time rule described earlier in this document.

Case definition 1: radiating neck complaints, based on symptoms only	
Symptoms:	• At least intermittent pain or stiffness in the neck and pain or paresthesias in ≥1 upper-extremity regions in association with head movements
	AND
Time rule:	• Symptoms present now or present on at least 4 days during the last 7 days
	or
	• Symptoms present on at least 4 days during at least 1 week in the last 12 months

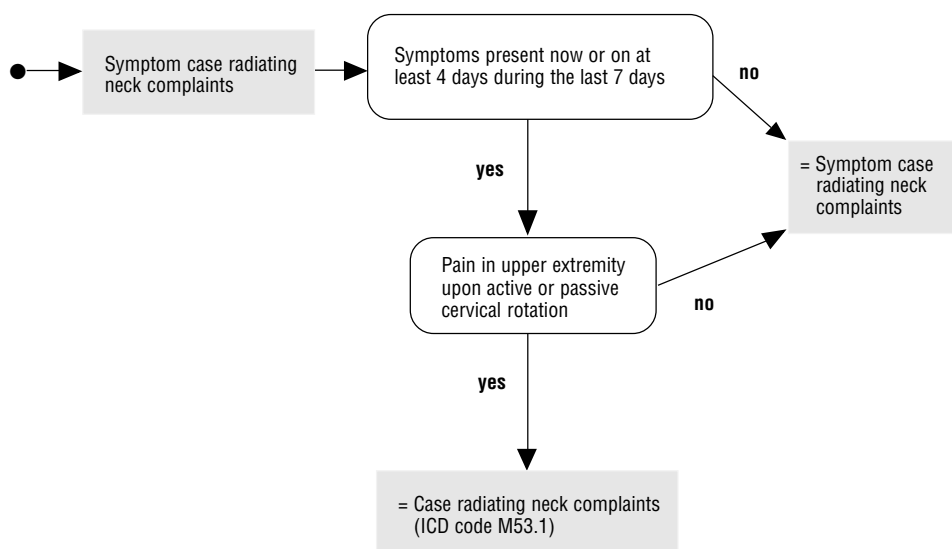
Case definition 2: radiating neck complaints, based on symptoms and physical examination signs	
Time rule:	• Symptoms present now or on at least 4 days during the last 7 days
	AND
Symptoms:	• At least intermittent pain or stiffness in the neck and pain or paresthesias in ≥1 upper-extremity regions in association with head movements
	AND
Signs:	• Pain in upper extremity on active or passive cervical rotation

! Note ! : Descriptions and photographs of the tests involved can be found in appendix A Photos 1 and 2

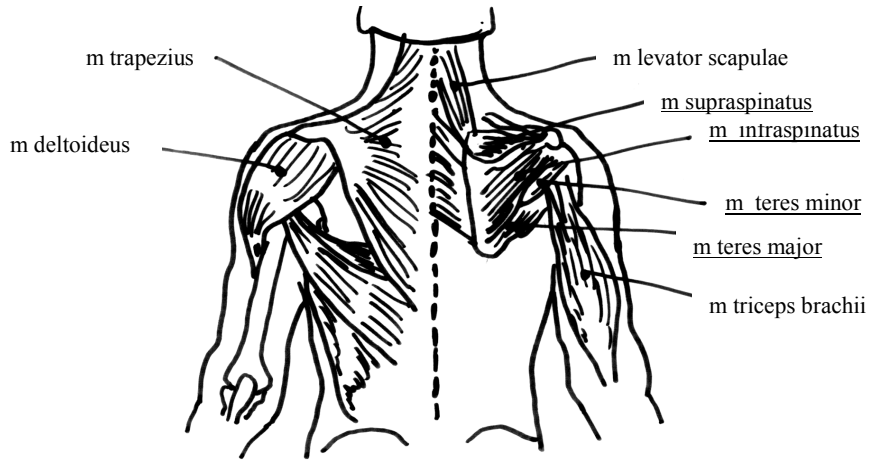
SYMPTOM CRITERIA FOR RADIATING NECK COMPLAINTS



SIGN CRITERIA FOR RADIATING NECK COMPLAINTS



2. Rotator cuff syndrome



Description of disorder and clinical features

Textbooks and the literature describe the rotator cuff syndrome as an irritation of structures in the subacromial space due to a decrease in vascularization and degenerative change caused by repeated impingement of the various types of tissues under the shoulder tectum. The structures responsible for the accompanying symptoms include the supraspinate muscle, the infraspinate muscle, the tendon of the caput longum of the biceps brachii muscle, the subacromial bursa, the subscapular muscle, and the tendons of the teres major and minor muscles.

The main symptom is intermittent, activity-dependent pain in the shoulder region. Symptoms are provoked when elevation movements of the upper arm, in comparison with those of the trunk, occur. Examples of these kinds of movements are pulling of a sweater, scratching the other shoulder or upper back, or closing a bra backwards. Possible limitations of shoulder movements are caused by pain or stiffness and do not follow the capsular pattern of the glenohumeral joint.

Differential diagnosis of rotator cuff syndrome and other upper-extremity musculoskeletal disorders

Most textbooks suggest distinguishing this disorder from osteoarthrosis of the glenohumeral joint. Ranney et al (45) excluded frozen shoulder in diagnosing rotator cuff tendinitis. Lyons & Orwin (46) mention cervical radiculopathy, glenohumeral instability, suprascapular nerve injury, acromioclavicular joint pathology, calcified tendinitis, and frozen shoulder as differential diagnoses that should be excluded.

Information on test properties

Pellechia et al (47) studied the intertester reliability of manual orthopedic physical examination of the shoulder (active, passive, and resistance tests) following the Cyriax approach. Certain combinations of positive tests were used to differentiate between diagnostic categories in the shoulder region (ie, all rotator cuff tendinitis, arthritis, and suprascapular neuritis). Agreement was found in the classification of 19 of 21 patients (kappa = 0.88), 9 of which had rotator cuff tendinitis.

Although not in an original study on test properties, but informative in this context, Toomingas (38) calculated the test properties [sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV)] of the self-administered examinations of 18 signs in the upper extremities using the results of a medical examination as the criterion. He used this procedure for a population for which over 500 examinations were compared. The subjects were a part of the Stockholm MUSIC I study (table 3).

The interexaminer reliability of physical tests and the validity of the diagnosis were examined in an evaluation of the Southampton examination schedule for the diagnosis of musculoskeletal disorders of the upper limb (48). In 88 hospital outpatients with rheumatic and orthopedic complaints, 43 pairs (86 limbs) of between-observer data were formed. Physical examinations were performed by trained research nurses or rheumatologists.

Table 3. Test properties [sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV)] of self-administered examinations of 18 signs in the upper extremities with the medical examination as criterion for rotator cuff syndrome, according to Toomingas (53).

	Test properties			
Test	Sensitivity	Specificity	PPV	NPV
Shoulder abduction range	0.29	0.93	0.05	0.99
Shoulder external rotation range	0.59	0.81	0.12	0.98

At the test level, excellent interobserver agreement was obtained for the presence of shoulder tenderness (kappa = 0.80), the presence of a painful arc (kappa = 0.93), pain on resisted shoulder abduction (kappa = 0.81), pain on resisted elbow flexion (kappa = 0.83), and pain on resisted shoulder external rotation (kappa = 0.90). The sensitivity and specificity of the examination schedule for bicipital tendinitis and rotator cuff tendinitis (gold standard in rheumatologists' opinions) for the 2 observers were 100% and 58% and 98 and 84%, respectively.

Marx et al (49) performed a formal literature search for a period of over 30 years (Medline 1966 to 1996, snowball method, expert references) to evaluate the reliability and validity of using a physical examination for the upper extremities. For rotator cuff, only 1 study was found (50); it concerned 45 patients with expected rotator cuff tears. With surgery as the gold standard, the sensitivity and specificity of the clinical diagnosis of rotator cuff tear by means of palpation and strength testing of shoulder abduction and external rotation was found to be 91% (95% confidence interval 76—98) and 75%, respectively. The predictive value of a positive test was 94%, and the predictive value of a negative test was 66%.

Examples of case definitions and criteria proposed or used in different studies

Definitions based on symptoms

No studies were found which used only symptoms to diagnose the rotator cuff syndrome.

Definitions based on symptoms and signs

For the development of epidemiologic criteria, Waris et al (51) reviewed the literature (6 studies which used case definitions) and sampled expert knowledge. For humeral tendinitis (supraspinous and biceps), the following diagnostic criteria were developed: symptoms: pain in the shoulder joint region and limited active movement because of pain; signs: the presence of a painful arc during arm abduction, pain on resisted shoulder abduction, and tenderness during palpation of the bicipital or supraspinous tendon.

Hagberg & Wegman (8) described 4 criteria used in former occupational studies of rotator cuff tendinitis (which they actually restricted to supraspinous tendinitis). The criteria were (i) localized shoulder pain and tenderness on palpation of the humeral head, pain with isometric contractions, limitations of the active range of movement, and a reduction of gross power, (ii) pain in the shoulder region and local tenderness on palpation, (iii) local pain, local tenderness on palpation, pain during abduction, and limited active abduction, and (iv) local pain and tenderness on palpation, in addition to pain at isometric abduction. Based on their review, they defined rotator cuff tendinitis as follows: symptom: localized shoulder pain; sign: tenderness on palpation over the humeral head.

In their cross-sectional study of 146 female industrial workers, Ranney et al (45) used the following minimal clinical criteria for establishing worksite rotator cuff tendinitis: symptom: pain in the deltoid area or in the front of the shoulder increased by glenohumeral movement; sign: rotator cuff tenderness on palpation. Frozen shoulder should be excluded. In addition, they classified the severity of the disorder as "mild" when these criteria were met, as "moderate" when pain persisted >2 hours after the cessation of work but was gone after a night's sleep or when the patient had tenderness plus pain on resisted activity if localized in an anatomically correct manner or a positive impingement test, and as "severe" when the pain was not completely relieved by a night's sleep.

In their evaluation of the intertester reliability of the Cyriax evaluation of shoulder patients, Pellechia et al (47) used the following criteria for rotator cuff tendinitis: symptom: shoulder pain; signs: either painful resisted shoulder abduction, internal, external rotation or elbow flexion and a painful arc during active abduction-elevation of the shoulder girdle, and pain on full passive elevation.

In their cross-sectional study of cumulative trauma disorders (CTD) among 145 medical device assemblers, Meservy et al (52) used the following criteria for rotator cuff tendinitis: symptoms: cumulative trauma disorders in the upper extremities (ie, pain, aching, stiffness, burning, numbness or tingling in the shoulder and self-reported work as cause of the problem and exclusion of nonwork accident or injury); signs: pain or tenderness (≥3 on a scale of 1—10) on active and resisted shoulder abduction.

In his thesis based on 6 articles, Toomingas (53) used the following minimal diagnostic criteria for rotator cuff tendinitis in his study, which was part of the MUSIC I study: present symptom location (ache, pain, or discomfort) at the shoulder and rotator cuff tenderness (on pal-

pation) and pain on abduction of either shoulder, internal rotation or external rotation (on resisted active contraction).

In their practice guidelines for occupational medicine, Harris et al (42 pp 11-17) provide the following diagnostic criteria for chronic rotator cuff tears (ICD-9 727.61): symptoms: pain over the deltoid area with overhead work and weakness on elevation and external rotation of the shoulder; signs: weakness in shoulder "thumbs down" abduction and weak external rotation.

For the development of clinical diagnostic criteria, Menoni et al (54) and De Marco et al (31) chose clinical maneuvers and instrumental tests on the basis of a sensitivity and specificity assessment and positive and negative predictive values whenever such data were available in the literature. For shoulder tendinitis, the following criteria were set: exceeding the anamnestic threshold (ie, pain, paresthesias, weakness or neurovegetative symptoms lasting for at least 1 week or occurring at least once a month without being preceded by acute trauma during the last 12 months), and active shoulder movements trying to evoke pain during flexion or abduction (painful arc between 70 and 120 degrees) or external rotation plus abduction, or internal rotation plus abduction.

In the Southampton examination schedule (48), the following diagnostic criteria are used for rotator cuff tendinitis: symptom as history of pain in the deltoid region and one of the following positive signs: resisted shoulder abduction, external or internal rotation. For bicipital tendinitis, the criteria were history of anterior shoulder pain as the symptom and pain on resisted active flexion or supination of the forearm as a positive sign. The physical examination protocol was started when pain was present for ≥1 days during the previous 7 days.

Lyons & Orwin (46) proposed diagnostic criteria for rotator cuff tendinopathy and the subacromial impingement syndrome. They suggested the following symptoms and signs in making the diagnosis for rotator cuff disorders: pain, commonly at the anterior or lateral side of the shoulder, aggravated by overhead work or throwing, decrease in internal rotation, tenderness on palpation, and a positive resistance test against abduction or internal rotation or external rotation. In addition, 10 more specialized tests were mentioned by the authors.

Harrington et al (55) reached a multidisicplinary consensus on the following minimum surveillance criteria for shoulder tendinitis: history of pain in the deltoid region and pain on ≥1 resisted shoulder movement (abduction, external rotation, or internal rotation). These criteria were taken over by Davis (56) as well.

In the development of a diagnostic instrument for the rotator cuff syndrome, the most weighted symptoms and signs of Sluiter et al (29 pp 35—40) that minimally led to a "probable" diagnosis were intermittent pain in the shoulder or deltoid region of the upper arm and a minimum of 2 of the following: painful arc during active elevation of the shoulder girdle, passive, end-ranging pain or restriction of 1 shoulder movement, a positive resistance test against 1 of the shoulder movements or elbow flexion.

Proposed case definitions

Although no studies were found that based a diagnosis of rotator cuff syndrome on symptoms alone, most studies were more or less consistent on the symptoms included in their criteria, and they contained both symptoms and signs. Therefore, a case definition based on symptoms only is constructed below, which includes 1 general tendinitis characteristic regarding the contractile feature of muscle-tendon tissue.

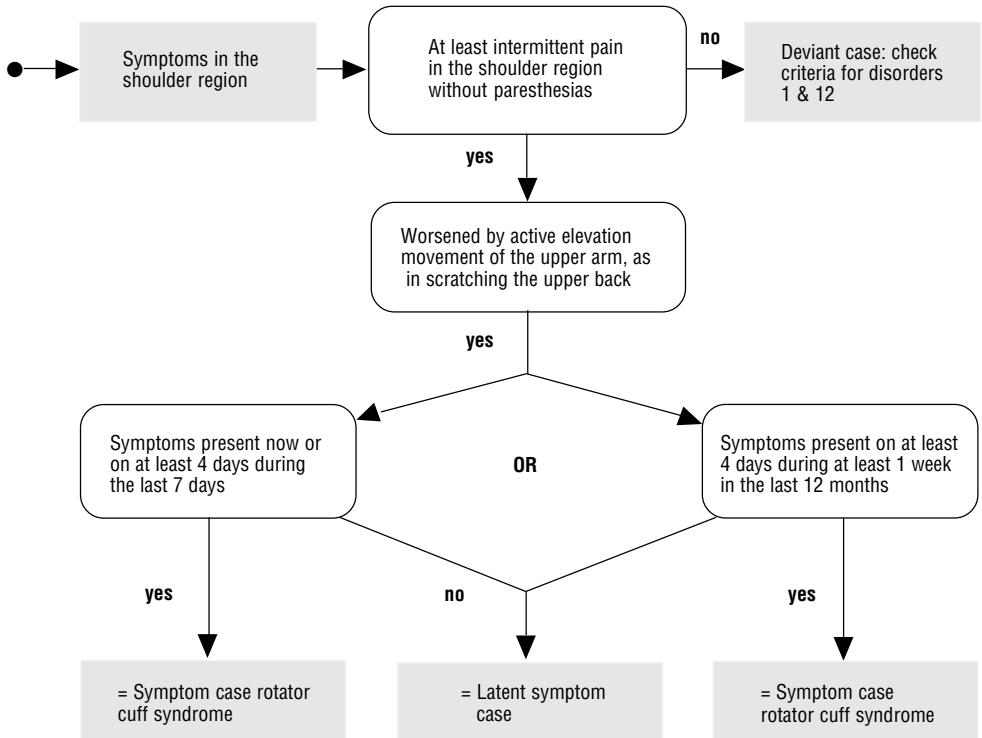
Because the subacromial bursa and the biceps tendon are included in the definition of rotator cuff syndrome, the signs included in the case definition for this document is based on the latest consensus established in the United Kingdom and the validation of the Southampton protocol. A time criterion is also included that is based on the time rule described earlier in this document.

