Chapter 3. Results (continued)

Cubital Tunnel Syndrome

Question #1: What are the appropriate methods and approaches for the early identification and diagnosis of cubital tunnel syndrome?

Evidence Base

Articles were included in this analysis if they reported data that could be used for evaluation of the test in diagnosing cubital tunnel syndrome, and they included ten or more patients.

Twenty-two articles met the initial inclusion criteria. Two (Table 171) were subsequently excluded because they contained no diagnostic data. The remaining 20 articles reported on a total of at least 557 cubital tunnel syndrome patients and at least 448 controls. These figures are approximate because Odusote et al. did not report the number of patients or controls in their study[489] and Eisen et al. did not report the number of controls in their 1974 article.[490] Three of the articles (15%) reported on multi-center trials; the rest were conducted at single centers. Half of the articles were from the United States, and half were from other countries.

Two articles (10%) reported only summary data for groups of patients (i.e., mean test results for cubital tunnel syndrome group and for control group). Four articles (20%) reported patient-level data either in tables or in charts from which counts of patients with positive and negative test results could be made. The remaining 14 articles reported those counts directly, but only nine articles (45% of total) reported sufficient information on both cubital tunnel syndrome patients and normal controls to permit both sensitivity and specificity to be determined. Details on data reporting levels and other characteristics of each study are found in Table 181 through Table 183.

Internal Validity of Results

Table 172 details aspects of study design and reporting that bear on the internal validity of the results: whether the published results truly reflect the diagnostic effectiveness of the test as used in the trial. The quality of reporting of these characteristics is summarized in Table 173. Only two articles reported that the person interpreting the test was blinded to patients' group assignment, and only one reported that the person performing the test was blinded. Blinding helps assure that test results were free of intentional or unintentional biases. The numbers of men and women in the cubital tunnel syndrome and control groups were not reported in 11 of the 20 articles (55%). Without reporting of these figures, one cannot be sure that the results of these studies were free of sex bias. Likewise, seven articles (35%) failed to report ages of patients and controls, even though some of the tests are known to be affected by age.

Generalizability of Results

Table 174 lists study characteristics that might affect the generalizability of results from the patient population in the study to the patient population. The quality of reporting of these characteristics is summarized in Table 175. Many studies did not report important patient characteristics such as sex and previous treatment. Without this information, one cannot determine whether diagnostic results were affected by these variables, or whether the results were representative of test performance in routine practice.

The overall quality of articles in this evidence base is low. Important variables that could affect the validity or generalizability of results from these studies were not reported. Though this lack of reporting is not evidence of bias in the studies, it limits the confidence one can have in any conclusions drawn from them.

A tabulation of patient selection and types of controls appears in Table 176. See Table 174 for the definition of these categories. Only three studies (15%) used objective criteria to define their cubital tunnel syndrome patient group, while eight (40%) diagnosed patients with unspecified methods. Eleven articles (55%) compared the cubital tunnel syndrome patients to healthy normal volunteers; this comparison may cause spectrum bias in the results because these control subjects may be less likely than patients referred for cubital tunnel syndrome testing to have other conditions that could cause false-positive test results.

The poor quality of the literature, particularly in reporting of study characteristics that demonstrate that study results are free of bias and generalizable to the diagnosis of cubital tunnel syndrome in routine practice, argues against trying to draw evidence-based conclusions from the results of a single study. If there is sufficient data on a particular test, meta-analytic techniques can be used to see if any of these variables affected study results.

Results

Table 177 tabulates reported tests (by type of test: there are different tests in each category) and patient selection categories in the 20 articles. There were no tests for which at least 10 articles reported sensitivity and specificity, not just for any one category of patient selection, but even for all categories combined. Therefore, we did not perform any meta-analyses of diagnostic tests for cubital tunnel syndrome.

The reported methods for defining cubital tunnel syndrome in the 20 included studies appear in Table 178. The most common criteria were symptoms (7 studies, 35%) and motor nerve conduction velocity across the elbow (6 studies, 30%). Seven studies (35%) used both clinical criteria and nerve conduction criteria, three studies (15%) used nerve conduction criteria only, and two studies (10%) used clinical criteria only. The table demonstrates the variability in authors' definitions of cubital tunnel syndrome. The lack of agreement on what constitutes cubital tunnel syndrome hinders assessing tests for diagnosing the condition.

Because there was little agreement in the clinical trial articles on appropriate diagnostic methods for cubital tunnel syndrome, we also examined review articles, to see if they identified any standard approaches to diagnosis. The four articles that reviewed cubital tunnel

diagnosis[57,97,491,492] listed typical symptoms of the condition, but did not recommend specific diagnostic strategies (i.e., which test to use first). They disagreed on the value of clinical signs like Tinel's sign. The only characteristic of cubital tunnel syndrome mentioned in all four articles was abnormal ulnar motor nerve conduction velocity at the elbow. Piligian[53] came closest to recommending a diagnostic strategy, suggesting that cubital tunnel syndrome be diagnosed using both symptoms (paresthesia of the fourth and fifth fingers and pain in the medial aspect of the elbow) and nerve conduction tests (reduced ulnar motor nerve conduction velocity at the elbow). There was not sufficient evidence in the reported clinical trials of these tests for us to meta-analyze their results and determine how effective they are.

Because ulnar motor nerve conduction velocity at the elbow was described as a characteristic of cubital tunnel syndrome in all four review articles we examined, and no tests for cubital tunnel syndrome met our *a priori* meta-analysis criteria, we abstracted sensitivity and specificity data from the three articles in which this was possible (the article by So et al.[173] was excluded because no specificity data was reported for the nerve conduction tests). The results reported in those three articles are presented in Table 179 and Figure 44. All three studies reported high specificity but low sensitivity.

Conclusions

All of the articles on diagnosis of cubital tunnel syndrome suffered from poor reporting of study methods and patient characteristics, so one cannot be assured that the results of any individual study were unaffected by bias. There were no diagnostic tests for cubital tunnel syndrome for which 10 or more articles reported sensitivity and specificity. Therefore, we could not perform meta-analyses to see if results were affected by differences in patient characteristics and study design. One test, ulnar motor nerve conduction velocity at the elbow, was mentioned by reviewers, and three studies reported high specificity and low sensitivity for this test. Due to the small number of studies, however, one cannot draw quantitative conclusions about the effectiveness of the test. There are insufficient data to permit evidence-based conclusions about the effectiveness of this or any other tests for cubital tunnel syndrome.

Table 171. Excluded Studies

Author	Reason for Exclusion
Okamoto, 2000 [493]	No diagnostic data
Rosenberg, 1995 [494]	No diagnostic data

Table 172. Study Design: Characteristics Affecting Internal Validity

Article	Funded by for-profit	Inclusion criteria	Exclusion criteria reported	Method of diagnosis	Patient selection	Comorbidity reported	Sex reported	Possible sex bias	Ages reported	Possible age bias	Duration of condition	Test operator blinded	Test reader blinded	Multiple readers	Method for multiple	Independent reference	Were patients given both
Montagna, 2000 [227]	NR	Yes	NR	NR	NR	NR	NR	GNR	NR	ANR	NR	NR	NR	NR	NR	No	No
Ellemann, 1999 [495]	NR	Yes	Yes	NR	NR	Yes	Yes	NC	Yes	NC	NR	NR	NR	NR	NR	No	No
Merlevede, 1999 [496]	NR	Yes	NR	Yes	NR	Yes	NR	GNR	NR	ANR	NR	NR	NR	NR	NR	No	No
Chiou, 1998 [497]	NR	Yes	NR	Yes	NR	NR	Yes	No	Yes	P	NR	NR	NR	2	NR	Yes	Yes
Dellon, 1997 [107]	Yes	Yes	Yes	Yes	NR	Yes	NR	GNR	NR	ANR	NR	NR	NR	NR	NR	Yes	Yes
Kaneko, 1997 [250]	NR	Yes	NR	Yes	NR	Yes	Yes	P	NR	ANR	NR	NR	NR	NR	NR	No	No
Britz, 1996 [498]	NR	Yes	NR	NR	Prospective	NR	Yes	GNR	Yes	ANR	NR	NR	Yes	NR	NR	No	No
Kingery, 1995 [499]	NR	Yes	Yes	Yes	NR	NR	NR	GNR	Yes	No	NR	NR	NR	NR	NR	No	No
Tassler, 1995 [115]	Yes	Yes	Yes	NR	Retrospective	Yes	NR	GNR	NR	ANR	NR	Yes	NR	NR	NR	Yes	Yes
Novak, 1994 [500]	No	Yes	Yes	Yes	NR	NR	Yes	No	Yes	P	NR	NR	NR	NR	NR	Yes	Yes
Uchida, 1993 [501]	NR	Yes	Yes	Yes	Retrospective	Yes	Yes	NC	Yes	NC	NR	NR	NR	NR	NR	No	No
Robinson, 1992 [502]	NR	Yes	Yes	Yes	Retrospective	NR	Yes	NC	NR	NC	Yes	NR	NR	NR	NR	No	No
So, 1989 [173]	NR	Yes	NR	Yes	NR	NR	NR	GNR	NR	ANR	NR	NR	Yes	NR	NR	Yes	No
Buehler, 1986 [503]	NR	Yes	Yes	Yes	NR	Yes	Yes	NC	NR	NC	NR	NR	NR	NR	NR	No	No
Kimura, 1984 [55]	NR	Yes	Yes	NR	NR	NR	Yes	No	Yes	No	NR	NR	NR	NR	NR	No	No
Tackmann, 1984 [54]	NR	Yes	NR	NR	NR	NR	NR	GNR	Yes	No	NR	NR	NR	NR	NR	No	No
Odusote, 1979 [489]	NR	Yes	Yes	NR	NR	Yes	NR	GNR	Yes	No	Yes	NR	NR	NR	NR	Yes	Yes
Ring, 1979 [504]	NR	Yes	NR	NR	Prospective	NR	Yes	C	Yes	P	NR	NR	NR	NR	NR	No	No
Eisen, 1977 [298]	NR	Yes	Yes	Yes	NR	NR	NR	GNR	Yes	P	NR	NR	NR	NR	NR	No	No

Article	Funded by for-profit	Inclusion criteria	Exclusion criteria reported	Method of diagnosis	Patient selection	Comorbidity reported	Sex reported	Possible sex bias	Ages reported	Possible age bias	Duration of condition	Test operator blinded	Test reader blinded	Multiple readers	Method for multiple	Independent reference	Were patients given both
Eisen, 1974 [490]	NR	Yes	Yes	Yes	Prospective	NR	Yes	GNR	Yes	No	NR	NR	NR	NR	NR	No	No

Key:
Possible sex bias: No—proportion women in epicondylitis group within 20% of proportion of women in control group; P—Patients were more likely to be female; C—Controls were more likely to be female; GNR—Genders not reported for both groups; NC—Study did not contain a separate control group
Possible age bias: No—mean age of epicondylitis group within 5 years of mean age of control group; P—Patients were older than controls; C—Controls were older than patients; ANR—Ages not reported for both groups; NC—Study did not contain a separate control group
Method for multiple test readers: Indep—Independent
NR—Not reported

Table 173. Summary of Characteristics Affecting Internal Validity

Study characteristic	Number of studies reporting	Details
Whether trial was funded by a for-profit institution	3 (15%)	For-profit funding: 2 (10%) No such funding: 1 (5%)
Patient inclusion criteria	20 (100%)	See Table 183
Patient exclusion criteria	12 (60%)	See Table 183
Method of diagnosis	12 (60%)	Clinical and NCS: 7 (35%) NCS only: 3 (15%) Clinical only: 2 (10%)
Was selection of patients prospective or retrospective?	6 (30%)	Prospective: 3 (15%) Retrospective: 3 (15%)
Were patient comorbidities reported?	8 (40%)	Various
Was the sex distribution of patients reported?	11 (55%)	[a]Percentage female: 31.6%
Was the percentage of females in the patient group within 20 percentage points of the control group?	5 (25%)	Yes: 4 (20%) No, patients were = 20% more female: 0 No, control group was =20% more female: 1 (5%)
Were patient ages reported?	12 (60%)	[a, b]Mean age: 46.6
Was the mean patient age within 5 years of the mean control age?	9 (45%)	Yes: 5 (25%) No, patients were = 5 years older: 4 (20%)
Was the duration of patients' condition reported?	1 (5%)	[a]Mean duration: 7.5 months
Was the test operator blinded?	1 (5%)	Yes: 1 (5%)
Was the test reader blinded?	2 (10%)	Yes: 2 (10%)
Were there multiple test readers?	1 (5%)	2 readers: 1 (5%)
What was the method for multiple test readers?	0	NA
Was the test compared to an independent reference standard?	6 (30%)	Yes: 6 (30%)
Were all patients given the test and the reference standard?	6 (30%)	Yes: 5 (25%) No: 1 (5%)

Key:
NA-not applicable
[a]Calculated on a per-patient basis (i.e., weighted by number of patients in each study reporting this characteristic)
[b]Calculation excludes study reporting median age [54] and study that failed to report the number of patients [489]

Table 174. Study Design: Characteristics Affecting Generalizability of Results

Article	Years in which trial was conducted	Number of centers	Country where trial was conducted	Inclusion criteria reported?	Exclusion criteria reported	Patient comor-bidity reported?	Sex reported	Ages reported	Duration of con-dition reported	Did all patients have previous conservative treatment?	Did any patients have previous surgical treatment?	Source of patients adequately described and generalizable to broader clinical practice?	Potential sel-ection bias for easy cases?	Potential sel-ection bias for difficult cases?
Montagna, 2000 [227]	NR	Single	Italy	Yes	NR	No	NR	NR	NR	No	No	No	Yes	No
Ellemann, 1999 [495]	NR	Multiple (<5)	Denmark	Yes	Yes	Yes	Yes	Yes	NR	No	No	No	Yes	No
Merlevede, 1999 [496]	NR	Single	Belgium	Yes	NR	Yes	NR	NR	NR	No	No	No	Yes	Yes
Chiou, 1998 [497]	NR	Single	Taiwan	Yes	NR	No	Yes	Yes	NR	No	No	No	No	No
Dellon, 1997 [107]	1993	Single	USA	Yes	Yes	Yes	NR	NR	NR	No	No	No	Yes	No
Kaneko, 1997 [250]	NR	Single	Japan	Yes	NR	Yes	Yes	NR	NR	No	No	No	Yes	No
Britz, 1996 [498]	NR	Multiple (<5)	USA	Yes	NR	No	Yes	Yes	NR	No	Yes	No	No	No
Kingery, 1995 [499]	NR	Single	USA	Yes	Yes	No	NR	Yes	NR	No	No	No	No	Yes
Tassler, 1995 [115]	1993-1994	Single	USA	Yes	Yes	Yes	NR	NR	NR	No	No	No	Yes	No
Novak, 1994 [500]	NR	Single	USA	Yes	Yes	No	Yes	Yes	NR	No	No	No	No	No
Uchida, 1993 [501]	1985-1992	Single	Japan	Yes	Yes	Yes	Yes	Yes	NR	No	No	No	No	No
Robinson, 1992 [502]	1984-1988	Single	Israel	Yes	Yes	No	Yes	NR	Yes	No	No	No	Yes	No
So, 1989 [173]	NR	Single	USA	Yes	NR	No	NR	NR	NR	No	No	Yes	No	No
Buehler, 1986 [503]	NR	Single	USA	Yes	Yes	Yes	Yes	NR	NR	No	No	No	Yes	No
Kimura, 1984 [55]	NR	Single	USA	Yes	Yes	No	Yes	Yes	NR	No	No	No	No	No
Tackmann, 1984 [54]	NR	Single	Germany	Yes	NR	No	NR	Yes	NR	No	No	No	No	No
Odusote, 1979 [489]	NR	Single	USA	Yes	Yes	Yes	NR	Yes	Yes	No	No	No	Yes	Yes
Ring, 1979 [504]	NR	Multiple (<5)	Israel	Yes	NR	No	Yes	Yes	NR	No	No	No	No	No