Case definition 1: rotator cuff syndrome, based on symptoms only	
Symptoms:	• At least intermittent pain in the shoulder region without paresthesias worsened by active elevation movement of the upper arm as in scratching the upper back
	AND
Time rule:	• Symptoms present now or on at least 4 days during the last 7 days
	or
	• Symptoms present on at least 4 days during at least 1 week in the last 12 months

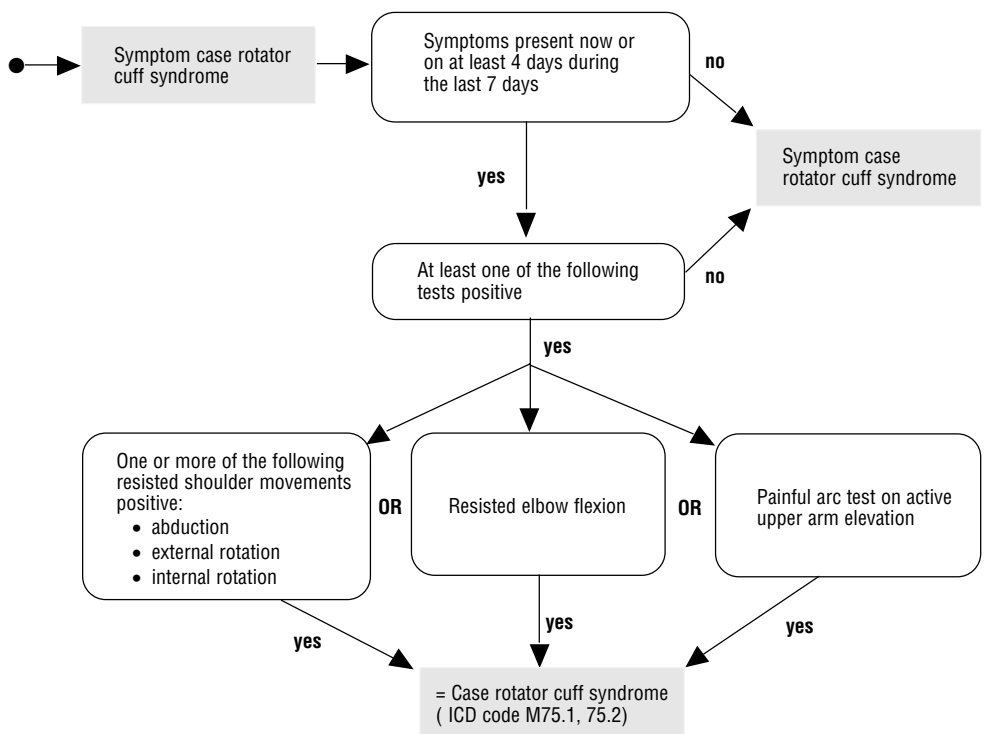
Case definition 2: rotator cuff syndrome, based on symptoms and physical examination signs	
Time rule:	• Symptoms present now or on at least 4 days during the last 7 days
	AND
Symptoms:	• At least intermittent pain in the shoulder region without paresthesias; pain worsened by active elevation movement of the upper arm as in scratching of the upper back
	AND
Signs:	• At least one of the following tests positive: ▲ resisted shoulder abduction, external rotation, or internal rotation ▲ resisted elbow flexion ▲ painful arc on active upper arm elevation

! Note !: Descriptions and photographs of the tests involved can be found in appendix A Photos 3—10

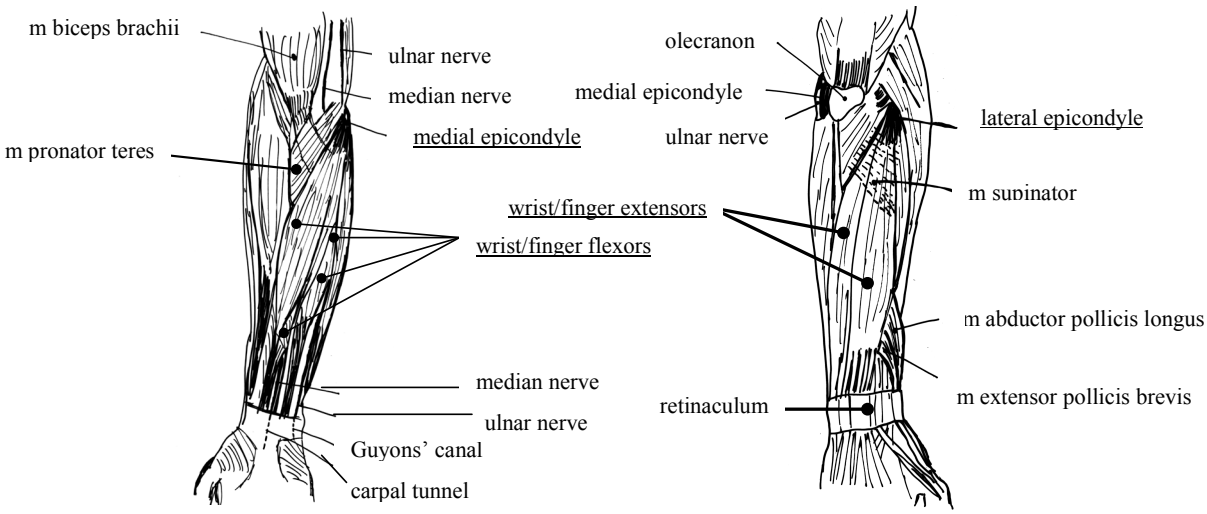
SYMPTOM CRITERIA FOR ROTATOR CUFF SYNDROME



SIGN CRITERIA FOR ROTATOR CUFF SYNDROME



3. Epicondylitis – lateral and medial



Description of disorder and clinical feature

Epicondylitis is a condition characterized by intermittent pain at the muscle-tendon junction or at insertion points of the wrist extensors (lateral epicondylitis) or wrist flexors (medial epicondylitis) in the elbow region. In textbooks and the literature, the clinical features of epicondylitis are described as patients' complaints of pain as the primary symptom, generally localized around the lateral or medial epicondyles but sometimes radiating distally to the forearm. Weakness of grip can also be present. Symptoms are often provoked by the grasping or lifting of objects (ie, by supination and pronation movements of the forearm or upon elbow extension). In the acute phase, symptoms can also occur during rest.

Differential diagnosis of epicondylitis and other upper-extremity musculoskeletal disorders

Radial tunnel syndrome is another possible cause of chronic elbow pain. Other possible causes include cervical syndrome and osteoarthrosis (eg, synovial irritation and chronic irritation of the ulnar-humeral or radiohumeral joint capsule) (57, 58).

Information on test properties

Sölveborn & Olerud (59) studied 123 patients with unilateral signs and symptoms of epicondylitis in a consecutive prospective series from their university hospital in Sweden in order to evaluate the range of motion (ROM) characteristics of the elbow and wrist joints in patients with radial epicondylalgia (tennis elbow). A related reliability study involved 16 healthy persons without a history of elbow or wrist disorder. Active and passive joint motion measurements were made with a simple plastic goniometer for wrist flexion, wrist extension, supination, and pronation. Also measured were radial and ulnar deviation, elbow flexion, and elbow extension. For the 92 patients with right-arm symptoms, the study found a significantly restricted ROM in the involved limb for every ROM measurement except passive supination. The greatest mean differences were found for wrist extension (11 degrees active, 8 degrees passive), wrist flexion (7 degrees active, 8 degrees passive), and pronation (7 degrees active, 12 degrees passive). For the 31 patients with left-arm symptoms, the ROM was significantly restricted for wrist flexion (5 degrees active, 4 degrees passive), supination (9 degrees active, 8 degrees passive), and elbow extension (4 degrees). The ROM of the healthy subjects used in the reliability study were consistent with those of the symptom-free side of the patients in the clinical series.

Pienimaki et al (60) evaluated the motor performance (reaction time, speed of movement, accuracy, coordination, and tapping speed) of 32 consecutive chronic tennis elbow patients referred to a university hospital and 32 referents from a random age- and gender-matched sample of healthy people in the local community. They found significantly slower reaction times for the involved arms of the patients than those of the corresponding arms of the referents (19—35% slower); there was also a significantly slower speed of movement (31—32%). In addition the

patients' healthy arms showed significantly slower reaction times (11—29% slower) and speed of movement (25—30% slower) than the corresponding arms of the referents. The authors considered these findings preliminary but suggested that the measurement of motor arm function may provide complementary data for diagnosis, treatment, and rehabilitation.

In a prospective randomized trial comparing the outcomes of 2 treatment methods (Cyriax physiotherapy and corticosteroid injections) for 106 patients with lateral epicondylitis, Verhaar (58) studied all patients with the disorder referred to an orthopedic elbow clinic of an academic hospital in Maastricht over a 1-year period. The physical examination of these patients included the measurement of ROM, pain provoked by resisted motion, palpation, and grip strength. The ROM was limited for only 7 of 107 patients, all induced by pain at passive or active extension. All the patients had pain upon resisted extension of the wrist (90 with severe pain and 16 with slight pain). Fifty of 106 patients had at least slight pain upon resisted supination of the forearm, but 56 of the106 did not experience pain with this maneuver. Eighty-eight of the106 patients had at least slight pain upon resisted extension of the middle finger, and 18 reported no pain with this maneuver. All of the 106 patients reported tenderness on palpation of the lateral epicondyle, the tenderness being slight in 24, moderate in 52, and severe in 30. Absolute grip strength before treatment was not reported; increased or decreased grip strength was reported only as an outcome parameter.

The interexaminer reliability of physical tests and the validity of diagnosis were examined in an evaluation of the Southampton examination schedule for the diagnosis of musculoskeletal disorders of the upper limbs (48). For 88 hospital outpatients with rheumatic and orthopedic complaints, 43 pairs (86 limbs) of interobserver data were formed. Physical examinations were performed by trained research nurses or rheumatologists. On the test level, excellent between-observer agreement was obtained for the presence of elbow tenderness laterally (kappa = 0.75), pain in the lateral elbow on resisted wrist extension (kappa = 0.75), and pain medial elbow on resisted wrist flexion (kappa = 0.75). The sensitivity and specificity of the examination schedule of lateral epicondylitis (gold standard in rheumatologists' opinions) for the 2 observers were 73% and 97%, respectively.

Examples of case definitions and criteria proposed or used in different studies

Depending on their purpose, studies have used a variety of case definitions and criteria for identifying and describing elbow-related musculoskeletal disorders in general and epicondylitis in particular. Some general studies of elbow-related musculoskeletal disorders have been based on self-reported symptoms. Most studies of epicondylitis have included physical examinations and have been based on both symptoms and signs.

Definitions based on symptoms

Studies based on symptoms have generally examined elbow disorders based on the frequency and duration of symptoms or on symptom interference with work activities (12).

Punnett et al (61) defined cases of elbow disorders among female garment workers as the presence of persistent elbow pain, numbness, or tingling lasting for most days for ≥1 month within the past year, not associated with previous injury, and beginning after first employment in garment manufacturing.

In their study of neck and upper-extremity disorders in electrical equipment and automobile assemblers, Ohlsson et al (62) defined a case as any elbow pain, elbow pain affecting work ability, and elbow pain in the last 7 days and the last 12 months.

In studies of newspaper employees (63) and government-employed teleservice representatives (64), NIOSH investigators defined elbow-related musculoskeletal disorders as self-reported pain with numbness, tingling, aching, stiffness, or burning in the elbow region and symptoms beginning after the start of the job, the symptoms lasting at least 1 week or occurring once a month within the past year and given a rating of 3 ("moderate") or greater on a 5-point scale.

Definitions based on symptoms and signs

In an early study of occupational neck and upper-limb disorders in a working population, Waris et al (51) used diagnostic criteria developed by a multidisciplinary group of specialists using a their literature review and their own clinical experience. Diagnostic criteria for epicondylitis included pain during rest or active movements of the wrist and fingers plus tenderness on palpation at the lateral or medial epicondyle plus pain on resisted extension (lateral) or resisted flexion (medial) of the wrist and fingers.

In a study of the prevalence of lateral epicondylitis in the general population of the Maastricht area in The Netherlands, Verhaar (58) used the following criteria: (i) complaints of pain at the lateral side of the elbow and (ii) provokable pain at the lateral epicondyle upon resisted extension of the wrist.

Byström et al (65) studied automobile assembly-line workers and compared them with a randomly selected

group from the general population. Epicondylitis was defined by symptoms (pain, ache, or discomfort during the last 7 days) plus tenderness to palpation of the lateral or medial epicondyle plus pain at the same epicondyle or in the forearm extensors or flexors on resisted wrist extension or flexion.

In their study of female workers with highly repetitive jobs, Ranney et al (45) used the following as "minimal clinical criteria" for diagnosing epicondylitis or tendinitis: pain localized to the lateral or medial aspect of the elbow plus tenderness to palpation of the lateral or medial epicondyle localized to this area or to soft tissues attached for a distance of 1.5 cm plus a positive modified Mill's test or reverse Mill's test (ie, extending the elbow, pronating the forearm, and then flexing the wrist; reversed for problems originating in the flexors). Of note is the authors' inclusion of pain distal to the epicondyle, but in the proximal half of the forearm. This inclusion reflects the view that epicondylar tenderness may be a proximal extension of a primary problem in the forearm muscles.

In their case-referent study to assess the motor performance of the arm in 32 consecutive patients with chronic unilateral tennis elbow referred to a university hospital, Pienimäki et al (60) used the following criteria to confirm the diagnosis of lateral epicondylitis: resisted wrist extension test plus Mill's test producing typical pain in the insertion area of the lateral epicondyle plus local tenderness on the lateral epicondyle upon palpation.

In their cross-sectional study of epicondylitis among 209 nursery school cooks and 366 referents, Ono et al (66) used the following criteria: tenderness on palpation of the lateral-medial epicondyles plus epicondylar pain on resisted extension (lateral) and flexion (medial) of the wrist with the elbow extended. Although "arm pain" was included as an item on a self-administered questionnaire, the item was not specific to the elbow region and was not analyzed in the study.

In a recent effort to establish consensus case definitions for the surveillance of common work-related upper-limb pain syndromes, Harrington et al (55) defined lateral epicondylitis as a lesion at the common extensor origin of the lateral epicondyle of the humerus causing the effects noted in the criteria. Their surveillance criteria included lateral epicondylar pain plus epicondylar tenderness plus pain on resisted extension of the wrist. For medial epicondylitis, the criteria were similar, but with pain on resisted flexion of the wrist.

In the Southampton examination schedule (48), the Delphi technique of Harrington et al (55) was used to develop the following criteria for diagnosing lateral and medial epicondylitis in large community surveys: pain over the lateral-medial elbow plus tenderness over the lateral-medial elbow plus induced pain over the lateral elbow upon wrist extension or over the medial elbow upon wrist flexion.

In the development of a diagnostic instrument for lateral-medial epicondylitis by Sluiter et al (29), the most weighted symptoms and signs that minimally led to a "probable" diagnosis were intermittent pain in the region of the lateral-medial epicondyle radiating into the forearm plus provocation of symptoms by exerting force with the hand plus a minimum of two of the following signs: positive resisted wrist extension or flexion, positive resisted wrist pronation or supination, painful stretching of collective wrist extensors or flexors, or positive palpation of muscle insertions at the elbow.

Extending the work of Menoni et al (54), which proposed a protocol for the anamnestic examination of patients with upper-limb complaints, De Marco et al (31) provided a guide to the clinical examination of patients who exceed the anamnestic threshold. For epicondylitis, this examination would be done when patients have pain on grasping or lifting or upon movement or from a triggering cause (anamnestic threshold: over the past 12 months, with a duration of at least 1 week or with a minimum of a monthly frequency of occurrence plus not caused by acute trauma). The examination for epicondylitis must evoke pain on palpation of the epicondyle plus pain on palpation of the tendons of the epicondyloid muscles, about 2 cm downstream from the epicondyle, plus pain upon passive wrist flexion with the elbow extended.

Proposed case definitions

The case definitions and diagnostic criteria proposed in this document are drawn from and consistent with most of those of the studies described in this section. All mention epicondylar pain as a common symptom, and most mention tenderness to palpation and pain upon resisted extension-flexion as commonly accepted signs. Most textbooks and clinical and epidemiologic studies included these symptoms and signs in their case definitions and diagnostic criteria. Although a right-left difference in tenderness with located epicondylar palpation in one patient might add valuable information for the individual clinician, in this document palpation is not included as a sign for this disorder because of the low reliability and comparability of the site and pressure of palpation between examiners that was found by Viikari-Juntura et al (67).

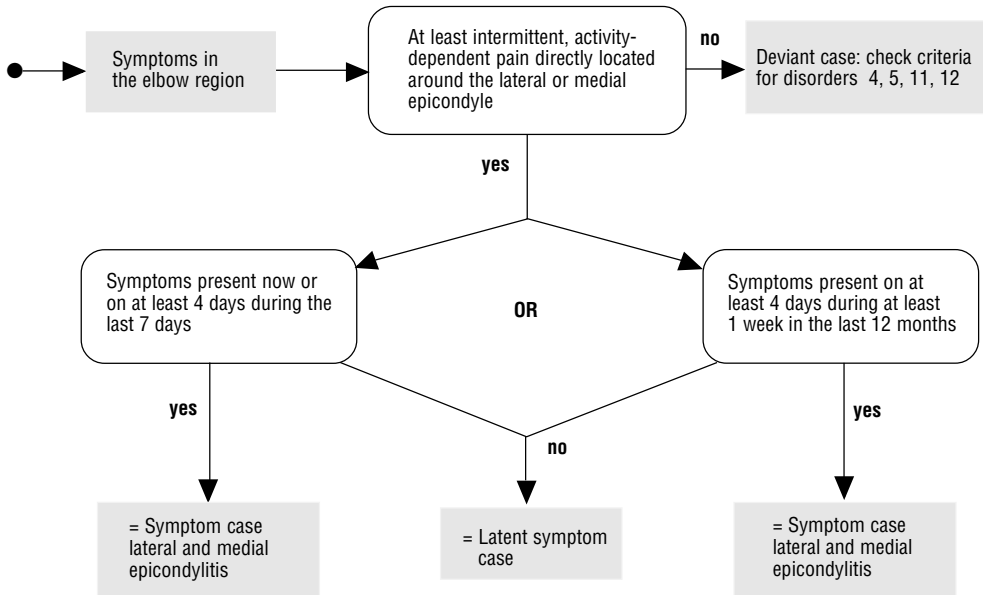
Some information was available about range of motion and motor performance, but these tests did not appear to be commonly used surveillance or diagnostic criteria for epicondylitis. The temporal dimension of the symptoms included in this document follows the time rule described earlier.

Case definition 1: epicondylitis, based on symptoms only	
Symptoms:	• At least intermittent, activity-dependent pain directly located around the lateral or medial epicondyle
	AND
Time rule:	• Symptoms present now or on at least 4 days during the last 7 days
	or
	• Symptoms present on at least 4 days during at least 1 week in the last 12 months

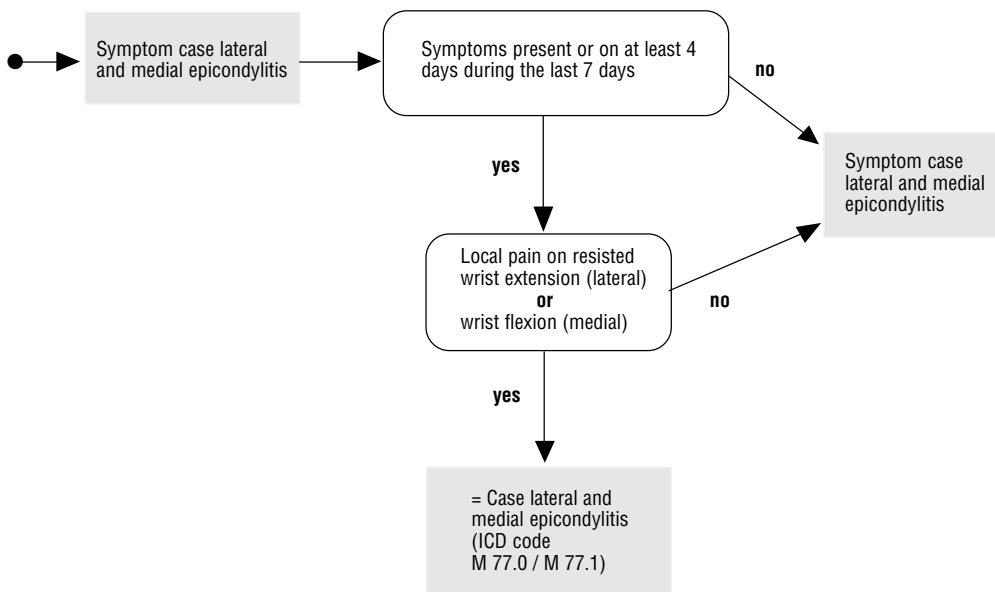
Case definition 2: epicondylitis, based on symptoms and physical examination signs	
Time rule:	• Symptoms present now or on at least 4 days during the last 7 days
	AND
Symptoms:	• At least intermittent, activity-dependent pain directly located around the lateral or medial epicondyle
	AND
Signs:	• Local pain on resisted wrist extension (lateral) or on resisted wrist flexion (medial)

! Note ! : Descriptions and photographs of the tests involved can be found in appendix A Photos 11 and 12

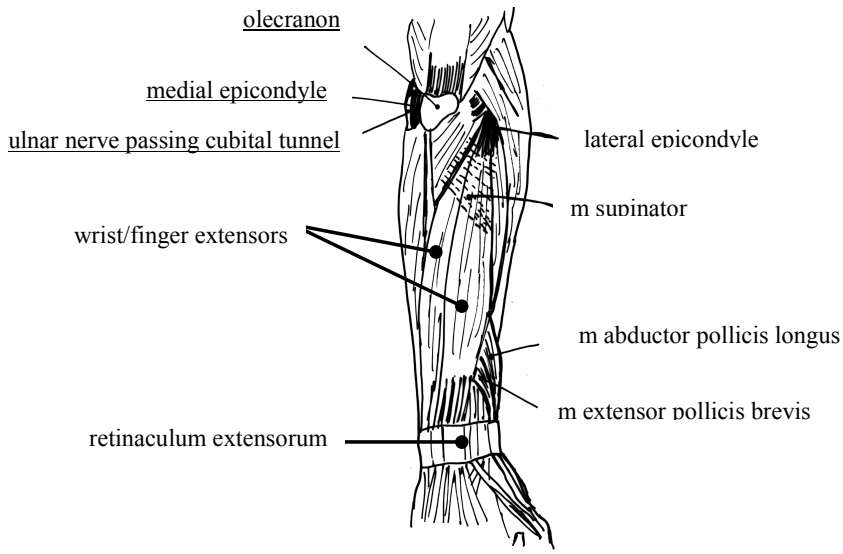
SYMPTOM CRITERIA FOR LATERAL AND MEDIAL EPICONDYLITIS



SIGN CRITERIA FOR LATERAL AND MEDIAL EPICONDYLITIS



4. Ulnar nerve compression at the elbow: cubital tunnel syndrome



Description of disorder and clinical features

The ulnar nerve is a motor and sensory nerve for the hand (68). At the elbow, the ulnar nerve passes posterior to the medial epicondyle and enters the cubital tunnel. The cubital tunnel consists of osseous walls formed by the medial epicondyle and olecranon. The floor of the tunnel is the medial collateral ligament of the elbow; the roof is a fibrous band (retinaculum) extending from the medial epicondyle to the olecranon (69, 70).

The cubital tunnel is the most common site of ulnar nerve compression, and the cubital tunnel syndrome is the 2nd most common peripheral compression neuropathy of the upper extremity (71—74). In textbooks and the literature, the clinical features of ulnar neuropathy at the elbow are described as follows: patient's common complaint of tingling or numbness in the 4th and 5th digits and the ulnar border of the palm. Weakness may or may not be present and may vary in nature from a very mild clumsiness to a pronounced hand weakness. Pain and tenderness may occur at the elbow and radiate toward the hand (75), but forearm muscles are often spared in lesions at the elbow (76). Patients may notice a worsening of symptoms at night in relation to sleep position (68, 69).

Differential diagnosis of cubital tunnel syndrome and other upper-extremity musculoskeletal disorders

It is not uncommon for compressive neuropathy at the elbow to be associated with additional compression proximally in the neck or brachial plexus or distally in the Guyon canal at the wrist. This phenomenon is known as the "double crush phenomenon" or "multiple crush phenomenon". Disease processes involving C8-T1 nerve roots or the brachial plexus can be present in a similar manner and should be considered in the differential diagnosis (70, 74). Thoracic outlet syndrome may involve compression of the medial cord in the brachial plexus and can produce the same symptoms.

Information on test properties

Provocative tests (elbow flexion test, Tinel's test, elbow flexion plus pressure test)

Elbow flexion has been shown to increase pressure in the cubital tunnel (77).

In their study of 204 elbows in 102 normal volunteer subjects, Rayan et al (78) found that approximately 10% of the elbows examined had a positive response to the elbow flexion test when performed for 1minute with the elbow fully flexed passively with both the wrist and shoulder in neutral position; 24% of the elbows had a positive response when any 1 of 4 different shoulder and wrist posture positions were used. This same study examined volunteers' response to the Tinel's sign at the ulnar nerve at the cubital tunnel with the elbow in 90 degrees' flexion (test defined as gentle percussion with 2 fingers over the nerve in the cubital tunnel). Altogether 31% of these asymptomatic subjects (24% of the elbows) had a positive Tinel's sign.

Rosati et al (79) replicated the Rayan et al (78) study of the elbow flexion test with 216 elbows of 108 healthy volunteer subjects [excluded were subjects with ulnar or other neuropathies, ulnar nerve dislocation at the cubital tunnel, cervicobrachialgias, sequelae of elbow fractures, axial deviations of the elbow or diabetes mellitus]. These authors found a positive test for 66 of 216 elbows (30.5%), but only 7 (3.6%) of the tests being positive after 1 minute, 24 (11.1%) being positive after 2 minutes, and 35 (16.2%) being positive after 3 minutes. In other words, the number of elbows with positive responses increased as the duration of the test increased from 1 to 3 minutes — even when a combination of tests with different positions were used.

Using abnormal nerve conduction studies as the gold standard, Novak et al (80) compared 32 patients with cubital tunnel syndrome from a single surgical practice with 33 referents with no history of numbness, pain, or paresthesias in the upper extremity in order to evaluate the usefulness of the following provocative tests: Tinel's sign, the pressure provocation test, the flexion test, and the combined pressure and flexion provocative test.

As shown in table 4, the combined test at 30 seconds yielded the highest sensitivity, specificity, and positive predictive value for this study population of patients with cubital tunnel syndrome and controls. No figures are known for the cluster properties of the Tinel's sign plus flexion test plus pressure test, in comparison with the figures of the combined pressure and flexion test. The authors recommend using the combined pressure and flexion test as the only test because of the excellent properties of the test (Novak et al, personal communication 1999).

In their prospective study to correlate magnetic resonance imaging (MRI), electrodiagnostic, clinical, and intraoperative findings in 31 elbows of 27 patients with ulnar nerve entrapment at the elbow and 10 referents, Britz et al (74) reported the following physical examination findings for the extremities of the patients: decreased pin prick response of the 4th and 5th digits in 27, positive 2-point discrimination of these digits in 5, mild weakness in 10, moderate weakness and atrophy in 2, moderate weakness with atrophy in 3, and severe weakness and atrophy in 5. Only 1 patient was normal in all these physical examination tests. The authors also reported the symptoms of the 31 extremities of the 27 patients. They were paresthesias of the 4th and 5th digits in 20, numbness of these digits in 17, and complaints of weakness in 9.

Ulnar electrodiagnostic and imaging studies

In a study of 21 patients with clinical symptoms and signs of ulnar neuropathy at the elbow and 20 referents (73), the sensitivity of motor ulnar conduction studies were 81% for the first dorsal interosseous muscle and 71% for the abductor digiti quinti muscle. The sensitivity of these ulnar motor studies was higher than that of the mixed ulnar nerve sensory study, which showed abnormality in only 57% of the patients.

Table 4. Comparison of 32 patients with cubital tunnel syndrome with 33 referents with no history of numbness, pain, or paresthesias in the upper extremity [taken from Novak et al (80)].

	Sensitivity	Specificity	Positive predictive value	Negative predictive value
Tinel's sign	0.70	0.98	0.94	0.87
Flexion test				
30 seconds	0.32	0.99	0.93	0.74
60 seconds	0.75	0.99	0.97	0.89
Pressure test				
30 seconds	0.55	0.98	0.92	0.81
60 seconds	0.89	0.98	0.95	0.95
Combined pressure and flexion test				
30 seconds	0.91	0.97	0.93	0.96
60 seconds	0.98	0.95	0.91	0.99

In their prospective study to correlate MRI, electrodiagnostic, clinical, and intraoperative findings for 31 elbows of 27 patients with ulnar nerve entrapment at the elbow and 10 referents, Britz et al (74) found that the sensory and motor conduction velocities confirmed ulnar neuropathy in 24 (77%) of the 31 elbows. Localization at the cubital tunnel was documented by nerve conduction studies for 21 (68%) of the elbows. MRI showed an increased signal of the ulnar nerve for 30 (97%) elbows and enlargement of the ulnar nerve for 23 (74%). No MRI abnormalities were found in the reference population. Denervation on the basis of electromyography was seen in 3 (10%) elbows. MRI, using a short tau inversion recovery (STIR) sequence, was more sensitive. An increased signal of the ulnar nerve as revealed by MRI was found for 30 (97%) elbows. MRI was also specific; 100% of the normal elbows had nonremarkable ulnar nerve configurations. The 12 patients who underwent surgery were found to have ulnar nerve compression.

Examples of case definitions and criteria proposed or used in different studies

Definitions based on symptoms

Although cubital tunnel syndrome and Guyon's canal syndrome were not described separately, Palmer et al (81) assessed 153 gas distribution operatives and used the following symptoms to define ulnar nerve entrapment: a history of paresthesias, numbness, or both in a pattern corresponding to ulnar nerve entrapment.

No occupational epidemiologic studies were found that used symptoms only as the basis for identifying cubital tunnel syndrome, but there is general agreement on the symptoms used in the studies based on symptoms and signs, as described in this section.

Definitions based on symptoms and signs

In an early epidemiologic and clinical study of neck and upper-limb disorders in slaughterhouse workers, Viikari-Juntura (82) used the following criteria for the clinical diagnosis of cubital tunnel syndrome: pain, paresthesias or numbness in the 4th or 5th fingers, tenderness to palpation at the cubital tunnel, Tinel's sign at the cubital tunnel possibly present, diminished sensation in the 4th and 5th fingers, and weakness of the interosseii and the 3rd and 4th lumbricales possible (ulnar nerve entrapment at the Guyon's tunnel, cervical syndrome, and thoracic outlet syndrome excluded).

In a prospective study of the usefulness of provocation tests in 44 extremities of 32 subjects with cubital tunnel syndrome, Novak et al (80) based their diagnosis of cubital tunnel syndrome on complaints of paresthesia and numbness in the ulnar nerve distribution, confirmed by abnormal nerve conduction studies across the cubital tunnel (a slowing of conduction velocity of less than 50 m/s across the elbow and a decrease of 15% at the elbow).

In their study of female workers with highly repetitive jobs, Ranney et al (45) used the following as "minimal clinical criteria" for diagnosing cubital tunnel syndrome: numbness and tingling distal to the elbow in the ulnar nerve distribution and tenderness over the ulnar nerve with a positive Tinel's sign or elbow flexion test or both.

In their prospective study to correlate MRI, electrodiagnostic, clinical, and intraoperative findings for 27 patients with ulnar nerve entrapment at the elbow, Britz et al (74) used the following criteria for subject inclusion: symptoms: numbness and paresthesias of the 4th and 5th digits and weakness and clumsiness of the hand; signs: sensory dysfunction in the 4th and 5th digits and dorso-ulnar aspect of the wrist and weakness of muscles innervated by the ulnar nerve, including the flexor carpi ulnaris, flexor digitorum profundus of the 5th digit, the dorsal and palmar interossei, and the adductor pollicus longus muscles.

In their clinical study of Swedish milkers, Stål et al (83) used the following criteria to diagnose cubital tunnel syndrome: patient information about numbness in the little finger, a selective weakness of the flexor digitorum profundus V and the abductor digitii minimi, and a positive Tinel sign over the ulnar nerve at the elbow level.

In their published occupational medicine practice guidelines, Harris et al (42) provide the following diagnostic criteria for ulnar nerve entrapment at the elbow (ICD–9 354.2): symptoms: pain or paresthesias in medial ring and small fingers (palm-up position); signs: the reproduction of symptoms with percussion or compression of the cubital tunnel, pain in the medial ring and small fingers on full elbow flexion, and weakness or atrophy of the ulnar hand intrinsics (unusual or late sign). A nerve conduction velocity of <4.5 milliseconds from elbow to hand (depending on the laboratory) is suggested as an additional diagnostic criterion.

In developing a diagnostic instrument for cubital tunnel syndrome, Sluiter et al (29) found the most weighted symptoms and signs that led to a "probable" diagnosis of cubital tunnel syndrome to be intermittent pain along the medial aspect of the forearm or elbow and radiation into the ulnar part of the hand, along with two of the following: a positive Tinel's sign of the ulnar nerve at the elbow, a positive reversed Phalen's test, and notable loss of tonus or atrophy in hypothenar muscles, thenar muscles, or intrinsic hand muscles.

Proposed case definitions

The literature suggests that paresthesias in the 4th and 5th digits are a more common initial complaint than pain and weakness. As has already been described, the combined elbow flexion-pressure provocation test has been found to be more sensitive and specific than Tinel's sign at the elbow, the elbow flexion test, and the pressure provocation test at the cubital tunnel (80). The criteria relating to time were selected according to the previously discussed time rule for entrapment neuropathies. Paresthesia can include numbness, tingling, burning, and hypo- or hypersensitivity. Patients may also complain of pain or subjective weakness or clumsiness of the hands. Additional signs can include tenderness over the cubital tunnel, sensory disturbance in the dorso-ulnar aspect of the hand and the dorsum of the little finger, and muscle weakness. A positive Tinel's sign over the ulnar nerve in the cubital tunnel is a further diagnostic sign, but only if the response differs from that of the unaffected side (84). This finding helps distinguish ulnar neuropathy at the elbow from compression at Guyon's canal. Further diagnostic testing may be necessary when clinical symptoms and findings are equivocal, when the site of nerve compression is uncertain, or when multiple sites are suspected. In such cases, motor and sensory nerve conduction studies may be helpful, although there is no consensus on the diagnostic value of the routine use of electrodiagnostic techniques in the diagnosis of cubital tunnel syndrome. Britz et al (74) found MRI to be both sensitive and specific,

correlating well with clinical and intraoperative diagnoses of compressive ulnar neuropathy at the elbow. Their study found MRI to be more sensitive than electrodiagnostic studies in the diagnosis of cubital tunnel syndrome.