Article	Years in which trial was conducted	Number of centers	Country where trial was conducted	Inclusion criteria reported?	Exclusion criteria reported	Patient comor-bidity reported?	Sex reported	Ages reported	Duration of con-dition reported	Did all patients have previous conservative treatment?	Did any patients have previous surgical treatment?	Source of patients adequately described and generalizable to broader clinical practice?	Potential sel-ection bias for easy cases?	Potential sel-ection bias for difficult cases?
Eisen, 1977 [298]	NR	Single	Canada	Yes	Yes	No	NR	Yes	NR	No	No	No	No	Yes
Eisen, 1974 [490]	NR	Single	USA	Yes	Yes	No	Yes	Yes	NR	No	No	No	No	No

Key:
NR—not reported

Table 175. Summary of Characteristics Affecting Generalizability

Study characteristic	Number of studies reporting	Details
Years in which study was conducted	4 (20%)	1984-1988: 1 (5%) 1985-1992: 1 (5%) 1993: 1 (5%) 1993-1994: 1 (5%)
Number of centers in which trial was conducted	20 (100%)	Single: 17 (85%) Multiple (<5): 3 (15%)
Country(s) where trial was performed	20 (100%)	USA: 10 (50%) Other: 10 (50%)
Patient inclusion criteria	20 (100%)	See Table 183
Patient exclusion criteria	12 (60%)	See Table 183
Were patient comorbidities reported?	8 (40%)	Various
Was the sex distribution of patients reported?	11 (55%)	[a]Percentage female: 31.6%
Were patient ages reported?	12 (60%)	[a, b]Mean age: 46.6 years
Was the duration of patients' condition reported?	1 (5%)	[a]Mean duration: 7.5 months
Did all patients have previous conservative treatment?	0	NA
Did any patients have previous surgical treatment?	1 (5%)	Yes: 1 (5%)
Adequate reporting of study's source of patients	1 (5%)	Yes: 1 (5%)
Was there a potential selection bias for easy cases?	9 (45%)	Yes: 9 (45%)
Was there a potential selection bias for hard cases?	4 (20%)	Yes: 4 (20%)

Key:
NA-not applicable
[a]Calculated on a per-patient basis (i.e., weighted by number of patients in each study reporting this characteristic)
[b]Calculation excludes study reporting median age [54] and study that failed to report the number of patients [489]

Table 176. Patient and Control Group Selection in Cubital Tunnel Syndrome Diagnostic Articles

Control Selection	Patient selection					Total
	Complex objective standard	Simple nerve conduction	Symptoms/ presented	Unspecified diagnosis	Workers at risk	
Healthy control group and asymptomatic arms of patients	0	0	1	0	0	1
Healthy control group	1	2	4	3	1	11
Other control group	0	0	2	2	0	4
Asymptomatic arm as control	0	0	1	0	0	1
No controls	0	0	0	3	0	3
Total	1	2	8	8	1	20

Table 177. Cubital Tunnel Syndrome Tests and Patient Groups

Legend:

Numeric entries in each cell— Total number of articles, articles from which sensitivity and specificity can be calculated

Test type	Patient selection				
	Complex objective standard	Simple objective standard	Symptoms/ presented	Unspecified diagnosis	Workers at risk
Composite nerve conduction	1, 1	1, 1	7, 4	2, 1	1, 0
Imaging	0, 0	0, 0	2, 1	0, 0	0, 0
Nerve conduction	1, 1	1, 1	5, 2	3, 1	1, 0
Sensory	0, 0	0, 0	1, 1	3, 1	0, 0
Signs/Symptoms	0, 0	1, 1	2, 2	3, 0	1, 0
Other	0, 0	0, 0	4, 3	2, 2	0, 0

See **Table 3** CODING OF PATIENT INCLUSION —METHODS SECTION for the definition of these groups

Table 178. Definitions of Cubital Tunnel Syndrome Used in Reported Clinical Trials

Article	Clinical findings			Nerve conduction studies			Comments
	SYM	CLN	OTH CLN	MCV ELB	OTH MOT	SEN	
Montagna, 2000 [227]	?	?	?	?	?	?	NR
Ellemann, 1999 [495]	?	?	?	?	?	?	NR
Merlevede, 1999 [496]	☑	?	?	☑	☑	?	
Chiou, 1998 [497]	?	?	?	?	?	?	NCS (tests not reported)
Dellon, 1997 [107]	?	☑	☑	?	?	?	
Kaneko, 1997 [250]	?	?	?	☑	?	?	
Britz, 1996 [498]	?	?	?	?	?	?	NR
Kingery, 1995 [499]	☑	?	?	☑	☑	☑	
Tassler, 1995 [115]	?	?	?	?	?	?	NR
Novak, 1994 [500]	☑	?	?	☑	?	?	
Uchida, 1993 [501]	☑	☑	?	☑	?	?	
Robinson, 1992 [502]	?	☑	?	?	?	?	NCS (tests not reported)
So, 1989 [173]	☑	☑	☑	?	?	?	
Buehler, 1986 [503]	?	?	?	?	☑	☑	
Kimura, 1984 [55]	?	?	?	?	?	?	NR
Tackmann, 1984 [54]	?	?	?	?	?	?	NR
Odusote, 1979 [489]	?	?	?	?	?	?	NR
Ring, 1979 [504]	?	?	?	?	?	?	NR
Eisen, 1977 [298]	☑	?	☑	?	☑	☑	
Eisen, 1974 [490]	☑	?	?	☑	☑	☑	
Totals (20 articles)	7	4	3	6	5	4	

Key:
SYM - Were positive symptoms included in the author's method of diagnosis?
CLN - Was a positive clinical exam included in the author's method of diagnosis?
OTH CLN - Were other clinical findings included in the author's method of diagnosis?
MCV ELB - Was ulnar motor nerve conduction velocity across the elbow included in the author's method of diagnosis?
OTH MOT - Were other motor conduction studies included in the author's method of diagnosis?
SEN - Were sensory conduction studies included in the author's method of diagnosis?
NR - Method of diagnosis was not reported

Table 179. Clinical Trial Results: Ulnar Motor Nerve Conduction Velocity at the Elbow for Diagnosis of Cubital Tunnel Syndrome

Study	TP	FN	FP	TN	Sensitivity (95% CI)	Specificity (95% CI)	PPV (95% CI)	NPV (95% CI)	Prevalence
[a]Odusote, 1979 [489]	72	181	10	229	28.5% 23.2% 34.4%	95.8% 92.4% 97.7%	87.8% 78.8% 93.3%	55.9% 50.9% 60.7%	51.4%
[b]Eisen, 1977 [298]	12	6	0	60	66.7% 43.3% 84.0%	100% 93.8% 100%	100% 75.0% 100%	90.9% 81.3% 95.8%	23.1%
[a, b]Kingery, 1995 [499]	16	34	2	68	32.0% 20.6% 46.1%	97.1% 90.0% 99.2%	88.9% 66.7% 97.0%	66.7% 56.9% 75.2%	41.7%

Insufficient data for meta-analysis

[a]Data reported on a per-arm basis, rather than per-patient.

[b]Counts for control group (false positive, true negative) estimated by ECRI from threshold reported by authors

Figure 44. Clinical Trial Results: Ulnar Motor Nerve Conduction Velocity at the Elbow for Diagnosis of Cubital Tunnel Syndrome

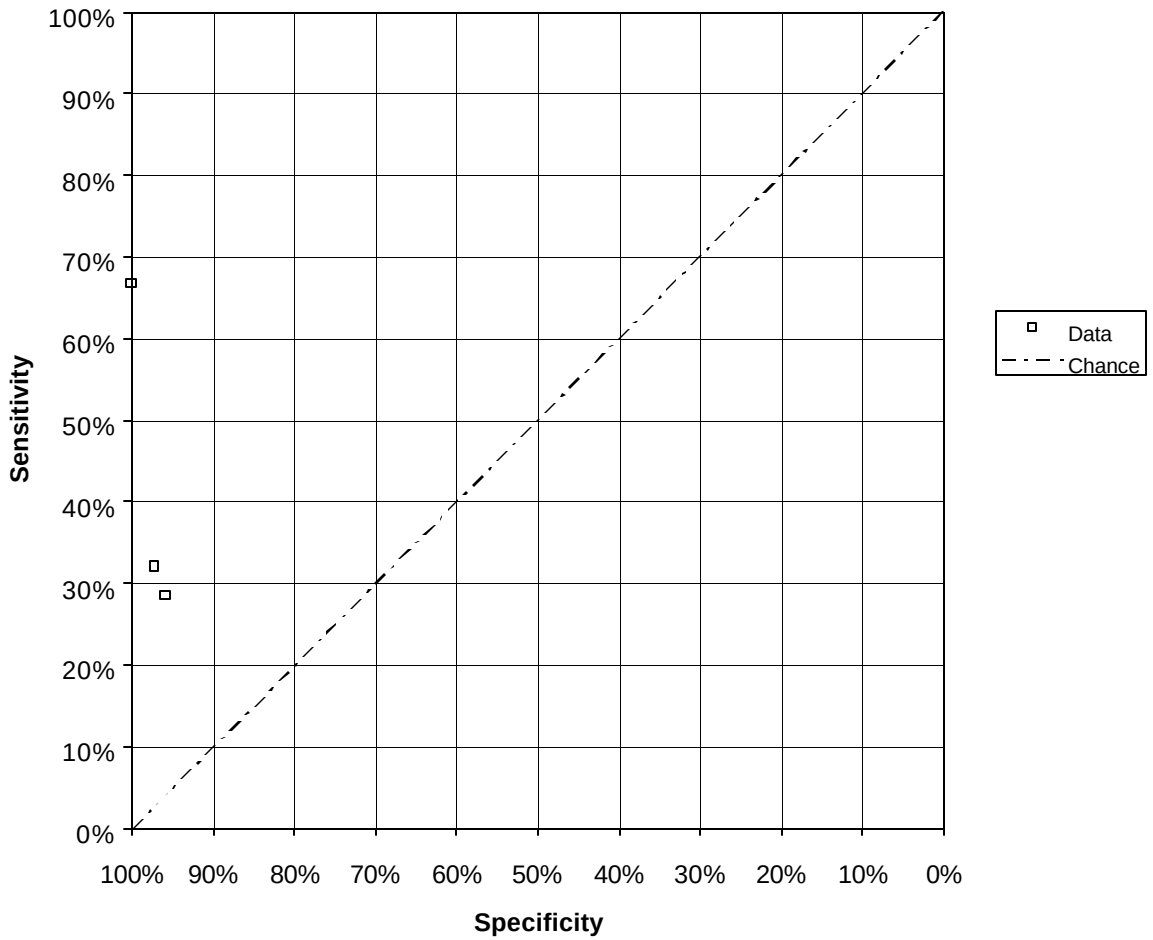


Table 180. Cubital Tunnel Syndrome–Test Types Reported

Article	Signs/ Symptoms	Sensory Tests	Nerve Conduction	Composite Nerve Conduction	Imaging	Other
Montagna, 2000 [227]	☐	☐	☐	☐	☐	☑
Ellemann, 1999 [495]	☐	☑	☐	☑	☐	☐
Merlevede, 1999 [496]	☐	☐	☑	☑	☐	☐
Chiou, 1998 [497]	☐	☐	☐	☐	☑	☐
Dellon, 1997 [107]	☑	☑	☐	☐	☐	☐
Kaneko, 1997 [250]	☐	☐	☑	☑	☐	☐
Britz, 1996 [498]	☑	☐	☐	☑	☑	☑
Kingery, 1995 [499]	☑	☐	☑	☑	☐	☑
Tassler, 1995 [115]	☐	☑	☐	☑	☐	☐
Novak, 1994 [500]	☑	☐	☐	☐	☐	☐
Uchida, 1993 [501]	☐	☐	☑	☐	☐	☐
Robinson, 1992 [502]	☑	☑	☐	☐	☐	☐
So, 1989 [173]	☐	☐	☑	☐	☐	☑
Buehler, 1986 [503]	☑	☐	☐	☐	☐	☐
Kimura, 1984 [55]	☐	☐	☑	☑	☐	☑
Tackmann, 1984 [54]	☐	☐	☑	☑	☐	☐
Odusote, 1979 [489]	☐	☐	☑	☑	☐	☑
Ring, 1979 [504]	☑	☐	☑	☑	☐	☐
Eisen, 1977 [298]	☐	☐	☑	☑	☐	☐
Eisen, 1974 [490]	☐	☐	☑	☑	☐	☐

Table 181. Cubital Tunnel Syndrome–Study Design

Article	Centers	Cubital tunnel groups	Cubital tunnel patients	Negative groups	Negative subjects	Prospective or retrospective design	Level of reporting	Could sensitivity and specificity be determined?
Montagna, 2000 [227]	Single	1	10	1	15	NR	Counts	Reported by authors
Ellemann, 1999 [495]	Multiple (<5)	1	39	0	0	NR	Patient level	Reported by authors (note: normed to contralateral hand)
Merlevede, 1999 [496]	Single	1	10	1	60	NR	Patient level	Calculated by ECRI
Chiou, 1998 [497]	Single	1	14	1	10	NR	Summary	No: only summary statistics reported
Dellon, 1997 [107]	Single	1	42	1	52	NR	Counts	Control data not reported
Kaneko, 1997 [250]	Single	1	10	1	46	NR	Summary	No: only summary statistics reported
Britz, 1996 [498]	Multiple (<5)	1	27	1	10	Prospective	Patient level	Reported by authors
Kingery, 1995 [499]	Single	1	42	1	40	NR	Counts	Reported by authors
Tassler, 1995 [115]	Single	1	13	1	14	Retrospective	Counts	Reported by authors
Novak, 1994 [500]	Single	1	32	1	33	NR	Counts	Reported by authors
Uchida, 1993 [501]	Single	1	60	0	0	Retrospective	Counts	No: no control group
Robinson, 1992 [502]	Single	1	22	0	0	Retrospective	Counts	No: no control group
So, 1989 [173]	Single	1	15	1	20	NR	Counts	Reported by authors
Buehler, 1986 [503]	Single	1	13	0	0	NR	Counts	No: no control group
Kimura, 1984 [55]	Single	1	44	1	25	NR	Counts	Control data not reported
Tackmann, 1984 [54]	Single	1	103	1	52	NR	Counts	Control data not reported
Odusote, 1979 [489]	Single	4	237	1	230	NR	Counts	Reported by authors
Ring, 1979 [504]	Multiple (<5)	1	32	1	50	Prospective	Counts	Control data not reported
Eisen, 1977 [298]	Single	1	18	1	60	NR	Patient level	Calculated by ECRI
Eisen, 1974 [490]	Single	1	30	1	48 limbs	Prospective	Counts	Control data not reported