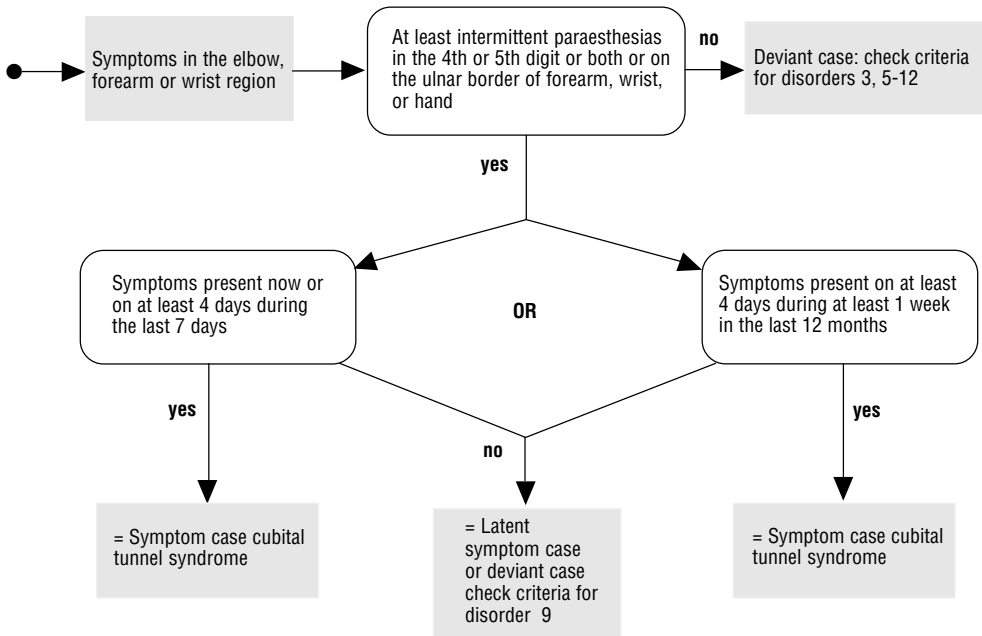
! Note ! When paresthesias are only present in the fingers, the symptom case definition for cubital tunnel syndrome may not differ from the symptom case definition for Guyon's canal syndrome (see pages 48—51) if pain is not present as a symptom in the latter. Then, however, the symptom case definitions can be used to register this symptom case as ulnar nerve compression.

Case definition 1: cubital tunnel syndrome, based on symptoms only	
Symptoms:	• At least intermittent paresthesias in the 4th or 5th digit or both or on the ulnar border of the forearm, wrist, or hand
	AND
Time rule:	• Symptoms present now or on at least 4 days during the last 7 days
	or
	• Symptoms present on at least 4 days during at least 1 week in the last 12 months

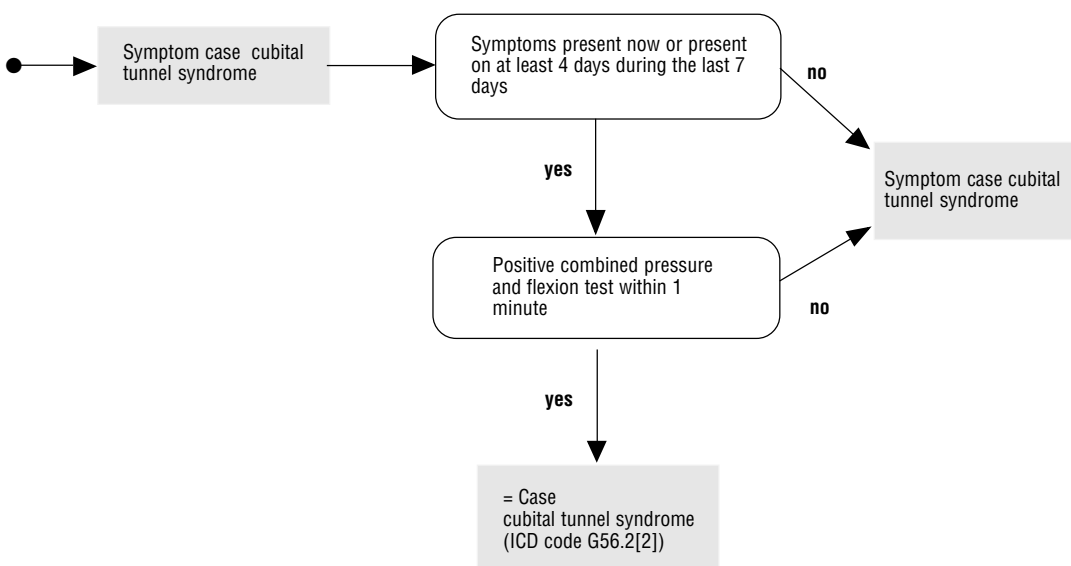
Case definition 2: cubital tunnel syndrome, based on symptoms and physical examination signs	
Time rule:	• Symptoms present now or on at least 4 days during the last 7 days
	AND
Symptoms:	• At least intermittent paresthesias in the 4th or 5th digit or both **or** on the ulnar border of the forearm, wrist, or hand
	AND
Signs:	• A positive combined pressure and flexion test

! Note ! : Descriptions and photographs of the tests involved, can be found in appendix A Photo 14

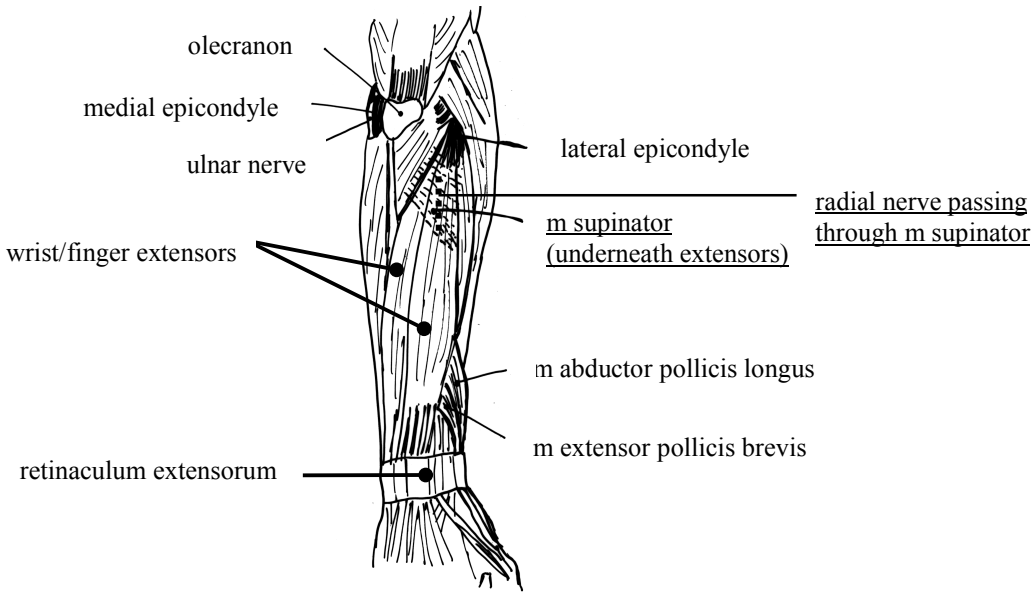
SYMPTOM CRITERIA FOR ULNAR NEUROPATHY AT THE ELBOW: CUBITAL TUNNEL SYNDROME



SIGN CRITERIA FOR ULNAR NEUROPATHY AT THE ELBOW: CUBITAL TUNNEL SYNDROME



5. Radial nerve compression: radial tunnel syndrome



Description of disorder and clinical features

The radial nerve arises from the posterior cord of the brachial plexus; it contains motor, cutaneous sensory, proprioceptive, and autonomic fibers (84—86). Near the elbow (at some point between 3 cm above and below the elbow joint), the nerve divides into the deep motor posterior interosseous nerve and the superficial sensory radial nerve (84, 85). The radial nerve is close to the following structures that can compress it: the fibrous arch at the origin of the supinator muscle (the arcade of Frohse), the origin of the extensor carpi radialis brevis muscle, and the vascular leash of Henry (the vessels arising from the radial artery to supply the mobile wad). The distal edge of the supinator muscle and an intramuscular fibrous band can also cause compression (87). The nerve can be compressed in the radial tunnel, which extends from the radial head to the inferior border of the supinator muscle (88).

Entrapment of the radial nerve in the forearm can produce a variety of symptoms and signs, depending on the locus of the compression. One constellation of symptoms and signs is called radial tunnel syndrome (RTS), which is generally characterized by forearm pain without motor weakness. Another constellation, posterior interosseous nerve syndrome (PINS), involves muscular paresis, with or without pain (84, 89, 90).

Differential diagnosis of radial nerve compression and other upper-extremity musculoskeletal disorders

The symptoms of radial nerve compression can be similar to those of lateral epicondylitis, chronic wrist pain, or tenosynovitis (86). In addition, extensor tendinitis, thoracic outlet syndrome, and cervical radiculopathy have overlapping symptoms and signs, and therefore a clear diagnosis is difficult (91).

Information on test properties

In a long-term follow-up study of 23 patients (24 extremities) who had radial tunnel surgery, Jebson & Engber (89) reported that all 23 of the patients had persistent pain in the proximal radial forearm and 6 had subjective sensory complaints in the distribution of the superficial branch of the radial nerve. Tenderness upon palpation over the radial tunnel was found in all 24 of the extremities studied, pain with resisted forearm supination in all 24, and pain with resisted middle-finger extension in 19 of the 24. Nerve conduction velocities were normal in the 21 patients who underwent neurophysiological testing. The surgical results suggested the

arcade of Frohse as the source of impingement for 20 of the extremities, the extensor carpi radialis brevis (ECRB) for 6, and the radial recurrent vessels for 4. Six patients with ECRB impingement had positive results on the resisted middle-finger extension test, but 11 of the patients with positive test results lacked evidence of compression by the ECRB. Thus this test was not a reliable indicator of ECRB impingement specifically.

In their study to evaluate a potentially more sensitive nerve conduction study for confirming the presence of clinically suspected radial tunnel syndrome, Kupfer et al (92) examined 25 consecutive patients requiring radial tunnel decompression and 25 asymptomatic referents. The diagnosis of radial tunnel syndrome was based on the criteria of Lister (84). Nerve conduction studies were done with subjects' arms in 3 positions, and the provoked difference in the motor latencies between the 3 positions was calculated as the differential latency. All 25 of the cases had differential motor latencies of ≥0.3 ms, while 24 had differential motor latencies of ≤0.2 ms. Only 1 of the 25 referents had a differential latency of 0.3 ms. The difference between the 2 groups was significant at $P<0.001$; the test subjects had a significantly greater differential latency than the referents did. In addition, the authors found close agreement between the preoperative and postoperative changes in differential latency and the clinical response to surgery. The patient judged to be a clinical failure (in that this patient did not return to the preoperative occupation) had a normal differential latency 30 days postsurgery, but an abnormal differential latency at 90 days postsurgery. The postoperative differential latencies were normal in the 24 patients with successful outcomes.

Lawrence et al (86) and Kupfer et al (92) discussed findings from previous studies on the role of conventional nerve conduction studies in the diagnosis of radial tunnel syndrome and concluded that these tests still have not been proved efficacious in the diagnosis of radial tunnel syndrome.

Examples of case definitions and criteria proposed or used in different studies

Studies based on symptoms

No studies were found that were based solely on symptoms, but there is general agreement on the symptoms used in the studies based on symptoms and signs.

Studies based on symptoms and signs

In her epidemiologic and clinical study of neck and upper-limb disorders among 117 slaughterhouse workers, Viikari-Juntura (82) used the following criteria for the clinical diagnosis of posterior interosseous nerve entrapment (Frohse's syndrome): pain in the elbow during rest, radiating pain downward or upward and tenderness at the edge of the superficial portion of the supinator muscle (the arcade of Frohse), and the extension force of the middle finger possibly diminished. The criteria noted specific exclusions for "epicondylitis syndrome, tenosynovitis and peritendinitis of the wrist and forearm" and noted that "the rest of the neurological examination" must be normal.

In his classic textbook on hand disorders, Lister (84) describes radial tunnel syndrome as one of aching pain, possible weakness in extending the wrist and fingers, tenderness along the radial nerve over the radial head, middle finger test, full passive wrist and finger flexion with elbow extension, and resisted supination of the extended arm.

Toomingas (53) used the following as minimum criteria for supinator syndrome in his methodological study to develop and evaluate different methods for measuring exposures and effects in epidemiologic studies of work-related musculoskeletal disorders: symptoms in the elbow-forearm, and deep forearm pain on palpation of Frohse's arc.

In a long-term follow-up study of 23 patients (24 extremities) who had radial tunnel surgery, Jebson & Engber (89) used the following criteria to make the clinical diagnosis: symptoms: pain in the proximal radial forearm or elbow; signs: tenderness over the radial tunnel, pain during resisted forearm supination, or pain during resisted middle-finger extension.

Kupfer et al (92) used the criteria of Lister to diagnose radial tunnel syndrome in their study to evaluate a nerve conduction study for confirming the presence of clinically suspected radial tunnel syndrome. Lister (84) described the syndrome as one of aching pain, possible weakness in extending the wrist and fingers, tenderness along the radial nerve over the radial head, middle finger test, full passive wrist and finger flexion with elbow extension, and resisted supination of the extended arm.

In their review of 26 cases of radial tunnel syndrome in 25 patients in a hand surgeon's practice, Sarhadi et al (88) used the following criteria for diagnosing radial tunnel syndrome: reproduction of the patient's pain symptoms upon the application of pressure over tender spots along the course of the radial nerve (just proximal to the lateral epicondyle to the dorsum of the forearm) identified by the patient upon stepwise palpation of the nerve by the examiner, pain on resisted supination of the forearm or resisted middle-finger extension; and subsidence of symptoms after infiltration of the area of maximal local tenderness with a local anesthetic.

In their study of treatment outcomes for 24 consecutive patients with forearm pain exacerbated by repetitive tasks to the point that they were unable to continue

a prior level of activity, Barthel et al (26) used the following clinical findings to categorize patients as having radial tunnel syndrome: pain on palpation of the radial tunnel area identified over the proximal extensor surface of the forearm and at the volar surface in the supinator area over the arcade of Frohse and weakness resisted middle-finger extension and resisted active wrist supination with the elbow fully extended and then at 90 degrees. (Weakness with full extension but no weakness at 90 degrees helped confirm the diagnosis of radial tunnel syndrome.)

In their practice guidelines for occupational medicine, Harris et al (42) provided the following diagnostic criteria for radial tunnel syndrome (ICD-9 354.3): symptoms: aching pain in the extensor-supinator area of the forearm; signs: reproduction of symptoms by percussion or compression of the radial tunnel, pain on stressing the extended middle finger (resisted extension), and maximum tenderness 4 fingerbreadths below the lateral epicondyle.

Proposed case definitions

The case definitions and diagnostic criteria proposed in this document have been drawn from and are consistent with those of most of the described studies. All mention pain as a common symptom, and some mention subjective complaints of weakness (primarily associated with the posterior interosseous nerve syndrome associated with the disorder). Tenderness to palpation over the radial nerve, distinct from the lateral epicondyle, is a widely used diagnostic test, as are both resisted forearm supination and resisted middle-finger extension. Similar to Sarhadi et al (88) and Jebson & Engber (89), our criteria require only 1 of the latter 2 tests to be positive with the palpation test as described by Barnum et al (85). (See appendix A.) This practice seems appropriate given Jebson & Engber's findings (89) that the resisted middle-finger test was not a reliable indicator of ECRB impingement in radial tunnel patients. Because resisted middle-finger extension may be positive with lateral epicondylitis as well, the site of complaints during testing determines whether the test is considered positive. The criteria relating to time were selected according to the previously described time rule.

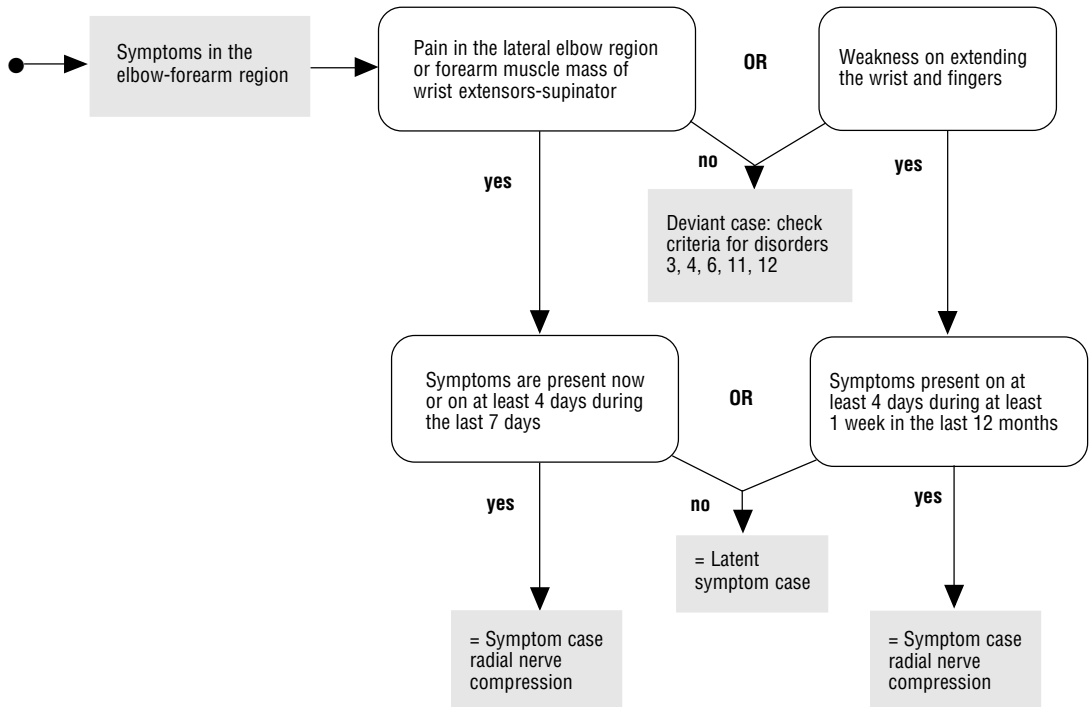
Conventional diagnostic tools like nerve conduction tests are often normal with radial tunnel syndrome, although they may be helpful in confirming the diagnosis of PINS paresis.

Case definition 1: radial nerve compression, based on symptoms only	
Symptoms:	• Pain in the lateral elbow region or forearm muscle mass of the wrist extensors-supinator or • Weakness on extending the wrist and fingers AND
Time rule:	• Symptoms present now or on at least 4 days during the last 7 days or • Symptoms have been present on at least 4 days during at least 1 week in the last 12 months

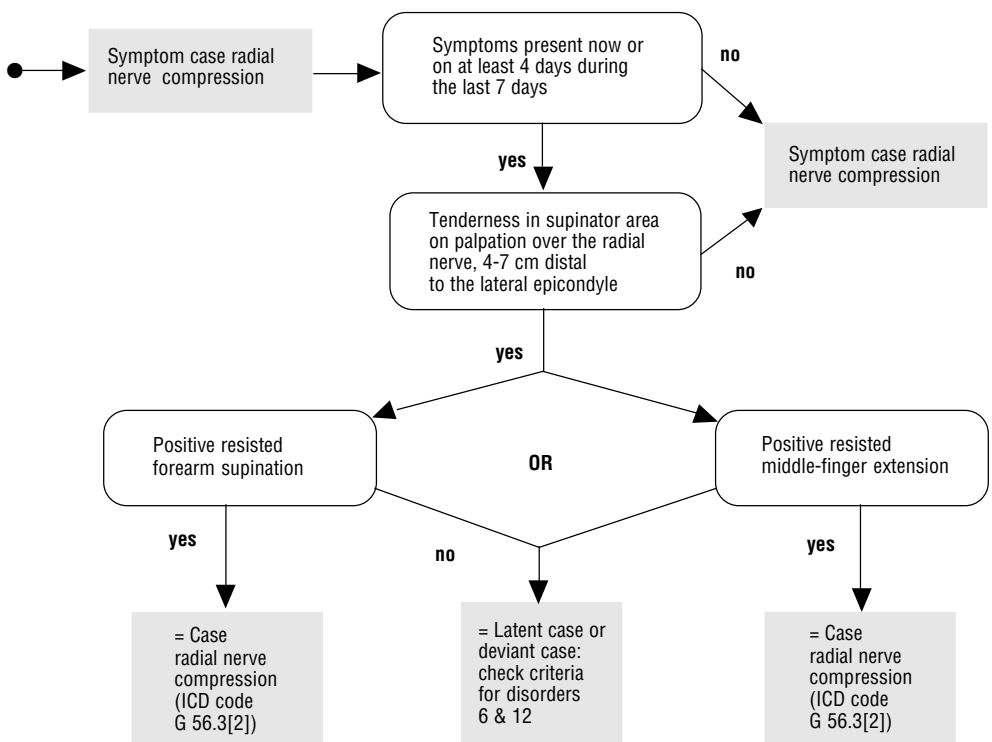
Case definition 2: radial nerve compression, based on symptoms and physical examination signs	
Time rule:	• Symptoms present now or on at least 4 days during the last 7 days AND
Symptoms:	• Pain in the lateral elbow region or forearm muscle mass of the wrist extensors-supinator or • Weakness on extending the wrist and fingers AND
Signs:	• Tenderness in the supinator area on palpation over the radial nerve 4-7 cm distal to the lateral epicondyle and • At least one of the following tests positive: ▲ resisted forearm supination ▲ resisted middle finger extension

! Note !: Descriptions and photographs of the tests involved can be found in appendix A Photos 13, 15, and 18

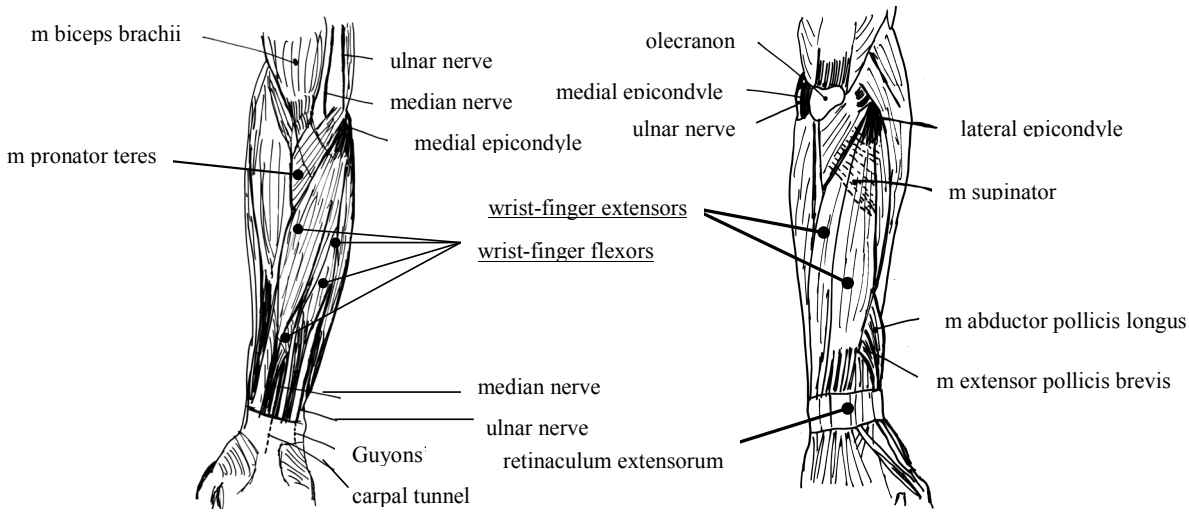
SYMPTOM CRITERIA FOR RADIAL NERVE COMPRESSION



SIGN CRITERIA FOR RADIAL NERVE COMPRESSION



6. Flexor-extensor peritendinitis or tenosynovitis of the forearm-wrist region



Description of disorder and clinical features

Tendinitis, tenosynovitis, peritendinitis, paratenonitis, tendinosis, and tendinopathy are pathoanatomic terms that are used and point to a pathological process in or around the tendon (93). In medical dictionaries, tendinitis is defined as inflammation of tendons and of tendon-muscle attachments. In sports literature, this inflammation was earlier said to be caused by microinjuries of tendon tissue as a result of repetitive mechanical load. Currently, the degenerative rather than inflammatory features of chronic tendon injuries are more clearly recognized (93). Tenosynovitis is an inflammation-like reaction around the vagina synovialis of the tendon sheaths producing crepitus as a sign, whereas tendinitis occurs in the part higher up on the tendon, where no extra surrounding tendon sheath is present.

Textbooks describe tendinitis of the flexor tendons in the forearm or wrist region as characterized by intermittent pain on movement of the hand or wrist. In addition, crepitus and local swelling of the tendon surroundings are present. Most commonly, the tendons of the deep flexors of digits II to IV are involved. In contrast to flexor tendinitis, the tendons of the wrist extensors can be involved separately (94). The tendons of the wrist extensors are easy to observe because of their superficiality and because these tendons have relatively more direct friction from the retinaculum extensorum. In addition, because the wrist extensors have been shown to be more active than the flexors in wrist stabilization and because they adopt a different means of action and biomechanics of the muscles, more tenosynovitis occurs at the dorsal aspect of the wrist.

Patients have pain when grasping or picking up objects and when moving the wrist and hand (31).

Differential diagnosis of flexor-extensor peritendinitis or tenosynovitis in the forearm-wrist region and other upper-extremity musculoskeletal disorders

Flexor-extensor peritendinitis or tenosynovitis in the forearm or wrist has to be differentiated from other upper-extremity musculoskeletal disorders (UEMSD) that may give rise to the same kind of symptoms in the forearm or wrist area. Flexor tendinitis of the forearm must be distinguished from medial epicondylitis, carpal tunnel syndrome, and ulnar nerve compression syndromes. Extensor tendinitis of the forearm must be distinguished from De Quervain's syndrome, lateral epicondylitis, and the radial tunnel syndrome.

Information on test properties

Baron et al (95) studied the reliability and validity of the Nordic musculoskeletal questionnaire and the survey of the National Institute for Occupational Safety and Health (NIOSH) in the United States using data of 852 supermarket and telephone workers. During the physical examination, the criterion of a tendon disorder,

defined as pain on resisted flexion or extension of the wrist and fingers, was positive for 25% of the subjects (N=287) who reported current hand pain.

Although not in an original study on test properties, but informative in this context, Toomingas (96) found a sensitivity and specificity of 0.30 and 0.96, respectively, for self-reported pain in the resisted wrist-extension test (N=523) with a medical examination as the criterion. The subjects were a part of the Stockholm MUSIC I study for the different tests.

Franzblau et al (97) studied the test-retest reliability of self-reported symptoms in the forearm, wrist, or hands of 148 workers at a plant manufacturing spark plugs and engine components. The questionnaire was filled out twice and the 2nd questionnaire was filled out 3 weeks after the first. The subjects were instructed to report a symptom if it had been present in at least 3 episodes or if 1 episode had lasted >1 week in the 12 months preceding the survey. Kappas of >0.75 were found for any elbow or forearm symptoms, right or left forearm symptoms or both, and wrist, hand or finger symptoms. For reported pain or aching symptoms, the kappa was 0.63 and 0.68, respectively.

Examples of case definitions and criteria proposed or used in different studies

Definitions based on symptoms

No studies were found which described flexor-extensor peritendinitis or tenosynovitis of the forearm-wrist region on the basis of symptoms only without adding activity-dependent symptoms that are considered signs. However, the studies that based their diagnoses on symptoms and signs highly agreed upon the symptoms involved.

Definitions based on symptoms and signs

Kuorinka & Koskinen (98) examined 93 scissor makers and compared them with 143 shop assistants. In diagnosing tenosynovitis and peritendinitis, they used the following criteria: localized tenderness and pain during movement, swelling of wrist tendons, and low grip force.

Viikari-Juntura (82) studied upper-limb disorders among slaughterhouse workers and used the following criteria for the clinical diagnoses of tenosynovitis and peritendinitis of the wrist and forearm under the assumption of the exclusion of other diagnoses: local ache or pain during movement and tenderness along the course of the tendon or muscle-tendon junction.

Armstrong et al (99) assessed 652 workers from each of 4 combinations of force and repetitiveness to which they had been exposed to in their workplace. The diagnostic criteria for tendinitis and tenosynovitis of the wrist-hand were as follows: symptoms: localized pain or swelling or both over the muscle-tendon structure, the pain lasting at least 1 week; signs: increased pain by resisted motion, possibly fine crepitus in the passive range of motion, no pain in the passive range of motion, and pronounced asymmetric grip strength, more than 4 kg.

Byström et al (65) assessed 199 automobile assembly-line workers and 186 subjects of the general population and used the following symptoms and signs in diagnosing hand-wrist tenosynovitis or peritendinitis: pain at the tendon, peritendinous area or muscle-tendon junction and swelling at the tendon sheath (peritendinous area), and pain during active movement at the muscle-tendon junction.

On the basis of what was found in the literature, Downs (100) described the signs and symptoms of flexor or extensor tendinitis as pain, swelling, crepitus, minimal paresthesias, and localized reproducible tenderness along tendons.

In a practitioner's guide of occupational overuse syndrome (101), subacute tendinitis of the wrist is described as dull ache over the dorsum of the wrists and forearm, exacerbated by certain repetitive activities, and some tenderness to touch. Diagnostic tests that should be included are passive and resisted wrist flexion and extension and passive and resisted wrist ulnar and radial deviation.

In their diagnostic classification system of work-related upper-extremity musculoskeletal disorders (WRUEMSD), De Marco et al (31) used the following requirements for the clinical examination of tendinitis and degenerative disorders of the wrist and hand: continuous pain continuous or occasional pain with pain-free intervals shorter than 30 days or pain occurring as a reaction to a specific triggering cause. [Physical examinations require inspection of the wrist-hand and positive tests (pain) of resisted wrist flexion and extension.]

Harrington et al (55) reached a multidisciplinary consensus over the following minimum diagnostic surveillance criteria for the diagnosis of tenosynovitis of the wrist: pain on movement localized to the affected tendon sheaths in the wrist and reproduction of pain by resisted active movement of the affected tendons with the forearm stabilized.

In practice guidelines for occupational medicine, Harris (42) provides the following diagnostic criteria for wrist or hand tendinitis or tenosynovitis (ICD-9 727.05): symptoms: pain localized to the muscle-tendon unit and triggering; signs: tenderness over tendon unit and synovial thickening and triggering or locking and crepitus.

In the protocol used for the Southampton examination schedule (48) in diagnosing tenosynovitis of the wrist, the following criteria were reported: symptoms:

pain on movement localized to the tendon sheaths in the wrist; signs: reproduction of pain by resisted active movement.

Proposed case definitions

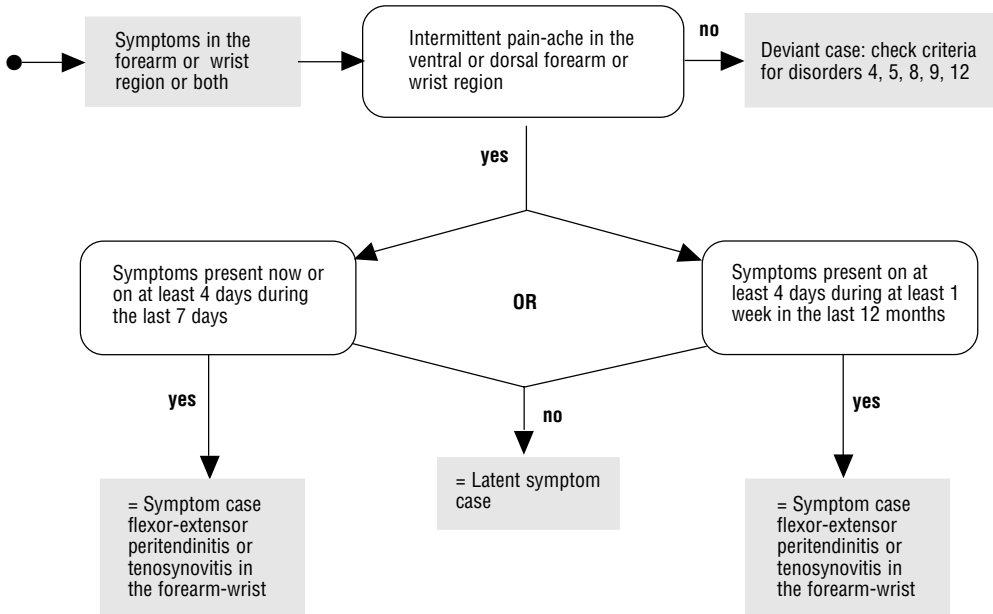
When the the case definitions from the aforementioned studies are compared, most agree on the symptoms and signs involved in flexor-extensor tendinitis of the forearm or wrist. In addition to the provocation of symptoms during testing by palpation, other tests are warranted for disorders of tendon-muscle junctions, and pain on active movement is a requirement that most of the studies included. Because of the difference in superficiality between the tendons of the wrist flexors and extensors, the reproduction of pain during palpation of the affected tendons or palpable crepitus or the observation of local swelling should be added as a useful sign when the symptoms are located at the dorsum of the wrist. The criteria related to time were selected according to the previously discussed time rule.