Table 182. Cubital Tunnel Syndrome–Patient Groups

Article	Disorder type	Patient selection	Number of patients	Percent female	Mean age	Age of youngest	Age of oldest	Duration of condition before treat-ment (mths)	Shortest duration	Longest duration	Patient co-morbidities reported?
Montagna, 2000 [227]	Carpal tunnel syndrome	Unspecified diagnosis	30	NR							No
Montagna, 2000 [227]	Cubital tunnel syndrome	Unspecified diagnosis	10	NR							No
Montagna, 2000 [227]	Normal	Healthy volunteers	15	NR							No
Ellemann, 1999 [495]	Cubital tunnel syndrome	Symptoms/ presented	39	54	46	21	72				Yes
Merlevede, 1999 [496]	Other	Other	24	NR							Yes
Merlevede, 1999 [496]	Normal	Healthy volunteers	60	63	33.6	13	61				Yes
Merlevede, 1999 [496]	Cubital tunnel syndrome	Simple nerve conduction	10	NR							Yes
Chiou, 1998 [497]	Cubital tunnel syndrome	Symptoms/ presented	14	43	50	21	80				No
Chiou, 1998 [497]	Normal	Healthy volunteers	10	50	45	30	60				No
Dellon, 1997 [107]	Normal	Other	52	62							Yes
Dellon, 1997 [107]	Carpal tunnel syndrome	Unspecified diagnosis	72	NR							Yes
Dellon, 1997 [107]	Cubital tunnel syndrome	Unspecified diagnosis	42	NR							Yes
Kaneko, 1997 [250]	Carpal tunnel syndrome	Unspecified diagnosis	15	87		40	54				Yes
Kaneko, 1997 [250]	Cubital tunnel syndrome	Unspecified diagnosis	10	20		45	56				Yes
Kaneko, 1997 [250]	Normal	Healthy volunteers	46	22		25	45				Yes
Kaneko, 1997 [250]	Combined WRUEDs	Unspecified diagnosis	10	50		40	62				Yes
Britz, 1996 [498]	Cubital tunnel syndrome	Symptoms/ presented	27	11	51	31	69				No
Britz, 1996 [498]	Normal	Healthy volunteers	10	NR							No

Article	Disorder type	Patient selection	Number of patients	Percent female	Mean age	Age of youngest	Age of oldest	Duration of condition before treat-ment (mths)	Shortest duration	Longest duration	Patient co-morbidities reported?
Kingery, 1995 [499]	Cubital tunnel syndrome	Symptoms/ presented	42	NR	51	32	72				No
Kingery, 1995 [499]	Other	Other	40	NR	47	28	76				No
Tassler, 1995 [115]	Carpal tunnel syndrome	Unspecified diagnosis	14	NR							Yes
Tassler, 1995 [115]	Cubital tunnel syndrome	Unspecified diagnosis	13	NR							Yes
Novak, 1994 [500]	Normal	Healthy volunteers	33	39	41	23	59				No
Novak, 1994 [500]	Cubital tunnel syndrome	Simple nerve conduction	32	41	46	24	81				No
Uchida, 1993 [501]	Cubital tunnel syndrome	Unspecified diagnosis	60	23	48.6	17	74				Yes
Robinson, 1992 [502]	Cubital tunnel syndrome	Unspecified diagnosis	22	55		18	65	7.5	16		No
So, 1989 [173]	Normal	Healthy volunteers	20	NR							No
So, 1989 [173]	Carpal tunnel syndrome	Unspecified diagnosis	22	NR							No
So, 1989 [173]	Cubital tunnel syndrome	Unspecified diagnosis	15	NR							No
Buehler, 1986 [503]	Cubital tunnel syndrome	Unspecified diagnosis	13	NR							Yes
Kimura, 1984 [55]	Normal	Healthy volunteers	25	40	40.8	20	66				No
Kimura, 1984 [55]	Cubital tunnel syndrome	Symptoms/ presented	44	32	41.6	18	64				No
Tackmann, 1984 [54]	Normal	Healthy volunteers	52	NR	a-39	20	69				No
Tackmann, 1984 [54]	Cubital tunnel syndrome	Symptoms/ presented	103	NR	a-43	12	76		0	72	No
Odusote, 1979 [489]	Other	Other	230	NR	48.8	17	88				Yes
Odusote, 1979 [489]	Cubital tunnel syndrome	Symptoms/ presented	NR	NR	56.1	21	83	34.4	1	636	Yes
Odusote, 1979 [489]	Cubital tunnel syndrome	Symptoms/ presented	NR	NR	49.8	30	78	9.6	0	108	Yes

Article	Disorder type	Patient selection	Number of patients	Percent female	Mean age	Age of youngest	Age of oldest	Duration of condition before treat-ment (mths)	Shortest duration	Longest duration	Patient co-morbidities reported?
Odusote, 1979 [489]	Cubital tunnel syndrome	Symptoms/ presented	NR	NR	49.2	16	70	11.2	0	108	Yes
Odusote, 1979 [489]	Cubital tunnel syndrome	Symptoms/ presented	NR	NR	45.6	22	77	16.4	0	120	Yes
Ring, 1979 [504]	Cubital tunnel syndrome	Workers at risk	32	6	40.6						No
Ring, 1979 [504]	Normal	Healthy volunteers	50	48	27.2						No
Eisen, 1977 [298]	Normal	Healthy volunteers	60	NR	41.5	11	74				No
Eisen, 1977 [298]	Carpal tunnel syndrome	Complex objective standard	30	NR	56.1	21	76				No
Eisen, 1977 [298]	Combined WRUEDs	Other	23	NR	50	7	68				No
Eisen, 1977 [298]	Cubital tunnel syndrome	Complex objective standard	18	NR	51.7	26	65				No
Eisen, 1974 [490]	Normal	Healthy volunteers	NR	NR	43.7	19	78				No
Eisen, 1974 [490]	Cubital tunnel syndrome	Symptoms/ presented	30	50	42.9	17	66				No

a—Study reported median age rather than mean age

Table 183. Cubital Tunnel Syndrome–Inclusion and Exclusion Criteria

Article	Reported Patient Inclusion Criteria	Reported Patient Exclusion Criteria
Montagna, 2000 [227]	Diagnosed with carpal tunnel or cubital tunnel.	None reported
Ellemann, 1999 [495]	Admitted for surgical treatment for symptoms consistent with sulcus compression in the ulnar nerve at the elbow: weakness of the small hand muscles innervated by the ulnar nerve, sensory disturbances, paresthesia, and tingling or pain in the ulnar, palmar side of the hand or little finger.	Exposure to vibration within the previous 24 hours, systemic illness, possible secondary neuropathies, polyneuropathy.
Merlevede, 1999 [496]	Cubital tunnel patients: Obvious ulnar neuropathy at the elbow. Motor or sensory deficit, and either 1) partial/complete motor conduction block across the elbow, or 2) MCV across the elbow <50 m/s. Other patients: Other neurological disorders but no symptoms of ulnar neuropathy.	None reported
Chiou, 1998 [497]	Complaints of aching pain and numbness over the medial elbow, ulnar side of the forearm, and ring and little fingers.	None reported
Dellon, 1997 [107]	Already diagnosed with either carpal tunnel or cubital tunnel. Diagnosis was based on the clinical history and physical examination, which included positive provocative testing, positive Tinel's sign at the wrist or elbow, abnormal tuning fork perception.	Cervical radiculopathy, diabetes, thoracic outlet syndrome, thyroid disease, collagen vascular disease, using narcotics or antidepressants.
Kaneko, 1997 [250]	Group 01: Coexisting entrapment neuropathy and cervical cord compression demonstrated by MRI. Group 02: Diagnosed with carpal tunnel. Group 03: Diagnosed with cubital tunnel. Group 04: Control group, no subjective symptoms or neurologic findings associated with peripheral or central lesions.	None reported
Britz, 1996 [498]	History and physical exam consistent with cubital tunnel syndrome. Symptoms included numb-ness and paresthesias of the ring and little fingers and weakness and clumsiness of the hand.	None reported
Kingery, 1995 [499]	Chronic paresthesias in the ulnar distribution	Carpal tunnel, brachial plexopathy, cervical radiculopathy, polyneuropathy.
Tassler, 1995 [115]	Symptomatic patients who had been diagnosed, had not been cured by nonoperative methods, and later received surgery for the condition.	Diabetes, alcoholism, other toxicity.
Novak, 1994 [500]	Patients diagnosed with cubital tunnel based on symptoms and nerve conduction tests. Symptoms included complaints of paresthesia and numbness in the ulnar nerve distribution. Nerve conduction criteria was conduction velocity across the elbow <50 m/s and a decrease of 15% at the elbow.	Previous surgery, or brachial plexus decompression.
Uchida, 1993 [501]	Signs and/or symptoms of high ulnar nerve palsy, and MCV across the elbow <48 m/s.	Radiculopathy, other signs and symptoms.
Robinson, 1992 [502]	Pre-operatively evaluated patients with cubital tunnel syndrome. Clinical diagnosis as well as positive nerve conduction for cubital tunnel based on a reduction to two-third of normal.	Intrinsic atrophy

Article	Reported Patient Inclusion Criteria	Reported Patient Exclusion Criteria
So, 1989 [173]	Patients were selected from referrals to the lab. Carpal tunnel: Confident clinical diagnosis based on history of pain and paresthesias in the hand and fingers, and physical findings that localized the pathology to the median nerve, e.g. sensory alteration or weakness in a median nerve distribution, Tinel's, or Phalen's. Cubital tunnel: Confident clinical diagnosis based on paresthesias or numbness in an ulnar nerve distribution, usually accompanied by weakness in ulnar-innervated muscles. In those patients without weakness on examination, the diagnosis of ulnar neuropathy at the elbow was not made unless there was percussion sensitivity at the cubital tunnel or the ulnar groove, or exacerbation of symptoms with elbow flexion.	None reported
Buehler, 1986 [503]	History and clinical findings consistent with cubital tunnel, confirmed by nerve conduction tests.	Generalized neuropathy, cervical disc disease, arthritis, elbow trauma.
Kimura, 1984 [55]	Patients with frank clinical signs and symptoms suggestive of cubital tunnel syndrome.	History of trauma, clinical or x-ray evidence of joint deformity or disease that predisposed to peripheral neuropathy.
Tackmann, 1984 [54]	Referred to lab with a clinical diagnosis of cubital tunnel syndrome.	None reported
Odusote, 1979 [489]	Symptomatic cubital tunnel syndrome.	Ulnar nerve lesion at the wrist, brachial plexus lesion, thoracic outlet syndrome, disease of the cervical roots, anterior horn cell disease, generalized polyneuropathy, familial multiple entrapment neuropathy, exposure to neurotoxins.
Ring, 1979 [504]	Sample of diamond polishers referred by their union for study participation. Not known to have major illness or ulnar nerve damage at the time of referral.	None reported
Eisen, 1977 [298]	Carpal tunnel patients: Sensory symptoms limited to one or both hands, normal ulnar sensory latency (<2.8 ms), normal ulnar sensory amplitude (>8.4 uV), and at least three of the following five criteria: 1) Sensory signs restricted to median distribution; 2) Weakness or wasting of the APB muscle; 3) Median DML >4.5 ms; 4) Median DSL >2.7 ms; 5) Median SNAP amplitude <8.6 uV or median SNAP duration >2.4 ms. Cubital tunnel patients: Sensory symptoms limited to one or both hands, normal median sensory latency (<2.7 ms), normal median sensory amplitude (>8.6 uV), and at least three of the following six criteria: 1) Sensory signs restricted to ulnar distribution; 2) Weakness or wasting of the ulnar-innervated muscles of the hand; 3) Ulnar DML >4.0 ms; 4) Ulnar proximal motor latency (stimulation just above the elbow) >8.9 ms; 5) Ulnar DSL >2.8 ms; 6) Ulnar SNAP amplitude <8.4 uV or ulnar SNAP duration >2.1 ms. Patients with proximal lesions: Sensory symptoms limited to one or both hands, but did not meet criteria for either carpal tunnel or cubital tunnel.	Subjects were excluded from the control group if there was neuromuscular disease, diabetes, alcoholism, peripheral neuropathy, or systemic dysfunction.
Eisen, 1974 [490]	Referred to lab because of subjective complaints of numbness and tingling limited to the ring and little fingers, and present for three or more weeks.	Definite muscle wasting or weakness, cervical disk disease, thoracic outlet syndrome, carpal tunnel, ulnar compression at the wrist, evidence for generalized neuropathy.

Question #2. What are the specific indications for surgery for cubital tunnel syndrome?

There is no published information available that directly addressed the question of specific indications for surgery for cubital tunnel syndrome. Therefore, this section will present the characteristics of patients who have received surgery as described in published studies. Because patients enrolled in clinical trials may differ from the general population of patients encountered in general practice, these data may not accurately reflect the general population of patients who have received surgery, and may be of limited utility when selecting candidates for surgery in the future. However, the present analysis is the most comprehensive guide available.

Evidence Base

For this question, we examined controlled trials and case series that described patients being surgically treated for cubital tunnel syndrome. We identified thirty-two such studies that included a total of 1,820 patients.