Case definition 1: flexor-extensor peritendinitis or tenosynovitis in the forearm-wrist, based on symptoms only	
Symptoms:	• Intermittent pain-ache in the ventral or dorsal forearm or wrist region AND
Time rule:	• Symptoms now or on at least 4 days during the last 7 days or • Symptoms present on at least 4 days during at least 1 week in the last 12 months

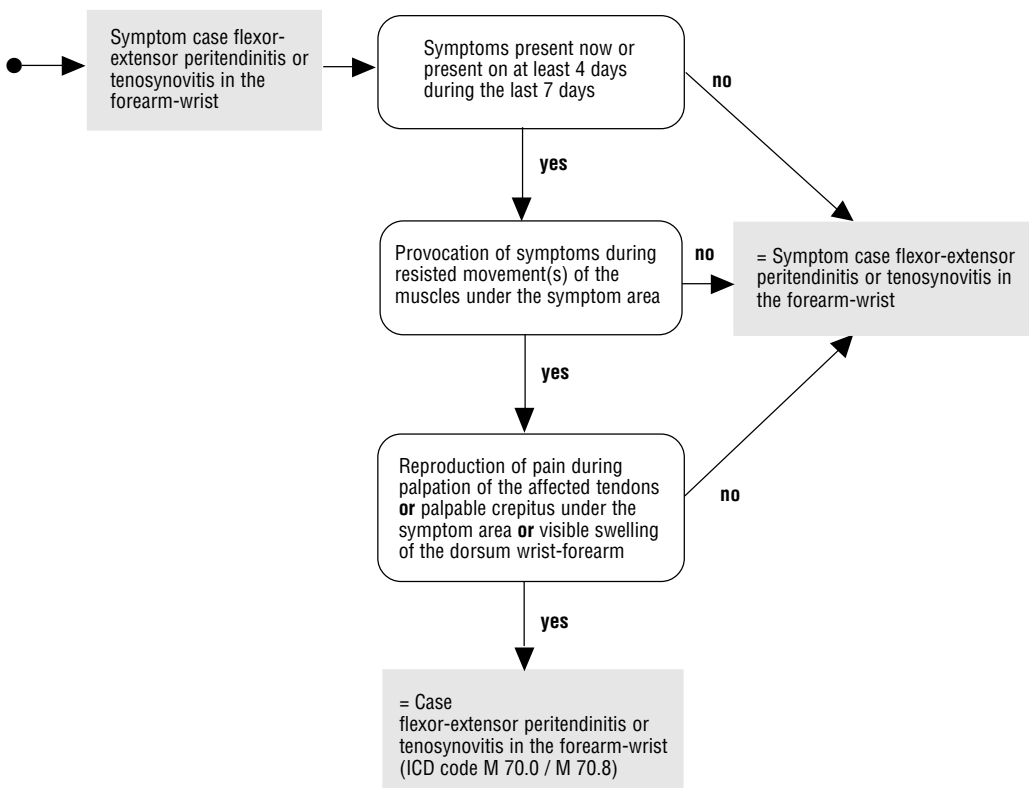
Case definition 2: flexor-extensor peritendinitis or tenosynovitis in the forearm-wrist, based on symptoms and physical examination signs	
Time rule:	• Symptoms now or on at least 4 days during the last 7 days AND
Symptoms:	• Intermittent pain-ache in the ventral or dorsal forearm or wrist region AND
Signs:	• Provocation of symptoms during resisted movement(s) of the muscles under the symptom area and • Reproduction of pain during palpation of the affected tendons or palpable crepitus under the symptom area or visible swelling of the dorsum wrist-forearm

! Note ! : Descriptions and photographs of the tests involved can be found in appendix A Photo 16 and 17

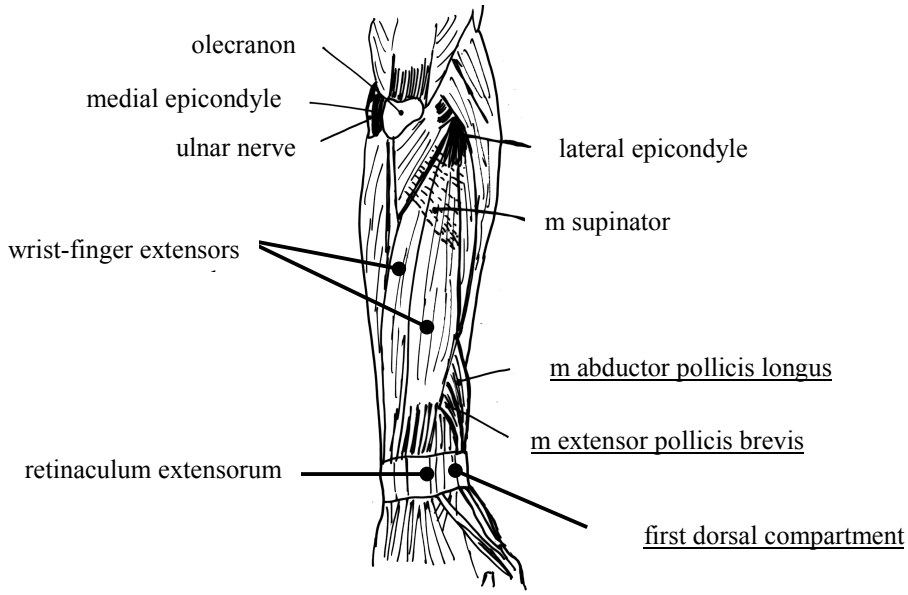
SYMPTOM CRITERIA FOR FLEXOR-EXTENSOR PERITENDINITIS OR TENOSYNOVITIS OF THE FOREARM-WRIST REGION



SIGN CRITERIA FOR FLEXOR-EXTENSOR PERITENDINITIS OR TENOSYNOVITIS OF THE FOREARM-WRIST REGION



7. De Quervain's disease



Description of the disorder and clinical features

Textbooks and the literature describe De Quervain's disease as a relatively common upper-extremity musculoskeletal disorder (UEMSD), involving a stenosing tenosynovitis or tendovaginitis of the 1st dorsal compartment of the wrist. This compartment contains the tendons and synovial sheaths of the abductor pollicis longus (APL) muscle and the extensor pollicis brevis (EPB) muscle (102). Some people have, however, separate (sub)compartments for the abductor pollicis longus and the extensor pollicis brevis. This anatomic anomaly may play a role in causation or help explain nonoperative treatment failures (103). The disorder is characterized by pain on the radial (thumb) side of the wrist and impairment in thumb function.

Differential diagnosis of De Quervain's disease and other upper-extremity musculoskeletal disorders

De Quervain's disease must be distinguished from osteoarthritis of the wrist or 1st carpometaphalangeal joint, wrist ligament strains, and scaphoid nonunion (55). Compression of the superficial radial nerve or distal posterior interosseous nerve may also produce wrist pain (104, 105).

Information on test properties

In a test of the validity and repeatability of the Southampton examination schedule for diagnosing musculoskeletal complaints of the upper limb in the United Kingdom, 43 patients (86 limbs) from rheumatology, orthopedic, and physiotherapy outpatient clinics were tested (48). The criteria for De Quervain's disease of the wrist were pain over the radial styloid and tender swelling of the 1st extensor compartment and either pain on resisted thumb extension or a positive Finkelstein's test. Using the opinion of a rheumatologist as the standard, the authors found the sensitivity and specificity of diagnosing De Quervain's disease to be 71% and 100%, respectively. The interobserver reliability of Finkelstein's test was excellent (kappa = 0.79), and the interobserver reliability of resisted thumb extension (kappa = 0.55) and radial wrist tenderness (kappa= 0.66) was good.

Although the sensitivity, specificity, and predictive value of Finkelstein's test have not been studied very often, the test is widely accepted and used by clinicians.

Examples of case definitions and criteria proposed or used in different studies

Studies based on symptoms

No studies were found based solely on symptoms, but there is general agreement on the symptoms used in the studies based on symptoms and signs.

Studies based on symptoms and signs

In a general study of upper-limb disorders among slaughterhouse workers, Viikari-Juntura (82) used the following criteria for the clinical diagnosis of tenosynovitis and peritendinitis of the wrist and forearm: local ache or pain during movement, tenderness along the course of the tendon or muscle-tendon junction, and all other diagnoses excluded.

In their cross-sectional study to evaluate the relationship between repetitiveness, forcefulness, and selected disorders of the hand and wrist in 652 workers at 7 worksites, Armstrong et al (99) used the following diagnostic criteria for De Quervain's disease: pain in the anatomic snuffbox that may radiate up the forearm, no history of fracture or radial wrist fracture, symptoms that lasted for at least 1 week or occurred more than 20 times in the last year, a physical examination that ruled out radial nerve entrapment, and a positive Finkelstein's test with a pain score of ≥4 (range 1—8).

In their prospective study of nonoperative treatment of De Quervain's disease in 99 wrists of 95 patients seen consecutively in an orthopedic surgery department, Witt et al (103) used the following as study inclusion criteria: pain radiating from the radial styloid process to the thumb and proximally into the forearm, increased pain on passive movement of the thumb and wrist, swelling and tenderness over the 1st dorsal compartment, and a positive Finkelstein's test.

In their retrospective cohort morbidity study of UEMSD in association with 37 job categories in a pork processing plant, Moore & Garg (106) used the following case definition for De Quervain's tenosynovitis: pain and tenderness localized to the radial aspect of the wrist and a positive Finkelstein's test. (Of the 104 observed conditions, there were 3 cases of De Quervain's tenosynovitis).

Weiss et al (107) compared 3 treatment methods for 93 wrists of 87 consecutive patients with De Quervain's disease and used the following criteria: pain in the radial wrist region, tenderness over the first dorsal compartment, and a positive Finkelstein's test.

In their cross-sectional study of forearm and hand disorders among 199 automobile assembly-line workers and 186 referents, Byström et al (65) used the following criteria for tenosynovitis or peritendinitis in the hand-forearm region: swelling with or without crepitation and tenderness to palpation along the tendon and pain at the tendon sheath, the peritendinous area of muscle-tendon junction during active movement of the tendon. A diagnosis of De Quervain's tendinitis also required a positive Finkelstein's test.

Ranney et al (45) used the following case definition in their study of 146 female workers in 5 industries: pain on the radial side of the wrist, tenderness over the 1st dorsal compartment, and a positive Finkelstein's test. Twelve persons (8%) had 14 diagnoses of De Quervain's tenosynovitis.

In their histopathological study of 23 consecutive cases of De Quervain's disease treated surgically and 24 control specimens, Clark et al (108) used the following clinical diagnostic criteria: a history of swelling localized to the radial border of the wrist, pain over the 1st extensor compartment on active extension of the thumb, and point tenderness and palpable thickening over the 1st extensor compartment.

Working with a group of health care professionals and a core group of experts from 9 different disciplines, Harrington et al (55) developed consensus surveillance case definitions and criteria for De Quervain's disease of the wrist. The criteria are pain centered over the radial styloid and tender swelling of 1st extensor compartment and either pain reproduced by resisted thumb extension or a positive Finkelstein's test.

In developing a diagnostic instrument for De Quervain's tenosynovitis, the most weighted symptoms and signs of Sluiter et al (29) that minimally led to a "probable" diagnosis were intermittent pain in the wrist region radiating into the thumb or radial part of the forearm and at least one of the following signs: positive resisted thumb extension or thumb abduction, a positive Finkelstein's test, palpable swelling in the 1st extensor compartment of the wrist, or positive palpation of the processus styloideus radii.

In their practice guidelines for occupational medicine, Harris et al (42 pp 1-1—8-25) provided the following diagnostic criteria for De Quervain's tenosynovitis (ICD-9 727,04): symptoms: pain over radial styloid or first dorsal compartment; pain worse with ulnar deviation, thumb flexion, adduction or abduction, and triggering; signs: tenderness over the radial styloid, mass over the radial styloid, crepitus, a thick tendon sheath, and pain upon passive stretching of the 1st dorsal compartment (Finkelstein's test).

Proposed case definitions

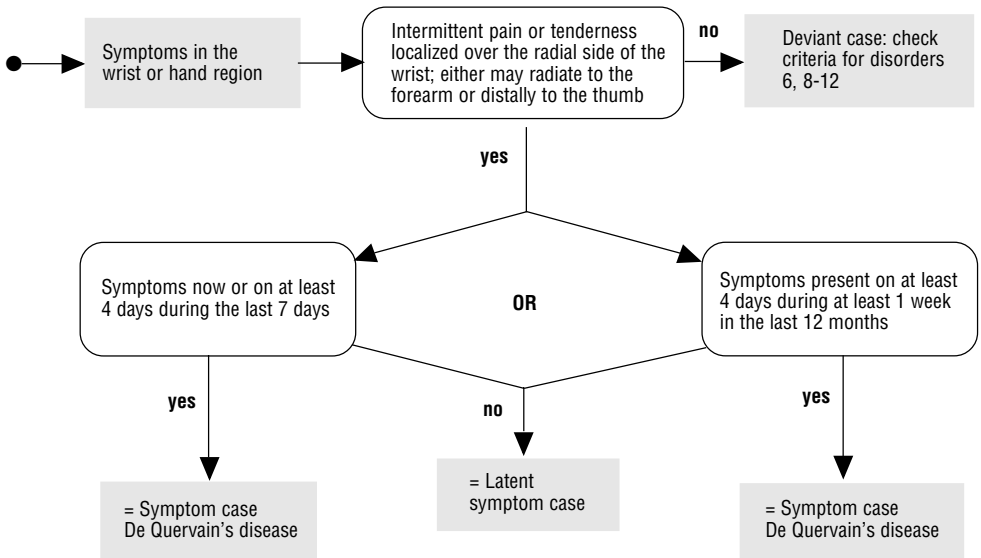
The case definitions and diagnostic criteria proposed in this document have been drawn from and are consistent with those of most of the described studies. All mention pain or tenderness localized over the radial styloid, the radial side of the wrist, or the 1st dorsal compartment. Some suggest that the pain may radiate distally to the thumb or proximally to the forearm. Fewer include swelling or palpable thickening of the first extensor compartment. Most include a positive Finkelstein's test, although an obvious left-right difference should be stressed. The criteria of Palmer et al (48) included resisted thumb extension, and the criteria were demonstrated to have perfect specificity. Sluiter et al (29) also included this test in their diagnostic criteria. The temporal dimension of the symptoms included in this section follows the time rule described earlier in this document.

Case definition 1: De Quervain's disease, based on symptoms only	
Symptoms:	• Intermittent pain or tenderness localized over the radial side of the wrist; either may radiate proximally to the forearm or distally to the thumb AND
Time-rule:	• Symptoms present now or on at least 4 days during the last 7 days or • Symptoms present on at least 4 days during at least 1 week in the last 12 months

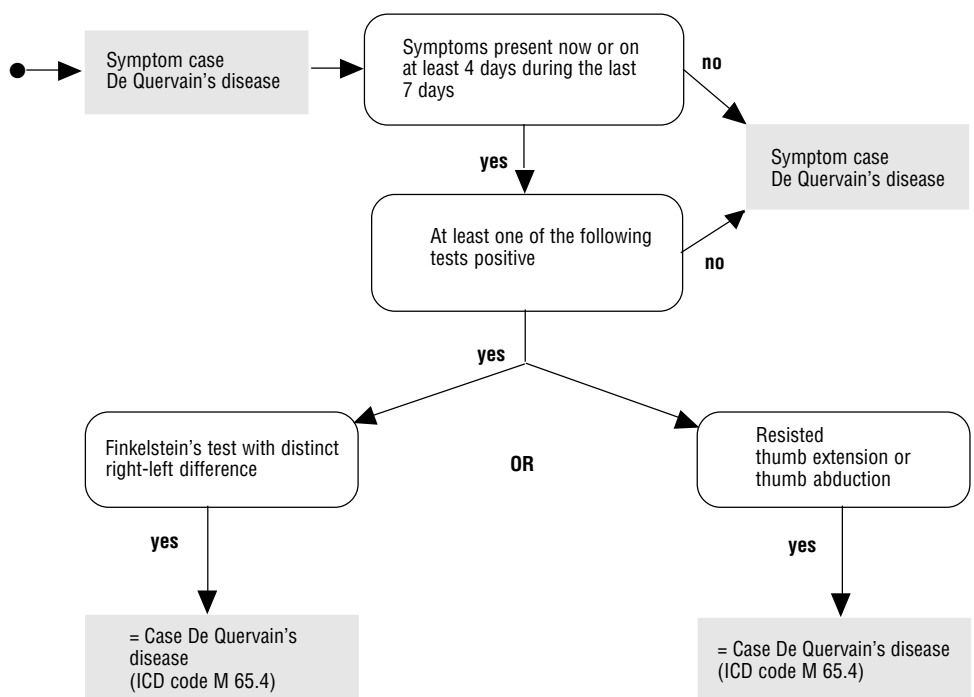
Case definition 2: De Quervain's disease, based on symptoms and physical examiation signs	
Time rule:	• Symptoms now or on at least 4 days during the last 7 days AND
Symptoms:	• Intermittent pain or tenderness localized over the radial side of the wrist; either may radiate proximally to the forearm or distally to the thumb AND
Signs:	• At least 1 of the following tests positive: ▲ Finkelstein's test ▲ Resisted thumb extension ▲ Resisted thumb abduction

! Note ! Descriptions and photographs of the tests involved can be found in appendix A Photos 19-21

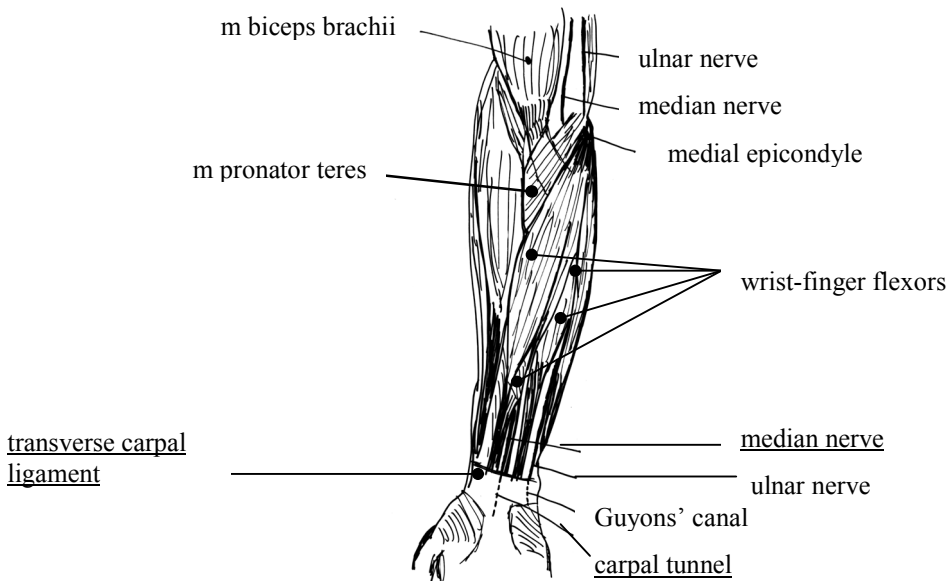
SYMPTOM CRITERIA FOR DE QUERVAIN'S DISEASE



SIGN CRITERIA FOR DE QUERVAIN'S DISEASE



8. Carpal tunnel syndrome



Description of disorder and clinical features

Carpal tunnel syndrome (CTS) is a clinical disorder resulting from intermittent or continuous compression of the median nerve at the wrist. The carpal tunnel has its boundaries by the carpal bones posteriorly, medially, and laterally, and the transverse carpal ligament (retinaculum flexorum) anteriorly (109).

In textbooks and the literature, the clinical features of patients are described as a complex of symptoms such as tingling, numbness, pain, or a burning feeling in the median nerve distribution at the palmar side of the hand and the 1st 3 fingers. Night complaints are common, and a subjective feeling of weakness and radiation of complaints can occur.

Differential diagnosis of carpal tunnel syndrome and other upper-extremity musculoskeletal disorders

The characteristics of the main symptom (paresthesias) of carpal tunnel syndrome require differential diagnosis from ulnar nerve compression syndromes, the thoracic outlet syndrome, hand-arm vibration syndrome, and cervical nerve root compression.

Information on test properties

Atterbury et al (110) clinically examined 25 symptomatic and 35 nonsymptomatic carpenters. Hand-wrist cases were selected on the basis of the case definition of hand-wrist symptoms given by the National Institute for Occupational Health and Safety (NIOSH) in the United States. In addition to the symptoms, a positive Tinel's sign or Phalen's test was required for the clinical diagnosis of carpal tunnel syndrome. Nerve conduction measures were used as the "golden test" and were performed for the median and ulnar nerve. A false-positive rate of 21% was found for the reference group for their "golden" electrodiagnostic test for median neuropathy.

Schierhout & Meyers (111) presented an overview on what is known about the test properties for carpal tunnel syndrome. Sensitivity in the Phalen's test and Tinel's sign range from 25% to 75%, and estimates of specificity fall between 70% and 90%. Katz et al (112) reported low predictive values for both Phalen's test and Tinel's sign [(the highest positive predictive value for Tinel's sign being 0.55 (95% CI 0.45—0.65 and the highest negative predictive value for Phalen's test being 0.74 (95% CI 0.62—0.84)] in a study on 110 patients referred to their laboratory.

Franzblau et al (97) evaluated the test-retest reliability of symptom reporting for 148 workers from a plant manufacturing spark plugs and engine components and involved in low, medium, or high frequency repetitive movements. A kappa value of 0.81 was found for symptom reporting of the following constellation of symptoms: numbness, tingling, burning or pain in the wrists, hands, or fingers. For hand diagrams, the test-retest reliability was 0.52, but the interobserver reliability for rating the hand diagrams was almost perfect (0.93).

del Pino et al (113) evaluated the test properties of Durkan's carpal compression test (CCT), which is performed by applying pressure with 2 thumbs over the retinaculum flexorum. The test is considered positive if complaints occurred within 30 seconds. The CCT was compared with Phalen's test and Tinel's sign for 200 hands of 180 patients and 200 hands of 100 volunteers. The patients had had symptoms for at least 6 months. A sensitivity of 87% and a specificity of 95% were found for the CCT. For Phalen's test, a sensitivity of 87% and a specificity of 90% were found, and for Tinel's sign (only assessed for 129 wrists) a sensitivity of 33% and a specificity of 97% were found.

Inter- and intraobserver reliability was studied for tests of carpal tunnel syndrome by hand therapists, surgeons, and occupational health workers of 12 patients, 6 of whom actually had carpal tunnel syndrome (when electrophysiological tests were used as the gold standard) in a study of Marx et al (114). There was substantial (0.61 < kappa < 0.81) interobserver reliability for Phalen's test and Tinel's sign. The intraobserver reliability of the 2 tests was found be moderate (kappa = 0.53) for Phalen's test and substantial (kappa = 0.80) for Tinel's sign. However, occupational health workers performed worse than hand therapists and surgeons.

Tetro et al (115) evaluated the test properties (sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV)) of Phalen's test, Tinel's sign, CCT, and a new test they called the "flexion and compression test" (table 5). This new test is performed by flexing the wrist and compressing the carpal tunnel with 1 thumb for 20 seconds. Ninety-five wrists of patients with carpal tunnel syndrome (electrodiagnostic testing used as the "gold standard") and 96 wrists of referents were tested. The figures for the positive and negative predictive values were calculated on the assumption of a 5% prevalence of carpal tunnel syndrome. Compared with the sensitivity of the CCT, that of the flexion-compression test was significantly higher. Compared with the sensitivity and positive predictive value of Tinel's sign and Phalen's test, those of the flexion-compression test were significantly higher.

Table 5. Sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of 4 tests used for carpal tunnel syndrome by Tetro et al (115). (CCT = carpal compression test)

	Test property			
Test	Sensitivity	Specificity	PPV	NPV
Phalen's test	0.61	0.83	0.16	0.98
Tinel's sign	0.74	0.91	0.29	0.99
CCT	0.75	0.93	0.35	0.99
Flexion-compression (20 seconds)	0.82	0.99	0.47	0.99

Marx et al (49) performed a formal literature search, using 30 years of Medline (1966 to 1996), a snowball method, and expert references to evaluate the reliability and validity of a physical examination of the upper extremity. In studies on carpal tunnel syndrome, the range of the sensitivity of Phalen's test and Tinel's sign was 67—88% and 26—73%, respectively, in the different studies. The range of the specificity of these measures was 32—86% and 55—94%, respectively, in the different studies.

In evaluating the reliability and validity of the Southampton examination schedule (48), 43 pairs (86 limbs) of interobserver data formed from 88 hospital outpatients with rheumatic and orthopedic complaints. Physical examinations were performed by trained research nurses or rheumatologists. The criteria for carpal tunnel syndrome were pain or paresthesias or sensory loss in the median nerve distribution and one of the following tests positive: Tinel's sign, Phalen's test, nocturnal exacerbation of symptoms, motor loss with wasting abductor pollicis brevis, or abnormal nerve conduction time. The interobserver reliability of Phalen's test was excellent (kappa = 1), and the interobserver reliability for a light touch of the index finger was good (kappa = 0.66). The sensitivity and specificity of the examination schedule for carpal tunnel syndrome (with a rheumatologist's opinion as the gold standard) for the 2 observers were 71% and 100%, respectively.

Examples of case defnitions and criteria proposed or used in different studies

Definitions based on symptoms

In their cross-sectional study of hand-wrist symptoms among 1058 female grocery checkers, Morgenstern et al (116) used self-reports of the following recent symptoms as criteria for carpal tunnel syndrome: pain in the hands or wrists and nocturnal pain in the wrists or hands that awakens the patient, numbness in the hands or fingers, and tingling in the hands or fingers. In their population, 12% reported all 4 symptoms.

Rempel et al (117) assessed the properties of a CTS diagnosis made by the following symptom characteristics alone: classic-probable symptom classification according to Katz's and Franzblau's hand diagram (numbness, tingling, burning, or pain in at least 2 of digits 1, 2, or 3, palm pain, wrist pain, or radiation proximal to the wrist being allowed). In data from a working population of 822 persons (not mentioned whether or not the population was at risk), these criteria revealed a sensitivity and specificity of 22% and 90%, respectively, and a positive predictive value of 20% with the assumption of electrodiagnostic findings as the gold standard and a disease prevalence of 10%.

Definitions based on symptoms and signs

In their cross-sectional study of forearm and hand disorders among 199 automobile assembly-line workers and 186 referents, Bystrom et al (65) used the following criteria for carpal tunnel syndrome [modified from Hagberg et al (118)]: nocturnal occurrence of paresthesias, tingling or numbness of the palmar side of the 3 radial fingers at least once a week during the past 3 months and a positive Tinel's sign or Phalen's test.

In their cross-sectional study among 146 female industrial workers, Ranney et al (45) used the following minimal clinical criteria for establishing worksite carpal tunnel syndrome: symptoms: numbness or tingling (or both) in the thumb, index, or middle finger with particular wrist postures or at night; signs: positive Phalen's test or Tinel's sign present over the median nerve at the wrist. In addition, they classified the severity of the disorder as "mild" when the aforementioned criteria were met, as "moderate" if there was sensory loss on testing or if it interfered significantly with day-to-day activities, and as "severe" if motor sensory loss was present.

In a thesis based on 6 articles, Toomingas (53) used the following minimal diagnostic criteria for carpal tunnel syndrome in his study, which was part of the MUSIC I study: symptoms: present ache, pain, or discomfort located at the wrist-hand; signs: positive Phalen's test (in one study) or positive Tinel's sign (in another study).

In a nested case-referent study among carpenters, Atterbury et al (110) used the following diagnostic criteria for work-related carpal tunnel syndrome: symptomatic work-related musculoskeletal disorder (ie, self-reported pain, aching, burning, numbness or tingling in the hands or wrists during the past year and the onset of these symptoms after starting work as a carpenter and symptoms occurring at least once a month or lasting at least 1 week and no history of injury, pain being reported at least as "moderate"), and either a positive Phalen's test or a positive Tinel's sign and minimal electrodiagnostic criteria.

In practice guidelines for occupational medicine, Harris (42 p 11-7) provides the following diagnostic criteria for carpal tunnel syndrome (ICD-9 354.0): symptoms: numbness or tingling in the thumb, index, middle fingers, especially at night or with activity, and hand pain radiating into the forearm and decreased grip strength and difficulty picking up small objects; signs: atrophy or decreased strength of the abductor pollicis brevis, opponens (advanced cases) and decreased sensation in the median nerve distribution and positive Tinel's sign and positive Phalen's test.

In the development of a diagnostic instrument for carpal tunnel syndrome, the most weighted symptoms and signs of Sluiter et al (29) that minimally led to a "probable" diagnosis were intermittent paresthesias, pain, or numbness in digits I to III, nocturnal symptoms, and minimally two of the following: positive Phalen's test, positive Tinel's sign, observable thenar atrophy, weakness on resistance thumb abduction, or sensory loss in the median nerve distribution.

Harrington et al (55) reached a multidisciplinary consensus on the following minimum diagnostic criteria for diagnosing carpal tunnel syndrome [these criteria were taken over by Davis (56) as well]: pain, paresthesias or sensory loss in the median nerve distribution and one of the following positive tests: Tinel's sign, Phalen's test, nocturnal exacerbation, motor loss with wasting of the abductor pollicis brevis, or abnormal nerve conduction time.

Rempel et al (117) reached a multidisciplinary consensus on the following symptoms and signs and additional tests in diagnosing carpal tunnel syndrome for epidemiologic studies. They emphasized that no perfect gold standard for carpal tunnel syndrome exists and that, in the absence of electrodiagnostic findings, the most accurate CTS diagnosis should be made by combining symptom characteristics and physical examination findings as follows: classic or probable symptom classification according to Katz's hand diagram and night symptoms and a positive physical examination (comprising either Tinel's sign, Phalen's test, 2-point discrimination, or CCT). In data from a working population of 822 persons, these criteria revealed a sensitivity and specificity of 7% and 99%, respectively, and a positive predictive value of 44%, with the assumption of electrodiagnostic findings as the gold standard, and a disease prevalence of 10%.

In the Southampton examination schedule (48), the following diagnostic criteria are used for carpal tunnel syndrome: symptoms: pain or paresthesias or sensory loss in the median nerve distribution and one of the following tests positive: Tinel's sign, Phalen's test, nocturnal exacerbation of symptoms, motor loss with wasting of the abductor pollicis brevis muscle, or abnormal nerve conduction time.

Proposed case definitions

The decisions for the case definitions for this document were based mainly on the expertise and results of the 2 latest consensus-based studies of Rempel et al (117) and Harrington et al (55). However, the duration of symptoms is considered in the case definition (based on the previously discussed time rule) as is the feasibility of performing physical examination tests by most (occupational) physicians. The CCT and the flexion-compression test are included on the basis of their test properties (115).

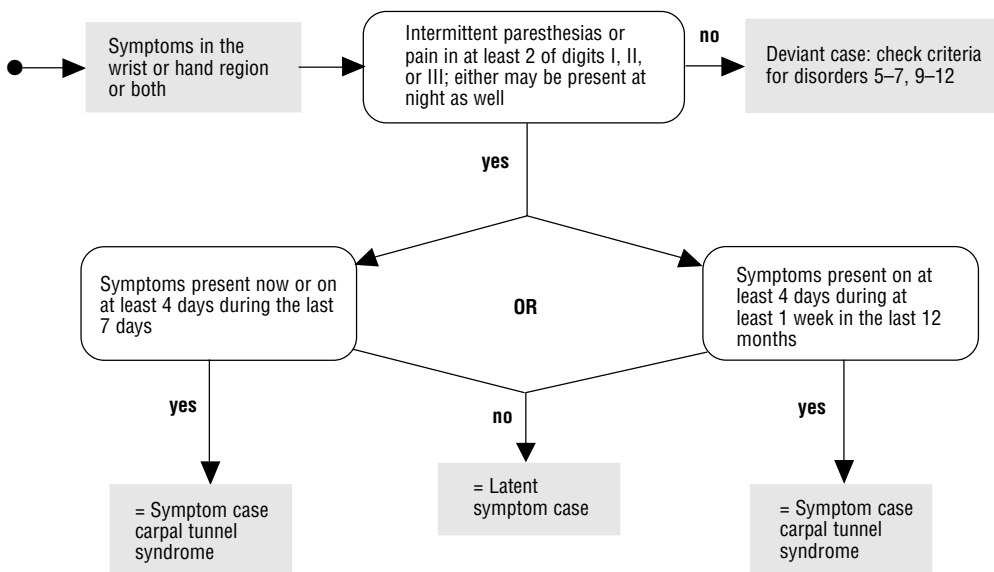
With further diagnostic testing, abnormal nerve conduction time might also be taken into account.

Case definition 1: carpal tunnel syndrome, based on symptoms only	
Symptoms:	• Intermittent paresthesias or pain in at least 2 of digits I, II, or III; either may be present at night as well (allowing pain in the palm, wrist, or radiation proximal to the wrist)
	AND
Time rule:	• Symptoms present now or on at least 4 days during the last 7 days
	or
	• Symptoms present on at least 4 days during at least 1 week in the last 12 months

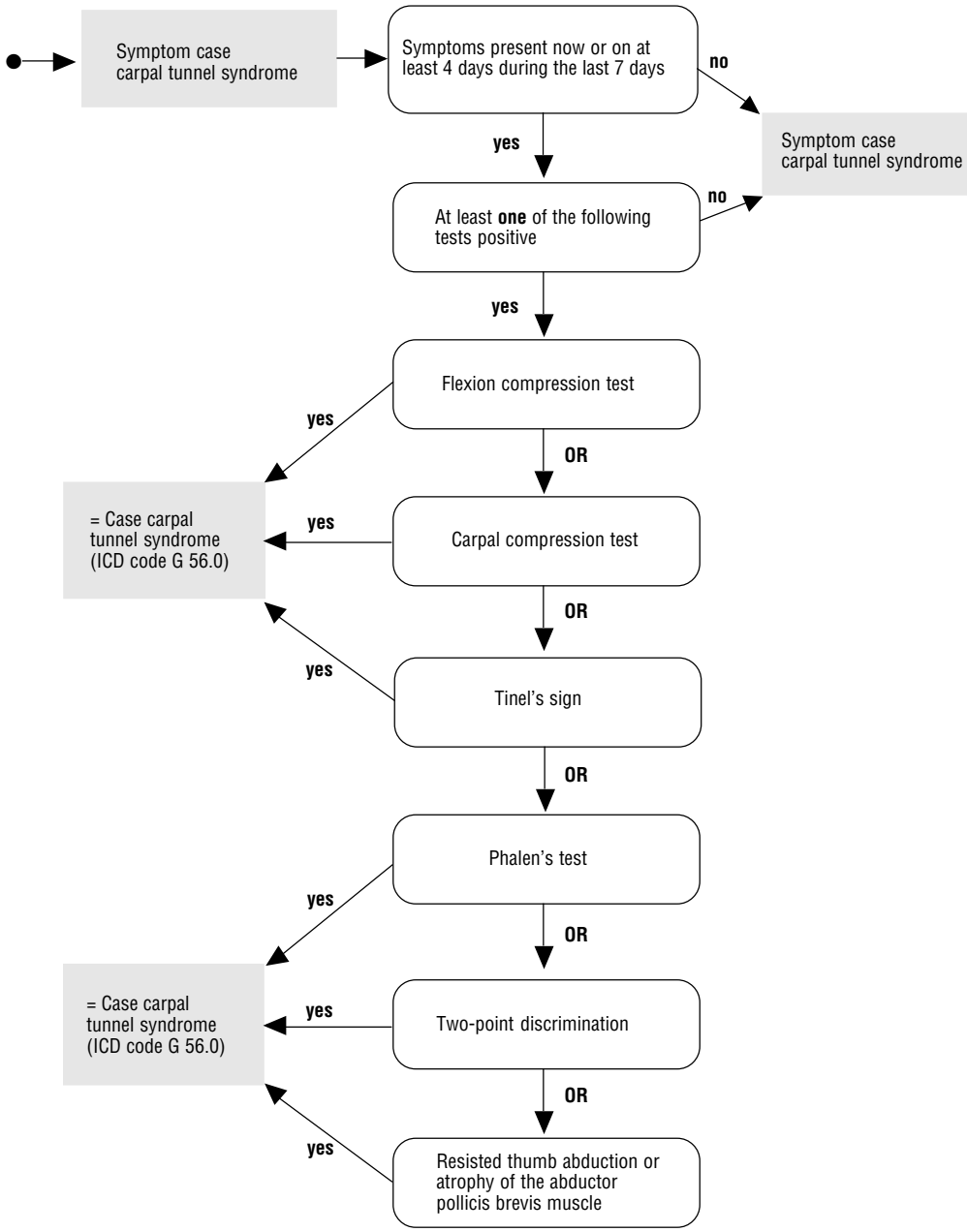
Case definition 2: carpal tunnel syndrome, based on symptoms and physical examination signs	
Time rule:	• Symptoms present now or on at least 4 days during the last 7 days
	AND
Symptoms:	• Intermittent paresthesias or pain in at least 2 of digits I, II, or III; either may be present at night as well (allowing pain in the palm, wrist, or radiation proximal to the wrist)
	AND
Signs:	• At least one of the following tests positive: ▲ Flexion compression test ▲ Carpal compression test ▲ Tinel's sign ▲ Phalen's test ▲ Two-point discrimination test ▲ Resisted thumb abduction or motor loss with wasting of abductor pollicis brevis muscle