Patient demographics

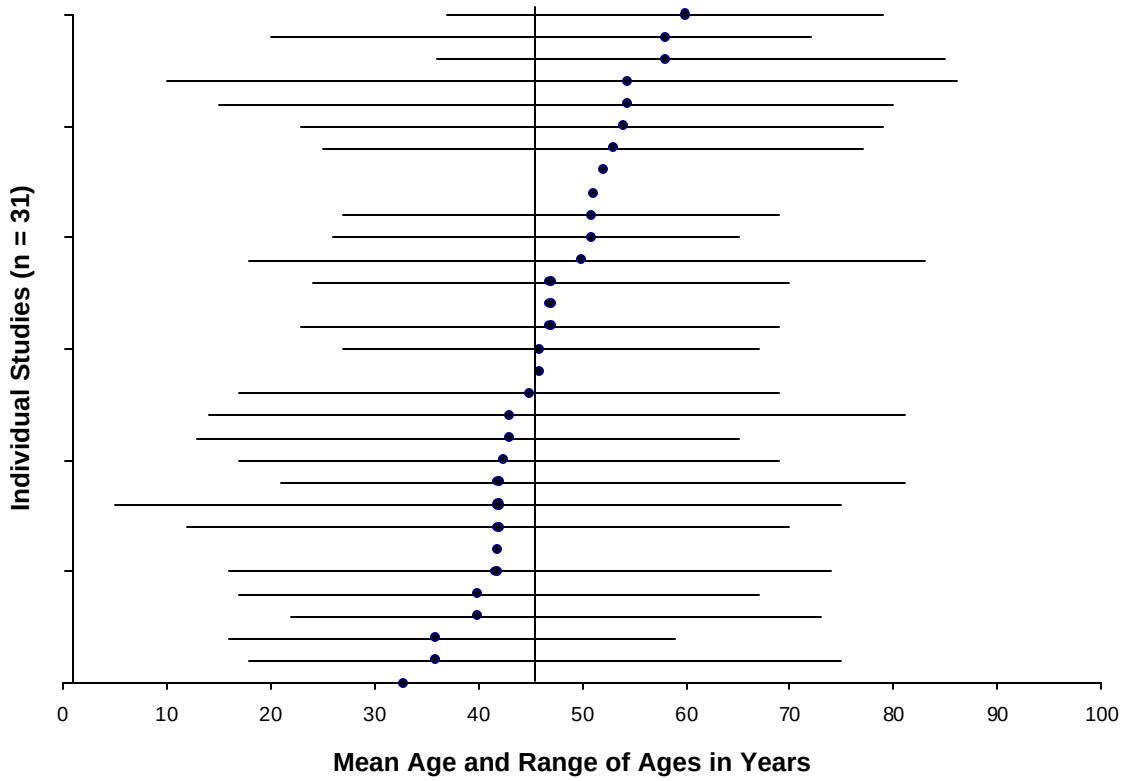
Table 184 shows the mean age, age range, and gender composition of the patient groups included in the trials. Thirty-one of the 32 studies (96.9%) reported information about the ages of the patients, and 29 of the studies (90.6%) reported information about the gender composition of the patient groups. The mean ages and age range are shown in Figure 45. In general, patients surgically treated for cubital tunnel syndrome were middle aged (a mean of 46.4 years of age), but ages ranged from under ten years old to almost 90 years of age. The percentages of women in the patient groups are shown in Figure 46. The patients were predominantly male (62%). None of the studies reported that patients were excluded/included on the basis of either age or gender.

Table 184. Ages and gender composition of patient groups receiving surgery for cubital tunnel syndrome

Study	Number of patients	Number of males	Number of females	Percent female	Age reported as mean or median?	Age	Age of youngest patient	Age of oldest patient
Artico 2000 [505]	236	140	96	40.7	Mean	42.5	17	69
Caputo 2000 [506]	20	13	7	35.0	Mean	47	24	70
Lascar 2000 [425]	71	59	12	16.9	Mean	50	18	83
Greenwald 1999 [507]	31	29	2	6.5	Mean	60	37	79
Tsai 1999 [508]	76	29	47	61.8	Median	42	21	81
Asami 1998 [509]	35	25	10	28.5	Mean	54.4	15	80
Seradge 1998 [510]	160	99	61	38.1	Mean	43	14	81
Glowacki 1997 [511]	40	17	23	57.5	Mean	40	17	67
Nouhan 1997 [512]	31	18	13	41.9	Mean	46	27	67
Tada 1997 [513]	50	44	6	12.0	Mean	58	20	72
Geutjens 1996 [514]	52	NR	NR	NR	Mean	58	36	85
Steiner 1996 [515]	41	29	12	29.3	Mean	46	NR	NR
Messina 1995 [516]	30	22	8	26.7	Mean	54	23	79
Nathan 1995 [517]	164	74	90	54.8	Mean	41.9	NR	NR
Pasque 1995 [518]	64	40	24	37.5	Mean	42	5	75
Manske 1992 [519]	26	15	11	42.3	Mean	40	22	73
Barrios 1991 [520]	53	37	16	30.2	Mean	42	12	70
Froimson 1991 [521]	34	6	28	82.4	Mean	47	NR	NR
Rogers 1991 [522]	14	8	6	42.9	Mean	36	16	59
Heithoff 1990 [523]	39	22	17	43.6	Mean	41.8	16	74

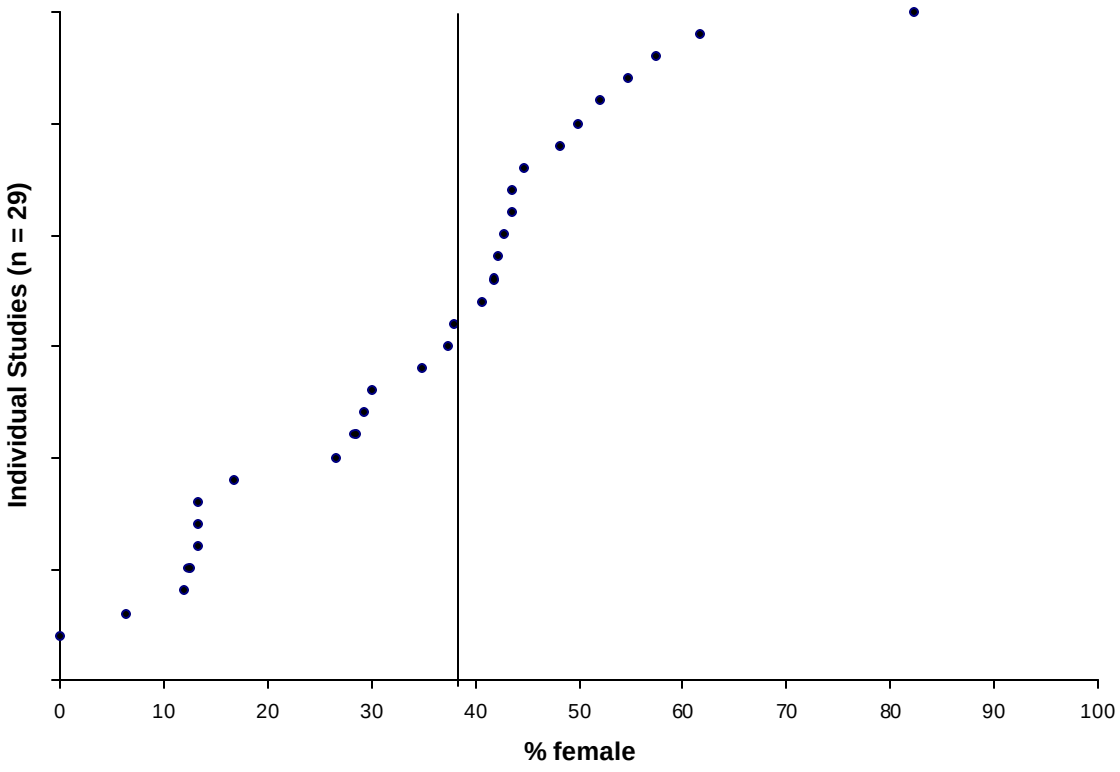
Study	Number of patients	Number of males	Number of females	Percent female	Age reported as mean or median?	Age	Age of youngest patient	Age of oldest patient
Goldberg 1989 [524]	46	22	24	52.2	Mean	47	23	69
Janes 1989 [525]	30	26	4	13.3	Mean	51	27	69
Kleinman 1989 [526]	47	26	21	44.7	Mean	45	17	69
Friedman 1986 [527]	22	22	0	0.0	Mean	52.1	NR	NR
Leffert 1982 [528]	38	NR	NR	NR	Mean	32.9	14	73
Foster 1981 [529]	48	29	19	50.0	Mean	51.2	NR	NR
Chan 1980 [530]	235	214	21	43.7	Mean	54.5	10	86
Craven 1980 [531]	30	26	4	13.3	Mean	53	25	77
Eaton 1980 [532]	16	12	4	13.3	Mean	36	18	75
Froimson 1980 [52]	29	27	2	12.5	Mean	43	13	65
Miller 1980 [533]	12	0	12	48.3	Mean	51	26	65

Figure 45. Mean ages and ranges of ages of patients treated surgically for cubital tunnel syndrome



The vertical line indicates the mean age

Figure 46. Gender composition of patient groups treated surgically for cubital tunnel syndrome



The vertical line indicates the mean % of females

Signs and symptoms

The signs and symptoms of patients before surgical treatment for cubital tunnel syndrome are listed in Table 185. The number of studies reporting on the proportion of patients in the study group having each sign and symptom are listed in Table 186 and shown in Figure 47. The mean percentage of patients reported to have each sign and symptom, and the range of reported percentages, are shown in Figure 48. In addition to the clinical signs and symptoms, some studies reported on the conduction velocity of the ulnar nerve. Nine of the 32 studies simply reported that all of the patients treated with surgery had "abnormal" nerve conduction velocities. One of the 32 studies reported that 31% of the patients had "abnormal" nerve conduction velocities. The definition of abnormal varied from study to study, and often no definition was supplied. Five of the 32 studies did not measure the nerve conduction velocity of the ulnar nerve before treating the patients with surgery. In 17 of the 32 studies it was not clear from the reported information whether nerve conduction velocities were measured.

Fifteen of the 32 studies reported how long the patients had had symptoms before being treated with surgery. The reported mean durations and ranges are shown in Figure 49. On average, patients had symptoms for 10 to 24 months before treatment.

Because fewer than 40% of the studies reported information about whether their patients had any specific signs and symptoms or other characteristics, the extent to which the available data reflects the typical cubital tunnel syndrome patient cannot be determined.

Table 185. Signs and symptoms of patients treated with surgery for cubital tunnel syndrome

Study	Number of Patients	Sign or symptom	Number of patients with sign or symptom	Percent of Patients
Artico 2000 [505]	236	Pain	104	44.1
Lascar 2000 [425]	71	Pain	13	18.3
Messina 1995 [516]	30	Pain	30	100.0
Nathan 1995 [517]	164	Pain	78	47.6
Manske 1992 [519]	26	Pain	26	100.0
Rogers 1991 [522]	14	Pain	14	100.0
Goldberg 1989 [524]	46	Pain	15	32.6
Foster 1981 [529]	48	Pain	31	64.5
Chan 1980 [530]	235	Pain	102	43.4
Eaton 1980 [532]	16	Pain	14	87.5
Miller 1980 [533]	12	Pain	7	58.3
Lascar 2000 [425]	71	Tinel's sign	45	63.4
Greenwald 1999 [507]	31	Tinel's sign	24	77.4
Seradge 1998 [510]	160	Tinel's sign	160	100.0
Nouhan 1997 [512]	33	Tinel's sign	30	90.9
Nathan 1995 [517]	164	Tinel's sign	43	26.2
Rogers 1991 [522]	14	Tinel's sign	14	100.0
Goldberg 1989 [524]	46	Tinel's sign	37	80.4
Foster 1981 [529]	48	Tinel's sign	27	56.2
Chan 1980 [530]	235	Tinel's sign	48	20.4
Eaton 1980 [532]	16	Tinel's sign	11	68.8
Lascar 2000 [425]	71	Numbness	23	32.4
Steiner 1996 [515]	41	Numbness	24	58.5
Goldberg 1989 [524]	46	Numbness	30	65.2
Foster 1981 [529]	48	Numbness	41	85.4
Chan 1980 [530]	235	Numbness	113	48.0
Eaton 1980 [532]	16	Numbness	4	25.0
Miller 1980 [533]	12	Numbness	12	100
Artico 2000 [505]	236	Paresthesias	219	92.8
Greenwald 1999 [507]	31	Paresthesias	24	77.4
Steiner 1996 [515]	41	Paresthesias	14	34.1
Foster 1981 [529]	48	Paresthesias	42	87.5
Chan 1980 [530]	235	Paresthesias	200	85.1
Craven 1980 [531]	30	Paresthesias	20	66.7
Eaton 1980 [532]	16	Paresthesias	9	56.3
Artico 2000 [505]	236	Wasting of the intrinsic muscles	156	66.1
Seradge 1998 [510]	160	Wasting of the intrinsic muscles	11	6.9
Steiner 1996 [515]	41	Wasting of the intrinsic muscles	30	73.2
Nathan 1995 [517]	164	Wasting of the intrinsic muscles	5	3.0
Goldberg 1989 [524]	46	Wasting of the intrinsic muscles	15	32.6
Foster 1981 [529]	48	Wasting of the intrinsic muscles	10	20.8
Chan 1980 [530]	235	Wasting of the intrinsic muscles	200	85.1
Artico 2000 [505]	236	Weakness	156	66.1
Lascar 2000 [425]	71	Weakness	31	43.7
Steiner 1996 [515]	41	Weakness	36	87.8

Study	Number of Patients	Sign or symptom	Number of patients with sign or symptom	Percent of Patients
Nathan 1995 [517]	164	Weakness	3	1.8
Foster 1981 [529]	48	Weakness	30	62.5
Eaton 1980 [532]	16	Weakness	4	25.0
Miller 1980 [533]	12	Weakness	12	100.0
Chan 1980 [530]	235	Hypalgesia/hypesthesia	216	91.9
Miller 1980 [533]	12	Hypalgesia/hypesthesia	12	100.0
Chan 1980 [530]	235	Tenderness	95	40.4
Eaton 1980 [532]	16	Tenderness	13	81.3
Messina 1995 [516]	30	Weakness of grip	30	100
Chan 1980 [530]	235	Weakness of grip	187	79.6
Chan 1980 [530]	235	Claw hand deformity	20	8.5
Lascar 2000 [425]	71	Clumsiness	6	8.5
Foster 1981 [529]	48	Dysthesia	39	87
Eaton 1980 [532]	16	Palpable nerve subluxation	3	18.8
Eaton 1980 [532]	16	Restricted range of motion	5	31.3
Lascar 2000 [425]	71	Stiffness	7	9.9
Nathan 1995 [517]	164	Ulnar nerve subluxation	4	2.4
Craven 1980 [531]	30	Wartenberg sign	18	60.0
Chan 1980 [530]	235	Wasting and weakness of the flexor muscles	37	15.7
Chan 1980 [530]	235	Weakness of the intrinsic muscles	200	85.1

Table 186. Reporting of signs and symptoms by studies of surgery to treat cubital tunnel syndrome

Sign or symptom	Number of studies reporting
Pain	11
Tinel's sign	10
Numbness	7
Paresthesias	7
Wasting of the intrinsic muscles	7
Weakness	7
Hypalgesia/hypesthesia	2
Tenderness	2
Weakness of grip	2
Claw hand deformity	1
Clumsiness	1
Dysthesia	1
Palpable nerve subluxation	1
Restricted range of motion	1
Stiffness	1
Ulnar nerve subluxation	1
Wartenberg sign	1
Wasting and weakness of the flexor muscles	1
Weakness of the intrinsic muscles	1
Moving 2-point discrimination	0
Night symptoms	0
Paresis	0
Semmes-Weinstein monofilament testing	0
Static 2-point discrimination	0
Swelling	0
Symptoms with ADLs	0

Figure 47. Percentage of studies reporting on the proportion of patients with each sign and symptom

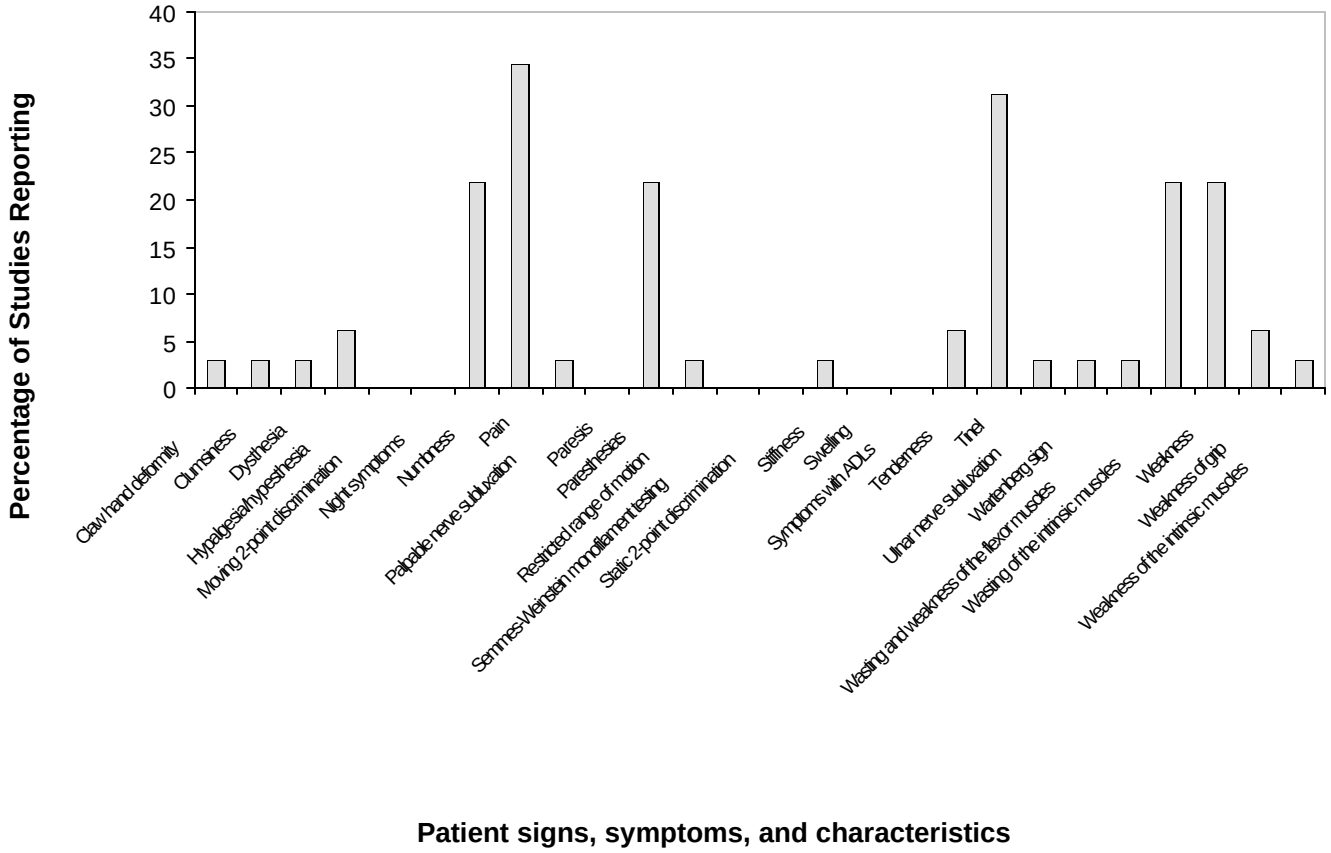


Figure 48. Mean percentage and range of percentages of patients reported to have each sign and symptom

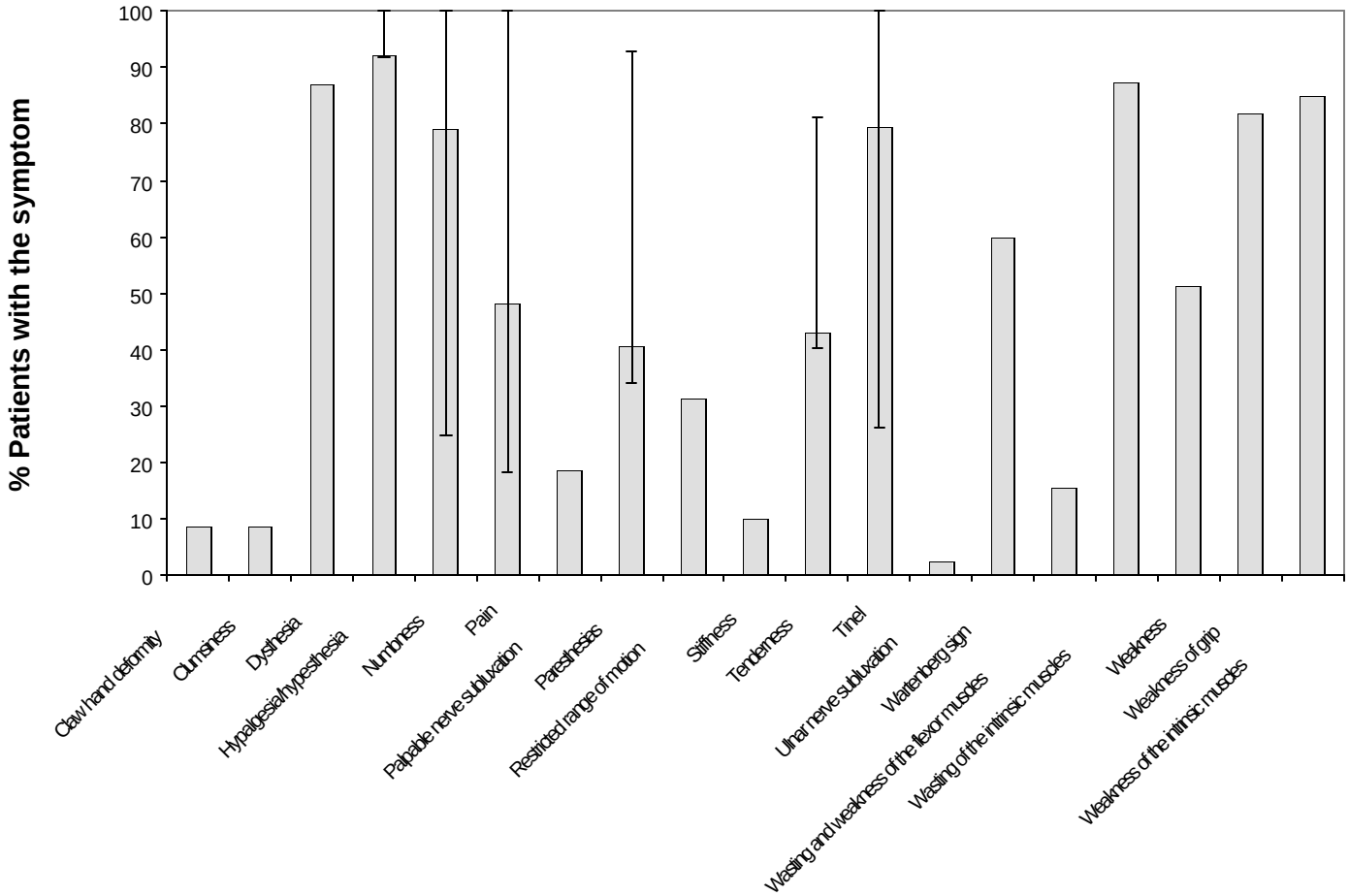
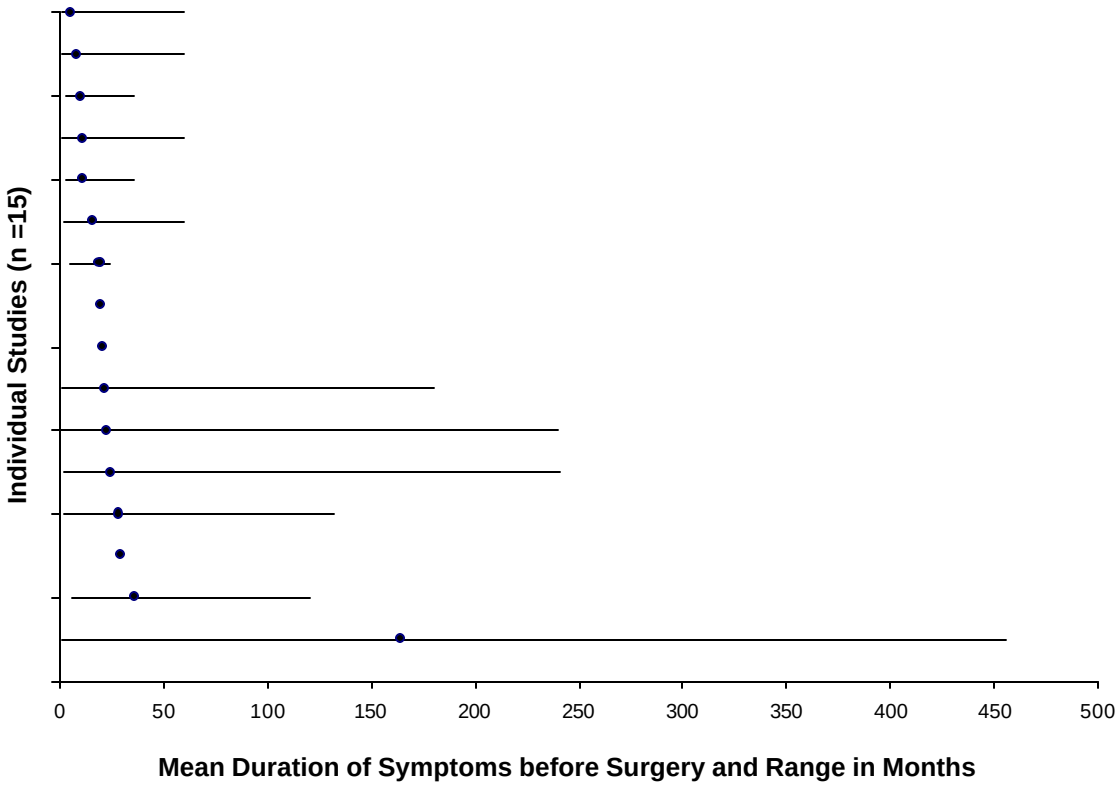


Figure 49. Mean and range of duration of symptoms before treatment



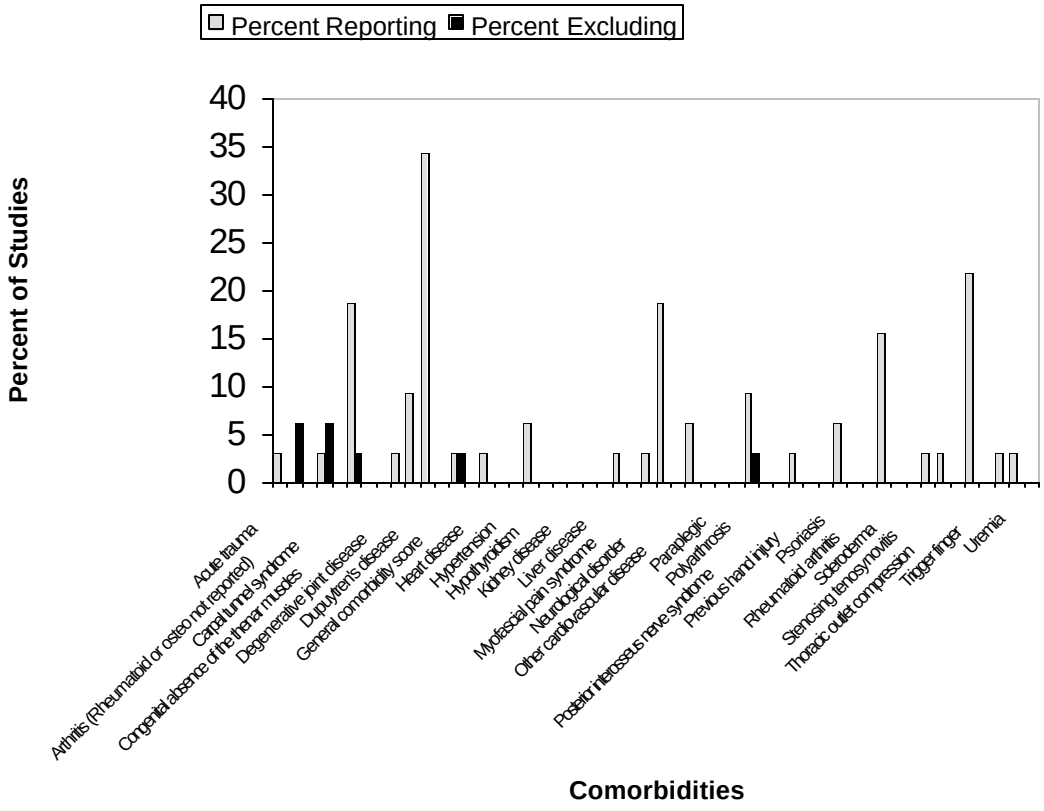
Occupations and work history

Of the 32 studies describing patients receiving surgery for cubital tunnel syndrome only one study reported the specific occupations of its patient group. Six studies reported on the percentages of patients receiving Workers' Compensation. One study reported on the percentage of patients able to work, and one study reported on the percentage of patients not able to work. Because so few studies reported data pertaining to the occupations and work history of their patient groups, it is difficult to make generalizable statements.

Comorbidities

The number of patients with comorbidities is incompletely reported in published studies of surgical treatment for cubital tunnel syndrome, as can be seen in Figure 50. The number of studies reporting the presence of a given comorbidity never exceeds 35% of the available studies. Further complicating analysis is the fact that some studies exclude patients with comorbidities. Because comorbidities are both underreported and patients with them may be excluded from clinical trials, it is difficult to reach conclusions about the presence of comorbidities among patients receiving surgery for cubital tunnel syndrome or the impact of comorbidities on whether a patient is a candidate for surgery.

Figure 50. Percentage of studies reporting and excluding comorbidities



Conclusions

Thirty-two studies of patients who received surgery for cubital tunnel syndrome were identified. Due to a lack of reported data, few trends or characteristics of patients who received surgery could be identified. The mean age of patients who received surgery for cubital tunnel syndrome was 46 years. The patients were slightly more likely to be male (62% male), and on average had symptoms 10 to 24 months before receiving surgical treatment.

Question#3. What are the relative benefits and harms of surgery for persons with cubital tunnel syndrome?