! Note ! Descriptions and photographs of the tests involved can be found in the appendix A Photos 20, 25—28

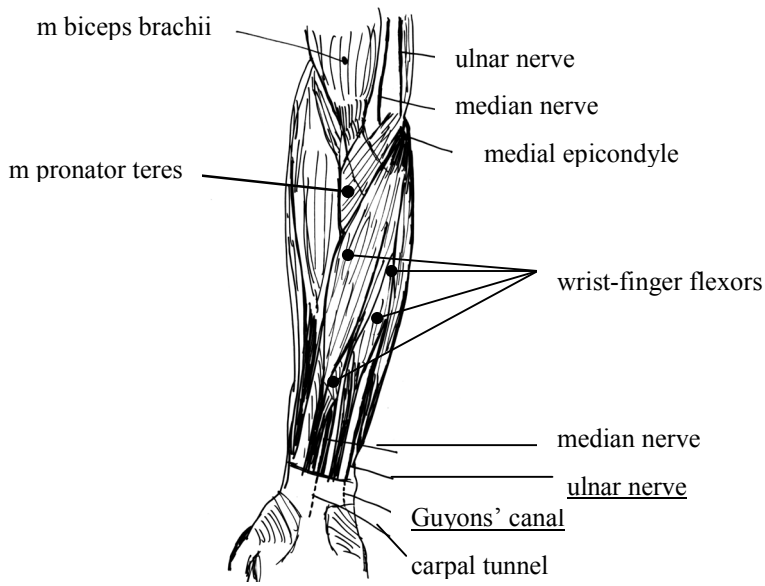
SYMPTOM CRITERIA FOR CARPAL TUNNEL SYNDROME



SIGN CRITERIA FOR CARPAL TUNNEL SYNDROME



9. Ulnar nerve compression at the wrist: Guyon canal syndrome



Description of the disorder and clinical features

Compression of the ulnar nerve can occur in Guyon's canal, which lies ulnar to the carpal tunnel between the hook of the hamatum bone and the pisiform bone. Only the ulnar nerve and artery pass through the canal, and it contains no tendons (119).

The canal has been divided into 3 anatomic zones – one containing both sensory and motor fibers, one with motor fibers only, and one with sensory fibers only (119—121). The motor branch innervates the hypothenar muscles, the 2 ulnar lumbricals, the adductor pollicis muscle, and part of the flexor pollicis brevis muscle (119). The pattern of sensory and motor symptoms associated with ulnar nerve compression at the wrist depends on the actual site of the compression within the canal. Souquet & Mansat (119) suggested that most cases with sensory only symptoms are associated with microtrauma.

Ulnar nerve entrapment at the wrist occurs infrequently. In textbooks and the literature, the clinical features of ulnar neuropathy at the wrist are described as follows: patients may complain of numbness or paresthesias of the 4th and 5th digits, often nocturnal but possibly diurnal as well (84, 120, 122,). Hand or forearm pain can be present. Ulnar nerve entrapment in Guyon's canal does not affect dorsal ulnar hand sensation because the dorsal branch rises proximal to the tunnel. If such a sensory disturbance is found, it suggests another site of compression (84, 119, 120, 123, 124). Depending on the site of the entrapment, motor function can be impaired in the hypothenar muscle and other intrinsic muscles of the hand, including the first dorsal interosseous muscle and the thumb adductor muscle (120). Patients with motor symptoms may complain of clumsiness in the precision pinch (119).

Differential diagnosis of Guyon's canal syndrome and other upper-extremity musculoskeletal disorders

Other potential sites of ulnar nerve compression must be ruled out, such as involvement in C8-T1 cervical pathology, thoracic outlet syndrome, and cubital tunnel syndrome. Symptoms in patients with carpal tunnel syndrome may be referred to the 4th and 5th digits in the absence of specific ulnar nerve entrapment (120).

Information on test properties

Netscher & Cohen (124) reviewed clinical information on 8 patients (11 extremities) with documented ulnar nerve entrapment at the wrist requiring surgery. Seven of the 8 patients had both sensory and motor findings. The other patient had isolated compression of the deep ulnar motor branch and exhibited marked wasting and weakness of the 1st dorsal interosseous muscle and thumb adductor muscle, but not sensory abnormality.

Although the clinical literature often describes the use of such tests as Tinel's sign and Phalen's test, no information was found on the diagnostic value of these tests for ulnar nerve entrapment at the wrist. Netscher & Cohen (124) described 8 patients with 11 instances of wrist-level ulnar nerve entrapment from his hand surgery practice. In his discussion, he noted that a positive pressure provocative test applied just proximal to Guyon's canal will produce numbness in the little finger and on the ulnar aspect of the ring finger and that Phalen's test may produce numbness in these same 2 fingers.

Because the electrophysiological localization of ulnar entrapment at the wrist is often difficult, several studies have reported results of electrodiagnostic techniques that may supplement the routine dorsal ulnar sensory studies and ulnar motor studies often performed to diagnose ulnar nerve compression at the wrist. Kothari et al (125, 126) studied the difference (Diff) in distal motor latencies to the medial-innervation 2nd lumbrical (2L) muscle and the ulnar-innervated palmar interosseous (PI) muscle — Diff 2L-PI — in 2 patients with clinically definite ulnar neuropathy at the wrist. They compared the results with those of 51 normal referents and 12 patients with clinical and electrophysiological ulnar neuropathy at the elbow (disease referents). They found that the Diff 2L-PI was essentially the same in the disease referent and normal subjects, but the Diff 2L-PI in the 2 patients with ulnar neuropathy at the wrist was well below the range for the normal and disease reference groups. In these patients, that distal motor latency to the PI was significantly longer than to the 2L.

McIntosh et al (127) evaluated 2 patients with clinical ulnar neuropathy at the wrist, 10 normal subjects, and 1 disease referent (with ulnar neuropathy at the elbow) using short-segment incremental studies (SSIS) across the wrist, recording from the 1st dorsal interosseous muscle, in addition to the Diff 2L-PI already described, as well as routine electrodiagnostic studies. They used the findings from their normal subjects to establish normal and abnormal values for the maximal change in latency and amplitude over each of 7 1-cm segments. The 1 disease referent was shown to have normal SSIS at the wrist, and the 2 patients with ulnar neuropathy at the wrist had clearly abnormal values. The SSIS precisely localized the ulnar nerve lesion in both patients.

Examples of case definitions and criteria proposed or used in different studies

Studies based on symptoms

No studies were found which were based on symptoms alone, but there is general agreement on the symptoms used in the studies based on symptoms and signs.

Studies based on symptoms and signs

Very few epidemiologic studies were found that specifically considered ulnar nerve entrapment at the wrist (Guyon's canal) as a specific outcome variable.

In an early epidemiologic and clinical study of neck and upper-limb disorders among slaughterhouse workers, Viikari-Juntura (82) used the following criteria for the clinical diagnosis of ulnar nerve entrapment at Guyon's tunnel: pain, paresthesias, numbness or weakness of the 5th finger, tenderness to palpation at the Guyon's tunnel possible, Tinel's sign at the Guyon's tunnel possible, diminished sensation in the 4th and 5th fingers or weak abduction of the 5th finger.

Ranney et al (45) used the following minimum clinical criteria for establishing a worksite diagnosis of ulnar tunnel syndrome in their study of 146 female workers in 5 industries: symptoms: numbness and tingling in the ulnar nerve distribution in the hand distal to the wrist; signs: positive Tinel's sign over the ulnar nerve at the wrist.

In proposing a protocol for a structured anamnestic survey of upper-limb disorders, Menoni et al (54) described Guyon's canal syndrome as paresthesias localized in the 4th and 5th digits, onset usually nocturnal (but diurnal onset also posssible), possible radiation of pain to the forearm, and, in the more advanced stages, possible development of hypoesthesia and impaired abduction of the fingers.

In the development of a diagnostic instrument for Guyon's canal syndrome, the most weighted symptoms and signs of Sluiter et al (29) that minimally led to a "probable" diagnosis were intermittent pain or either numbness or paresthesias in the ulnar border of the hand and symptoms in the little finger and a minimum of one of the following: a positive Tinel's sign of the ulnar nerve at the wrist, a positive reversed Phalen's test, or notable loss of tonus or atrophy in hypothenar muscles, thenar muscles, or intrinsic hand muscles.

Proposed case definitions

Textbooks and clinical studies consistently include paresthesias or numbness or both in the 4th and 5th digits as primary sensory symptoms of ulnar nerve entrapment

at the wrist. At the same time, they note ulnar nerve compression at the wrist will spare sensation in the dorsal sensory branch of the hand and that, if such symptoms can be provoked, the compression is proximal to Guyon's canal. Pain is mentioned, although less often. The literature clearly notes that the constellation of symptoms may vary, depending on the site of compression, and that symptoms may be sensory-motor, sensory, or motor in nature. Leclercq (123) has suggested that intrinsic muscle paresis may not be appreciated if the clinical examination is performed too quickly and that it is important to perform a comparative examination of the other side, measuring muscle motor strength and evaluating the strength of the different forms of pinch and grasp. Although used, most studies agree that Tinel's sign and a positive Phalen's test may not always be present. For this reason and according to the discussion in Netscher & Cohen (124), the positive pressure test over the Guyon canal is included as another possible diagnostic sign. The temporal criteria in the following case definition follow the earlier-described time rule. Nerve conduction and electromyographic studies may confirm and help localize the entrapment.

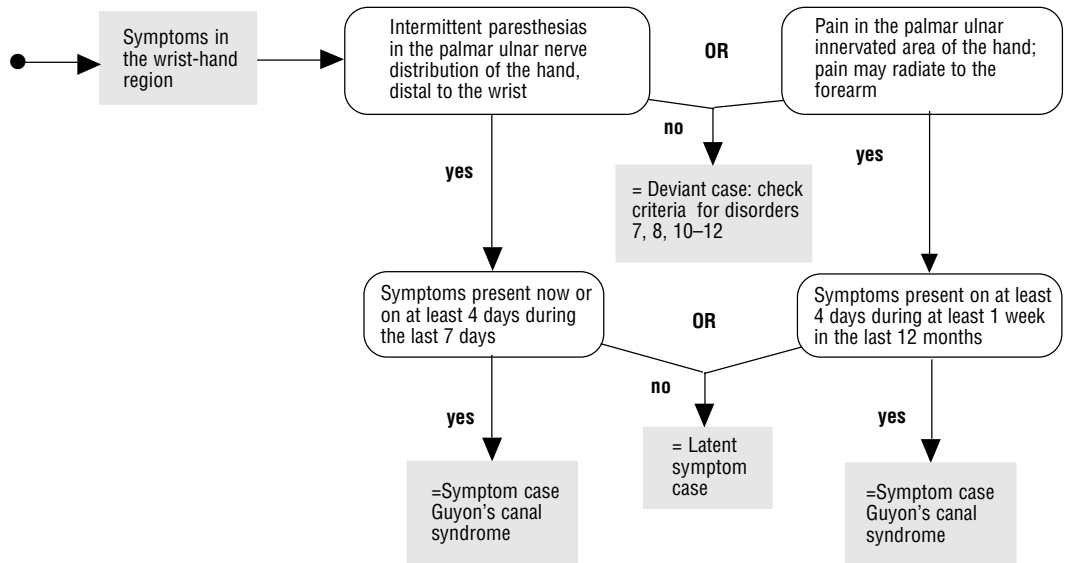
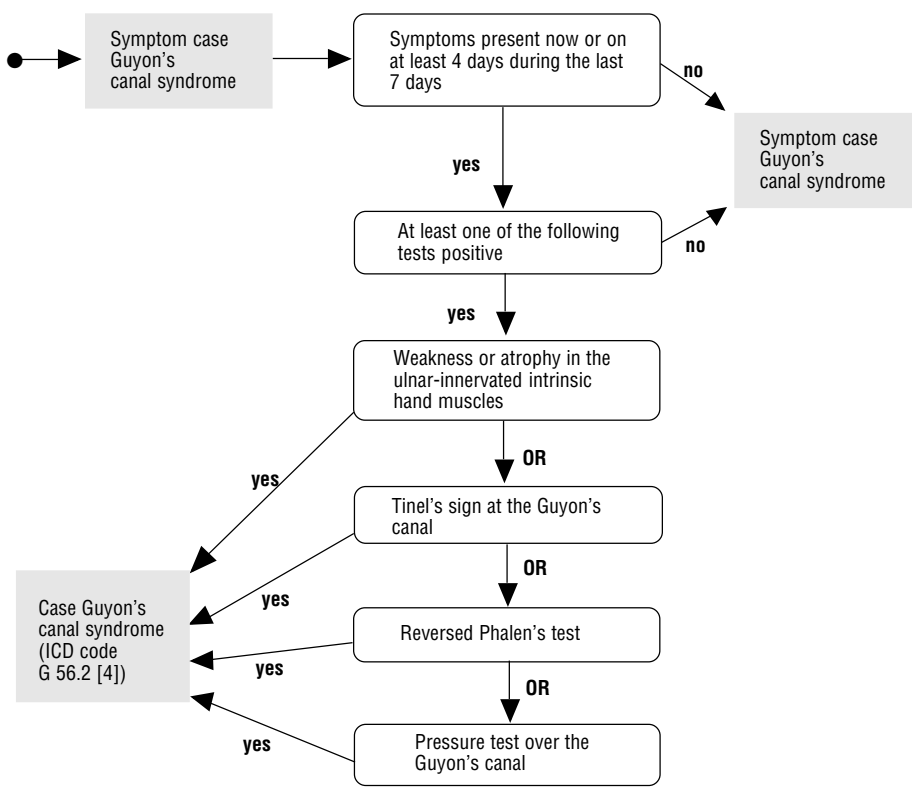
! Note ! When pain is not present, it has to be noted that the symptom case definition of Guyon's canal syndrome may not differ from the symptom case definition of cubital tunnel syndrome (see pages 43—47). In such a case, however, the symptom case definitions can be used to register this symptom case as ulnar nerve compression.

Case definition 1: Guyon's canal syndrome, based on symptoms only	
Symptoms:	• Intermittent paresthesias in the palmar ulnar nerve distribution of the hand, distal to the wrist or • Pain in the ulnar innervated area of the hand; the pain may radiate to the forearm AND
Time rule:	• Symptoms present now or on at least 4 days during the last 7 days or • Symptoms present on at least 4 days during at least 1 week in the last 12 months

Case definition 2: Guyon's canal syndrome, based on symptoms and physical examination signs	
Time rule:	• Symptoms present now or on at least 4 days during the last 7 days AND
Symptoms:	• Intermittent parasthesias in the palmar ulnar nerve distribution of the hand, distal to the wrist or • Pain in the ulnar innervated area of the hand, which may radiate to the forearm AND
Signs:	• At least one of the following tests positive: ▲ Weakness or atrophy in the ulnar-innervated intrinsic hand muscles ▲ Tinel's sign ▲ Reversed Phalen's test ▲ Pressure test over the Guyon canal

! Note ! Descriptions and photographs of the tests involved can be found in appendix A Photos 22 & 23

SYMPTOM CRITERIA FOR ULNAR NERVE COMPRESSION AT THE WRIST: GUYON'S CANAL SYNDROME



SIGN CRITERIA FOR ULNAR NERVE COMPRESSION AT THE WRIST: GUYON'S CANAL SYNDROME