The scope of our answer to this question is determined by the scope of the published literature. The relevant literature consists of one study that compares anterior transposition to decompression surgery, one study that compares anterior transposition to epicondylectomy, and one study that compares variants of anterior transposition (see the Introduction for a description of these surgical procedures). Therefore, one can only address the relative benefits and harms of these surgical procedures. There are no published studies that compared surgery to placebo or untreated groups. Because of this, the absolute benefit of surgery cannot be determined; only the relative benefits of different types of surgery can be inferred.

Evidence base

We considered only controlled trials that evaluated treatments for patients with cubital tunnel syndrome for this section of the report. Six studies were retrieved. Three did not meet the inclusion criteria (See the Inclusion criteria section) and were excluded. These three studies and their reasons for exclusion are listed in Table 187. The remaining three studies, which included a total of 301 patients, were included in the answer to this question. The outcomes reported by these studies are listed in Table 187.

Table 187. Excluded studies

Study	Reason for exclusion
Tsai 1995 [65]	Reports on patients who are reported on elsewhere.[508]
Antoniadis 1997 [534]	Reports on only a subset of the patients entered into the trial.
Gabel 1990 [535]	Reports on only a subset of the patients entered into the trial.

Quality of the literature

Internal validity

Details of the study designs relevant to the internal validity of the trials are shown in Table 188. Two of the three trials did not randomly assign patients to treatment groups. If patients are not randomly assigned to groups, there may be important differences between these groups that could contribute to any observed differences in outcomes.

One of the three trials was prospective and one trial was retrospective. The third trial may have also been retrospective, but the study design was not explicitly described in the published article. Retrospective studies are more prone to bias than are prospective studies because the former are necessarily performed on a select group of patients.

One of the three trials used physicians blinded to the type of treatment to evaluate the patients. The other two trials did not employ any type of blinding. Lack of blinding of the patient to the type of treatment, in particular when using subjective outcome measures, can alter measurements of treatment effect because patients might unconsciously rate their condition differently in order to please the clinician.[474] However, the nature of the surgical treatments used in these trials precludes blinding of the patients so we did not consider this a study weakness. We did consider lack of blinding of the evaluating physician to be a weakness. This is because if the evaluating physician is aware of the treatment given, it is possible that he/she may unconsciously bias the patient's responses by giving leading instructions.[474]

Two of the trials did not analyze their data according to the intent-to-treat principle. Ignoring attrition when analyzing the data can create a bias in the results. Where possible, we have tried to compensate for this by attempting to gauge the maximum possible effect of not following this principle. Thus, we assumed that all patients who were not followed until the end of the study received unsuccessful treatment. This is a highly conservative assumption. However, if statistical significance is obtained under this assumption, one can be more confident that the magnitude of this design weakness is not large enough to overturn the results of a statistically significant trial. For the trial by Geutjens 1996, we were able to re-calculate the data in an intent-to-treat fashion. We were not able to do this for the trial by Chan 1980 because the data were presented in terms of numbers of arms, but the initial total number of arms was not reported, and the attrition data was in terms of numbers of patients.

Both Chan 1980 and Asami 1999 reported data in terms of the number of arms treated, not the number of patients treated. The validity of this approach cannot be determined. It violates the assumption of independence that underlie the statistical tests. This typically leads to underestimation of standard errors and spurious statistically significant results (Type I errors). For the purposes of this analysis, we have ignored the assumption of independence. In the study by Chan 1980, there were only 35 bilateral cases out of 235 cases in total (14.8%), and in the study by Asami 1998 there were only 6 bilateral cases out of 41 cases in total (14.6%). Therefore, the violation of the assumption of independence in these studies may be relatively inconsequential.

Table 188. Internal validity

Study	Number of patients	Number of centers	Funded by a for-profit agency?	Study design	Blinding	% Attrition	Intent to treat analysis	% Compliance
Asami 1998 [509]	35	1	NR	CT	No	0	Yes	NA
Geutjens 1996 [514]	52	1	No	RCT	Rater	17.3	No; corrected for	NA
Chan 1980 [530]	214	1	NR	Retro	No	6.5	No	NA

CT = controlled trial
RCT = randomized controlled trial
Retro = retrospective
NA = not applicable
NR = not reported

Generalizability

Characteristics of the patient groups enrolled in the three trials are shown in Table 189. Studies of the epidemiology of cubital tunnel syndrome, and our analysis of patients enrolled in clinical trials of surgery to treat cubital tunnel syndrome (see the answer to Question #2), have found that patients are typically in their forties and fifties, and are more likely to be male than female. The patients enrolled in these three trials fit this profile: the mean ages of the patients in all three trials were in the late fifties, with a range of 15 to 85. The patients were predominantly male. Thus, the results of the trials can be generalized to patients other than those enrolled in the trials.

None of the studies reported any information as to the employment status, work history, or occupations of the patients.

Conclusions

All three trials appear to be generalizable. The trial by Geutjens 1996 appears to be well-designed. However, the other two trials have weaknesses in design (not randomized, not blinded, retrospective) that may introduce bias into the results and weaken the conclusions drawn from the data.

Table 189. Generalizability information: patient characteristics

Study	Number of patients	Mean age and range	% female	Duration of conditon mean and range	% Patients with diabetes	% Patients with arthritis	% Patients with prevous relevant injuries	% Patients with other relevant nerve impingement conditons	% Patients with peripheral neruopathy	% Patients pregnant	% Patients on kidney dialysis	Did the study exclude patients with severe disease?	Did the study exclude patients with mild disease?
Asami 1998 [509]	35	55 (15-80)	28.5	NR	NR	NR	NR	NR	NR	NR	NR	No	No
Geutjens 1996 [514]	52	58 (36-85)	NR	NR	NR	0	NR	NR	NR	NR	NR	No	No
Chan 1980 [530]	214	54.5 (10-86)	23.4	1.6 (1-456)	2.3	10.7	NR	NR	NR	NR	NR	No	No

NR = not reported

Results

Success of Treatment

Three trials of a total of 301 patients reported on the relative success of different surgical techniques. The studies all used patient-rated categorical questionnaires to determine the success of the treatment. The reported results are shown in
Table 190.

Because no studies compared the same therapies, no meta-analysis could be performed. We calculated p-values and effect sizes (Hedges' d) for each study by collapsing the scales into dichotomous outcomes (excellent-better vs. same-worse). For the study by Asami 1999, we calculated the effect size (Hedges' d) using a method described by Torgersen.[536] For the trial by Geutjens 1996, we calculated the effect sizes and the p-value using a conservative method to account for the attrition as discussed in the section on study quality. We were unable to correct for attrition in our analysis of the data from the trial by Chan 1980 as explained in the section on study quality. The results of the studies are summarized in Table 191.

Asami 1998 found that transposition with preservation of extrinsic vessels led to statistically significantly better global outcomes than transposition without preservation of extrinsic vessels, but the calculated effect size did not reach statistical significance. This apparent discrepancy can be attributed to the fact that tests of statistical significance depend upon two factors, an effect size and the number of patients. Thus, a trial with a very small, statistically non-significant effect size can be found to be statistically significant simply by increasing the number of patients.

The success of treatment with anterior transposition as compared to the other types of surgery evaluated (decompression and medial epicondylectomy) is summarized in Figure 51 and Figure 52. Figure 51 displays the p-values of the statistical tests, while Figure 52 shows the effect sizes we calculated. The data from the study by Guetjens 1996 indicates that patients treated with epicondylectomy have statistically significantly improved outcomes compared to patients treated with anterior transposition. The difference between the two groups in the study by Chan 1980 did not reach statistical significance. The study had sufficient statistical power to have detected a relatively small difference between the groups, so it appears that this lack of a statistically significant difference is truly the result of a small or absent difference between the groups, and not due to low statistical power.

Table 190. Results of global assessment

Study	Number of patients	Global assessment patient-reported categories	Statistical significance of difference between groups
Geutjens 1996 [514]	26 medial epicondylectomy 26 anterior transposition	At 54 months Epicondylectomy - 12 excellent, 8 better, 4 same, 1 worse Transposition- 6 excellent, 6 better, 5 same, 3 worse	chi-squared test[a] p = 0.022587
Asami 1998 [509]	8 transposition without extrinsic vessels 27 transposition with extrinsic vessels	In terms of number of arms: At 70 months mean (range 12-147) Without vessels- 3 excellent, 3 better, 4 same With vessels- 16 excellent, 12 better, 3 same	chi-squared test p <0.05
Chan. 1980 [530]	101 decompression 99 anterior transposition	In terms of number of arms: At 22 months Decompression- 34 excellent, 60 better, 18 same, 3 worse Transposition- 22 excellent, 77 better, 19 same, 2 worse	chi-squared test[a] p = 0.879[b]

[a] calculated by ECRI
[b] the authors reported that an undescribed statistical test showed that the difference between the groups was statistically significant.

Table 191. Success of surgical treatment for cubital tunnel syndrome

Study	Number of patients	Time of follow-up	Which treatment was more successful?	Was the difference statistically significant?	Minimal difference between groups the study had statistical power to detect	Effect size Hedges' d (95% CI)[a]
Geutjens 1996 [514]	26 medial epicondylectomy 26 anterior transposition	54 months	Medial epicondylectomy,	Yes	NA	0.74 (0.08 to 1.40)
Asami 1998 [509]	8 transposition without extrinsic vessels 27 transposition with extrinsic vessels	70 months	Transposition with preservation of extrinsic vessels	Yes	NA	-0.66 (-1.38 to 0.07)
Chan 1980 [530]	101 decompression 99 anterior transposition	22 months	Decompression	No	9%	0.21 (-0.05 to 0.47)

a calculated by ECRI

Figure 51. Success of surgical treatment: statistical tests comparing anterior transposition to other types of surgery

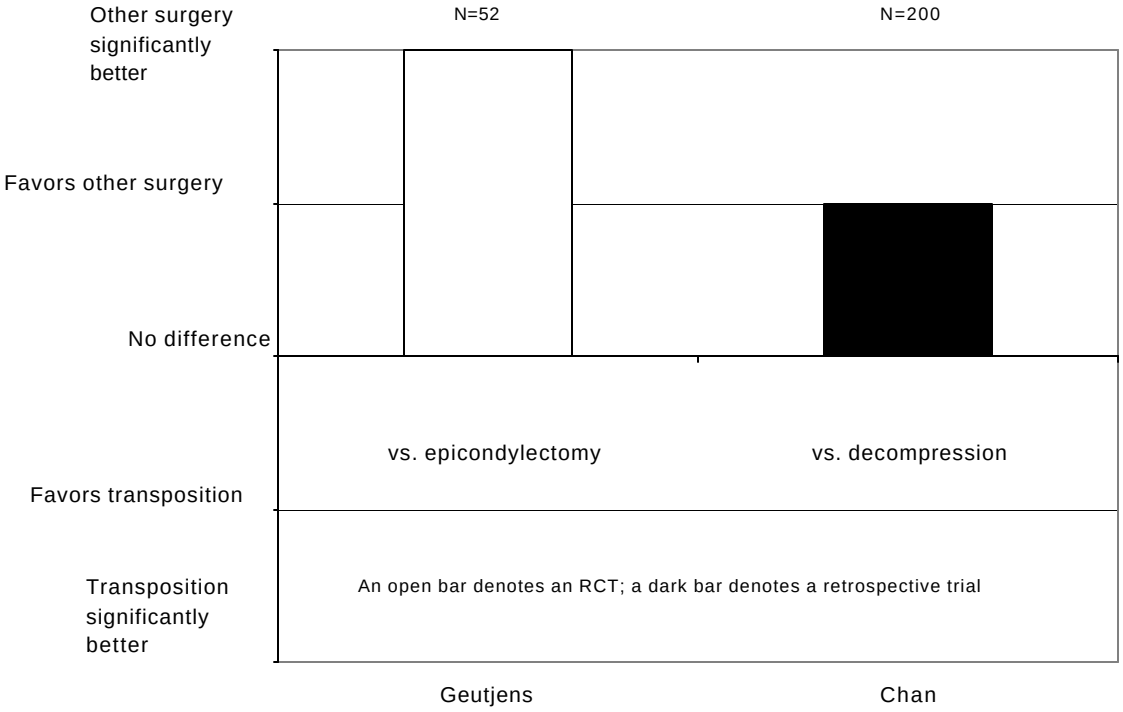
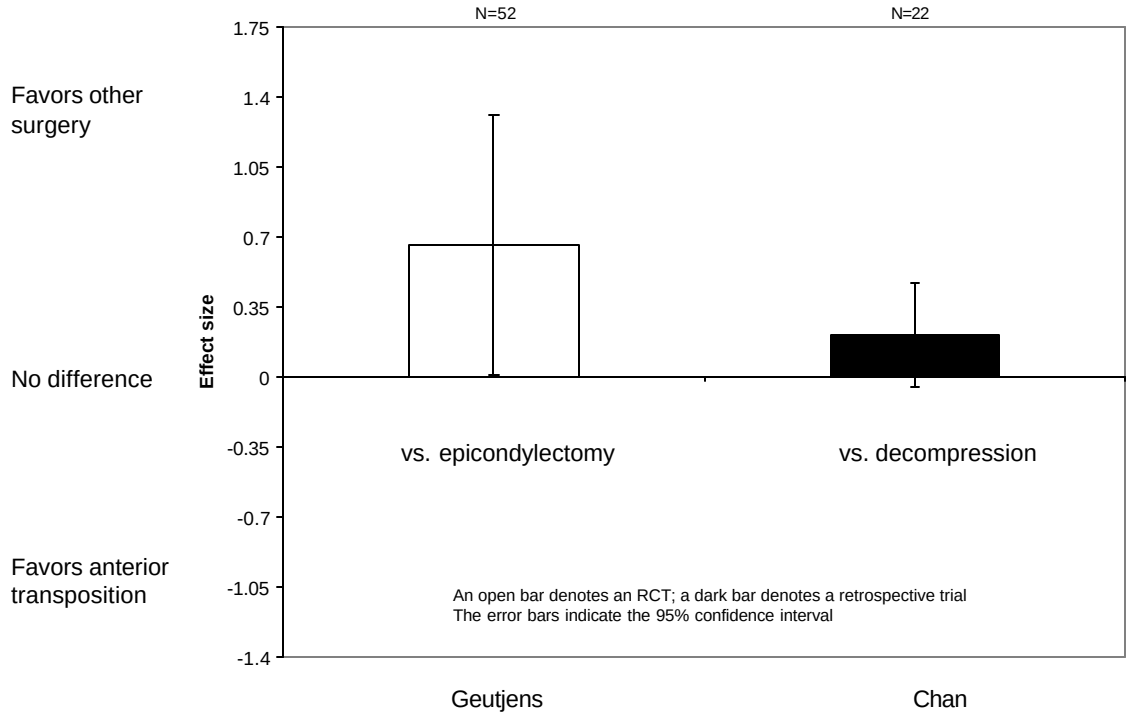


Figure 52. Success of surgical treatment: effect sizes of different types of surgery compared to anterior transposition



Work Status

None of the trials reported on this outcome.

Pain

Three trials of a total of 301 patients reported on the relative success of different surgical techniques in treating the pain of cubital tunnel syndrome. One of the studies had patients rate their pain after treatment on a five-point scale. The other two studies asked the patients whether their pain had been relieved. These two studies reported their data in terms of the number of arms, not the number of patients. The extent to which this affects the validity of the statistical analysis may be small, as was discussed in the section on Study quality. The reported data and effect sizes are summarized in Table 193. We could not compensate for attrition in either study due to the nature of the reported data. The effect of surgical treatment on pain is summarized in Table 193. The results of the statistical tests are shown graphically in Figure 53. The effect sizes we calculated are shown in Figure 54.

Transposition with preservation of the extrinsic vessels was found to relieve pain to a greater extent than without the extrinsic vessels, but the effect size of this result did not reach statistical significance. The data from the study by Geutjens 1996 indicates that patients treated with epicondylectomy had a greater relief of pain than did patients treated with anterior transposition.

The data from the study by Chan 1980 suggests that patients treated with anterior transposition had a greater relief of pain than did patients treated with decompression.

Table 192. Pain results

Study	Number of patients	Reported pain	Statistical significance of difference between groups
Geutjens 1996 [514]	26 medial epicondylectomy 26 anterior transposition	At 54 months, on a 0-5 point pain scale, epicondylectomy - Mean 0 SD 0 Transposition- Mean 0.45 SD 0.86	Test not reported P<0.05
Asami 1998 [509]	8 transposition without extrinsic vessels 27 transposition with extrinsic vessels	At 70 months mean (range 12-147) Without- 8 (80%) arms pain-free With- 29 (93.5%) arms pain free	chi-squared test P<0.05
Chan 1980 [530]	101 decompression 99 anterior transposition	At 22 months, Decompression- 28 (27.7%) arms pain free Transposition- 58 (58.6%) arms pain-free	chi-squared test p <0.000010

a calculated by ECRI

Table 193. Effect of treatments on pain

Study	Number of patients	Time of follow-up	Which treatment was more successful in relieving pain?	Was the difference statistically significant?	Effect size Hedges' d (95% CI)[a]
Geutjens 1996 [514]	26 medial epicondylectomy 26 anterior transposition	54 months	Medial epicondylectomy	Yes	0.73 (0.17 to 1.29)
Asami 1998 [509]	8 transposition without extrinsic vessels 27 transposition with extrinsic vessels	70 months	Transposition with preservation of extrinsic vessels	Yes	-0.70 (-1.86 to 0.47)
Chan 1980 [530]	101 decompression 99 anterior transposition	22 months	Anterior transposition	Yes	-0.68 (-1.00 to -0.35)

a calculated by ECRI

Figure 53. Effect of surgery on pain: statistical tests of anterior transposition vs. other types of surgery

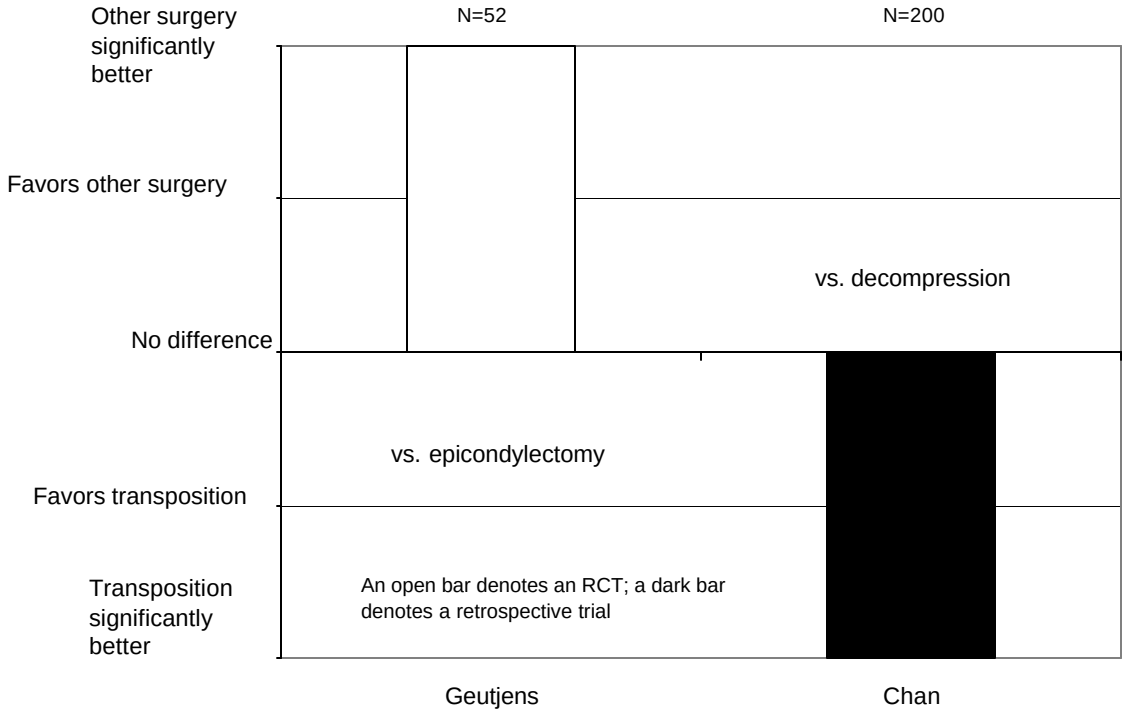
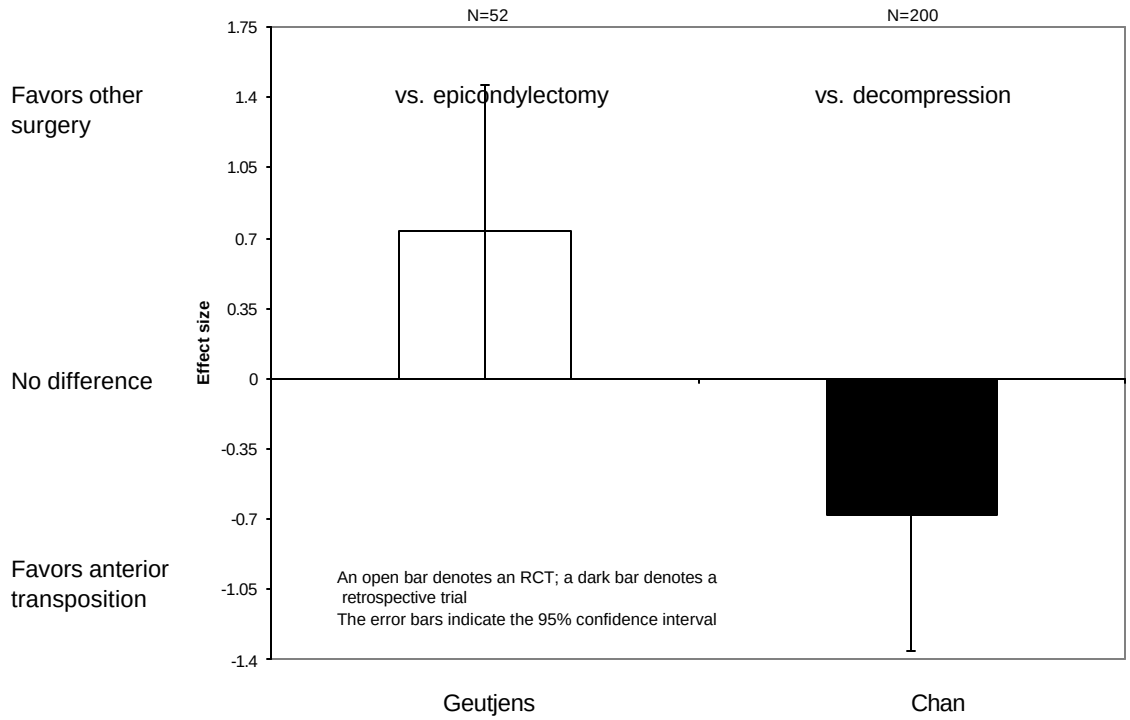


Figure 54. Effect of surgery on pain: effect sizes of anterior transposition vs. other types of surgery



Function and activities

None of the studies reported patient-oriented outcomes addressing the ability of the patient to function and resume normal activities.

Quality of life

None of the studies reported on this outcome.

Morbidity and Complications

None of the included studies reported on this outcome. However, various authors have reported complications that may occur with certain types of surgery. These complications are listed in Table 194. The frequencies with which these complications may occur cannot be determined.

Table 194. Complications reported to occur after surgery for cubital tunnel syndrome

Type of surgery	Complications reported
Decompression	Subluxation of the ulnar nerve [56]
Medial epicondylectomy	Elbow instability [63]
	Trauma and damage to ulnar nerve [66]
Anterior transposition	Compression of the ulnar nerve at a new site [64]
	Extensive scar formation [67]
	Subluxation of the ulnar nerve [64]
	Injury to the flexor carpi ulnaris motor branches [56]
	Injury to the ulnar nerve [56 537 64]
	Disruption of blood flow to the ulnar nerve [64]
	Formation of adhesions that limit elbow mobiltiy [56]

Conclusions

One randomized controlled trial of 52 patients found that medial epicondylectomy was superior to anterior transposition in relieving pain and in improving global outcome scores. Although this study had a relatively high attrition rate, our calculations suggest that this did not influence the conclusions of the study. The results of this study are suggestive, but it is problematic to arrive at a strong evidence-based conclusion from the results of only one trial. Therefore, replication of this study is desirable.

The other two trials, one comparing decompression to anterior transposition and the other comparing anterior transposition with and without preservation of extrinsic vessels, have design weaknesses that could influence interpretation of their results. Because of their design weaknesses the results of these trials cannot be considered definitive in the absence of further study.

There are insufficient data available to definitively determine the rates of surgical complications for any of the described surgical procedures.

Question #4. Is there a relationship between specific clinical findings and specific treatment outcomes among patients with cubital tunnel syndrome?

In addressing this question, we considered whether published literature suggests that there are specific clinical findings that predict positive or negative outcomes after treatment for cubital tunnel syndrome. The studies we considered all attempted to identify predictors by using regression techniques or by comparing outcomes in different groups of patients with different pre-treatment clinical findings. Correlations between patient characteristics and outcomes are considered in the answer to Question 6, and correlations between duration of symptoms and outcomes are considered in the answer to Question 5.

Excluded studies

Table 195 shows studies that were retrieved to address this question but did not meet the inclusion criteria.

Table 195. Excluded studies

Study	Reason for exclusion
Glowacki 1997 [511]	Stratified study that did not examine any correlations that were also examined by at least two other studies
Pasque 1995 [518]	Stratified study that did not examine any correlations that were also examined by at least two other studies
Friedman 1986 [527]	Stratified study that did not examine any correlations that were also examined by at least two other studies

Evidence Base

We examined eleven studies describing a total of 544 patients.

Study quality

The evaluation of the quality of the literature for this question differs from quality evaluations of studies of treatments. This is because for the question at hand the randomized controlled trial is not necessarily the most informative study design. Single-arm case series, if appropriately analyzed, can yield valid information for the purposes of addressing this question. However, the method of data analysis, not the study design, is an important consideration when considering the quality of the studies relevant to this question. We emphasize the results of studies that employ multiple regression techniques rather than stratification. We also consider whether a study was prospective or retrospective. We refer the reader to Question 4 Carpal Tunnel Syndrome for a more complete discussion of these issues.

Table 196 shows relevant quality characteristics of studies that met the inclusion criteria for this question.

Table 196. Study quality

Study	Prospective?	Methods used to identify predictor variables
Tada 1997 [513]	Yes	Multiple regression
Froimson 1991 [52] 1980 [521]	No	Stratification
Caputo 2000 [506]	Yes	Multiple regression[a]
Lascar 2000 [425]	No	Stratification
Nouhan 1997 [512]	No	Stratification
Kleinman 1989 [526]	Yes	Stratification
Tsai 1999 [508]	Yes	Stratification
Nathan 1995 [517]	No	Multiple regression
Manske 1992 [519]	Yes	Multiple regression[a]
Miller 1980 [533]	Yes	Multiple regression[a]
Foster 1981 [529]	No	Multiple regression[a]

[a] performed by ECRI

Results

The relationship of specific clinical findings to treatment outcomes in those studies that used regression to identify predictor variables are shown in Table 197. There are six such studies of a total of 278 patients. Also presented in Table 197 are all of the variables used in each multiple regression, including non-clinical outcome variables that do not address this question directly. The variables that do address this question are indicated in bold in the table.

One out of three studies found a statistically significant correlation between less severe pre-treatment symptoms and a higher score on global outcome. One of three studies of nerve conduction velocity found a statistically significant correlation between the presence of normal nerve conduction velocity before treatment and a higher score on global outcome.

We investigated these relationships further by examining the results of studies that stratified their patients according to severity of symptoms or nerve conduction velocity (see Table 198). Three of four studies of symptom severity found a statistically significant correlation between less severe symptoms and a higher score on global outcome. Neither of the studies that stratified by nerve conduction velocity found a statistically significant correlation between this variable and a higher score on global outcome.

One explanation for why some studies found a statistically significant relationship between pretreatment symptom severity and posttreatment global outcome scores and others did not is that the studies that found a statistically significant correlation tended to have more patients than did studies that did not (Figure 55). This suggests that the smaller studies lacked the statistical power to find significance[1]. Thus, it can be tentatively concluded that patients presenting with milder symptoms tend to have better outcomes after surgery, regardless of the type of surgery, than do patients presenting with more severe symptoms.

Similar considerations may explain why not all studies found a significant correlation between nerve conduction velocity and outcomes. The one study that reported a statistically significant correlation was much larger than the other studies that found no statistically significant correlation (Figure 56). It is possible that the other studies did not find a statistically significant correlation because of their small size[1]. However, because only one study found a significant relationship between nerve conduction velocity and global outcome scores, it is difficult to reach a definitive evidence-based conclusion about the relationship between the two variables.

[1] A quantitative analysis of the statistical power of each study could not be performed due to incomplete reporting of data.

Table 197. Relationship between specific clinical findings and treatment outcomes among patients with cubital tunnel syndrome (multiple regression analysis)

Study	N	Type of surgical treatment	Outcomes	Variables examined by at least two studies- is there a significant correlation with the outcome?						Unique study variables
				Age	Gender	Duration of symptoms before treatment	**Severity of symptoms**	**Nerve conduction velocity**	Etiology	
Tada 1997 [513]	40	Epicondylectomy	Global outcome (success of surgery)	NS	-	NS	**Sig.**	**-**	-	Range of motion (NS)
Caputo 2000 [506]	20	Anterior transposition	Global outcome (success of surgery)	NS	NS	NS	**NS**	**-**	Sig.	Workers' compensation (NS), **muscle atrophy (NS)**
Nathan 1995 [517]	131	Decompression	Global outcome (success of surgery)	NR	NR	NR	**NR**	**Sig.**	NR	Normal 2-point discrimination (Sig.)
Manske 1992 [519]	27	Decompression	Global outcome (success of surgery)	-	-	NS	**-**	**NS**	Sig.	
Miller 1980 [533]	12	Mixture of types	Pain relief	-	-	NS	**-**	**NS**	-	
Foster 1981 [529]	48	Mixture of types	Global outcome (success of surgery)	Sig.	NS	NS	**NS**	**-**	-	

Bolded text indicates variables that directly address the current question. NR indicates that the study did not report what variables it included in the mulltiple regression equation

Table 198. Stratified studies (success of surgical treatment)

Study	Type of surgery	N patients	Stratification variable	
			Severity of symptoms	Nerve conduction velocity
Froimson 1991 and 1980 [52 521]	Epicondylectomy	66	Sig.	-
Lascar 2000 [425]	Anterior transposition	53	Sig.	NS
Nouhan 1997 [512]	Anterior transposition	31	NS	-
Kleinman 1989 [526]	Anterior transposition	40	-	NS
Tsai 1999 [508]	Decompression	76	Sig.	-

Figure 55. Studies reporting no significant correlation between the severity of symptoms and success of treatment may be underpowered

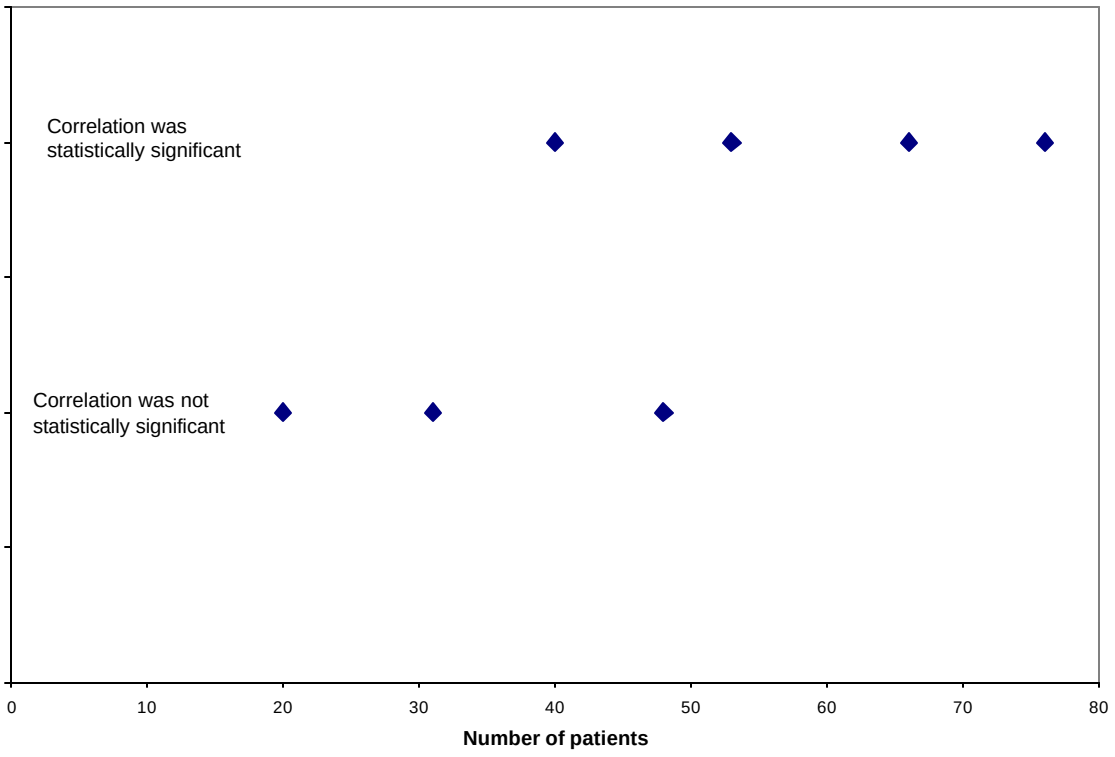
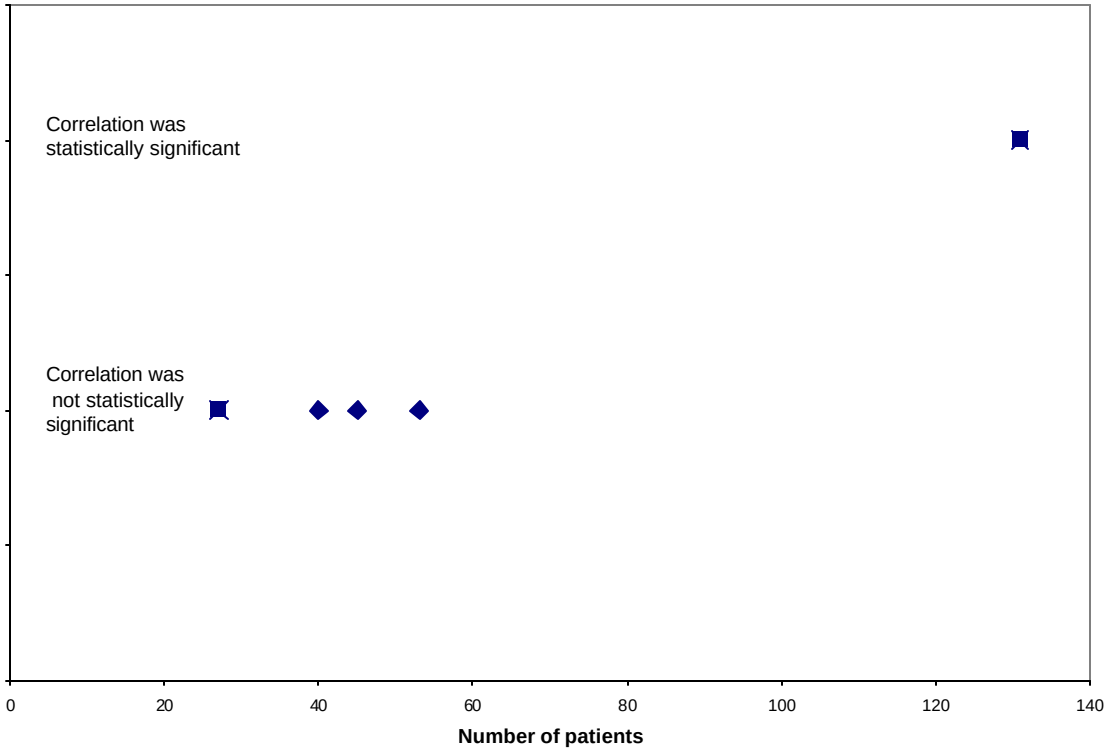


Figure 56. Studies reporting no significant correlation between nerve conduction velocity and success of treatment may be underpowered

Squares denote studies that performed multiple regressions. Diamonds denote studies that used stratification.



Conclusions

The only clinical finding variable shown by more than one study to significantly predict treatment outcomes was severity of symptoms. This correlation was statistically significant in four out of seven studies that examined it. The studies that did not find a statistically significant correlation may have been underpowered. Therefore, currently available evidence tentatively suggests that there is a correlation between having less severe symptoms and having a higher global outcome score after surgical treatment for cubital tunnel syndrome. There are insufficient data to reach evidence-based conclusions about the relationships between other clinical findings and treatment outcomes.

Question #5. Is there a relationship between duration of symptoms and specific treatment outcomes among patients with cubital tunnel syndrome?

In addressing this question, we considered whether published literature suggests that there are specific treatment outcomes that can be predicted by duration of symptoms before treatment for cubital tunnel syndrome. The studies we considered all attempted to identify predictors by using regression techniques or by comparing outcomes in different groups of patients with different pre-treatment clinical findings.

Evidence Base

We identified fourteen studies of 843 patients that addressed this question. All retrieved studies met the inclusion criteria.

Study quality

The evaluation of the quality of the literature for this question differs from quality evaluations of studies of treatments. This is because for the question at hand the randomized controlled trial is not necessarily the most informative study design. Single-arm case series, if appropriately analyzed, can yield valid information for the purposes of addressing this question. However, the method of data analysis, not the study design, is an important consideration when considering the quality of the studies relevant to this question. We emphasize the results of studies that employ multiple regression techniques rather than stratification. We also consider whether a study was prospective or retrospective. We refer the reader to Question 4 Carpal Tunnel Syndrome for a more complete discussion of these issues.

Table 199 shows relevant quality characteristics of studies that met the inclusion criteria for this question.

Table 199. Study quality

Study	Prospective?	Methods used to identify predictor variables
Seradge 1998 [510]	No	Stratification
Tada 1997 [513]	Yes	Multiple regression
Caputo 2000 [506]	Yes	Multiple regression[a]
Glowacki 1997 [511]	Yes	Stratification
Pasque 1995 [518]	No	Stratification
Barrios 1991 [520]	Yes	Stratification
Kleinman 1989 [526]	Yes	Stratification
Friedman 1986 [527]	Yes	Stratification
Manske 1992 [519]	Yes	Multiple regression[a]
Miller 1980 [533]	Yes	Multiple regression[a]
Mannerfelt 1997 [538]	Yes	Multiple regression[a]
Bimmler 1996 [539]	Yes	Stratification
Chan 1980 [530]	No	Stratification
Foster 1981 [529]	No	Multiple regression[a]

[a] performed by ECRI

Results

The relationship between patient outcomes and duration of symptoms before treatment in those studies that used regression to identify predictor variables are shown in Table 200. There are six such studies of a total of 195 patients. Also presented in Table 200 are all of the variables used in each multiple regression. None of these studies reported that there was a statistically significant correlation between the duration of symptoms before treatment and treatment outcomes.

In order to extend these data, we examined the results of the studies that stratified according to duration of symptoms (Table 201). Six out of eight of these studies found the same result, namely that there was no statistically significant correlation between duration of symptoms before treatment and global outcome score. There was no consistent relationship between the size of the study and the statistical significance of its findings. Likewise, there was no consistent relationship between whether the study was prospective and the statistically significance of its findings.

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Table 200. Relationship between duration of symptoms and treatment outcomes among patients with cubital tunnel syndrome (multiple regression analysis)

Study	N	Type of surgical treatment	Outcomes	Mean duration of symptoms (range)	Statistical significance	Other variables examined
Tada 1997 [513]	40	Epicondylectomy	Global outcome (success of surgery)	22 months (1-180 months)	NS	Age (NS), severity of symptoms (Sig), range of motion (NS)
Caputo 2000 [506]	20	Anterior transposition	Global outcome (success of surgery)	12.6 months (1-72 months)	NS	Age (NS), gender (NS), severity of symptoms (NS), etiology (Sig), workers' compensation (NS), muscle atrophy (NS)
Mannerfelt 1997 [538]	48	Mixed types	Global outcome (success of surgery)	14.6 months (2-73 months)	NS	Age (NS), Gender (NS)
Manske 1992 [519]	27	Decompression	Global outcome (success of surgery)	10.5 months (3-36 months)	NS	Nerve conduction velocity (NS), etiology (Sig)
Miller 1980 [533]	12	Mixture of types	Pain relief	19.2 months (4-48 months)	NS	Nerve conduction velocity (NS)
Foster 1981 [529]	48	Mixture of types	Global outcome (success of surgery)	23.5 months (0.3-240 months)	NS	Age (Sig), gender (NS), severity of symptoms (NS)

Table 201. Stratified studies (success of treatment)

Study	Type of surgery	N	Mean duration of symptoms (range)	Statistical significance (duration associated with better outcome)
Seradge 1998 [510]	Epicondylectomy	160	8 months (2-57 months)	NS
Glowacki 1997 [511]	Anterior transposition	45	5.5 months (0.75-72 months)	Sig (Shorter duration, ≤2.5 months)
Pasque 1995 [518]	Anterior transposition	48	25 months (2-241 months)	NS
Barrios 1991 [520]	Anterior transposition	19	14 months	Sig (Shorter duration, <12 months)
Kleinman 1989 [526]	Anterior transposition	40	Reported only for separate subgroups	NS
Friedman 1986 [527]	Anterior transposition	22	11.3 months (3-36 months)	NS
Bimmler 1996 [539]	Surgery, mixed types	79	NR	NS
Chan 1980 [530]	Surgery, mixed types	235	18.6 months (<1-456 months)	NS

Conclusions

Fourteen studies of three different types of surgical treatment reported on the relationship between duration of symptoms and outcomes. Six studies analyzed their results using multiple regression, but all did not find a statistically significant relationship between duration of symptoms and outcomes. Eight studies stratified patients according to symptom duration. Five of these latter studies, including the two largest ones, also did not find a statistically significant relationship. Consequently, currently available evidence does not suggest a clear-cut relationship between the duration of symptoms before treatment and the success of surgery. There are insufficient data available to reach evidence-based conclusions about the relationship between symptom duration and other treatment outcomes.

Question #6. Is there a relationship between patient characteristics and specific treatment outcomes among patients with cubital tunnel syndrome?

In addressing this question, we considered whether published literature suggests that there are specific clinical findings that predict positive or negative outcomes after treatment for cubital tunnel syndrome. The studies we considered all attempted to identify predictors by using regression techniques or by comparing outcomes in different groups of patients with different pre-treatment clinical findings.

Excluded studies

Table 202 shows studies that were retrieved to address this question but did not meet the inclusion criteria.

Table 202. Excluded studies

Study	Reason for exclusion
Nathan 1995 [517]	Stratified study with no patient characteristics-outcome comparisions reported by at least three studies
Miller 1980 [533]	Stratified study with no patient characteristics-outcome comparisions reported by at least three studies

Evidence Base

Subsequent to these exclusions, we examined fifteen studies of 942 patients that addressed this question.

Study quality

The evaluation of the quality of the literature for this question differs from quality evaluations of studies of treatments. This is because for the question at hand the randomized controlled trial is not necessarily the most informative study design. Single-arm case series, if appropriately analyzed, can yield valid information for the purposes of addressing this question. However, the method of data analysis, not the study design, is an important consideration when considering the quality of the studies relevant to this question. We emphasize the results of studies that employ multiple regression techniques rather than stratification. We also consider whether a study was prospective or retrospective. We refer the reader to Question 4 Carpal Tunnel Syndrome for a more complete discussion of these issues.

Table 203 shows relevant quality characteristics of studies that met the inclusion criteria for this question.

Table 203. Study quality

Study	Prospective?	Methods used to identify predictor variables
Seradge 1998 [510]	No	Stratification
Tada 1997 [513]	Yes	Multiple regression
Goldberg 1989 [524]	No	Stratification
Caputo 2000 [506]	Yes	Multiple regression[a]
Lascar 2000 [425]	No	Stratification
Glowacki 1997 [511]	Yes	Stratification
Nouhan 1997 [512]	No	Stratification
Pasque 1995 [518]	No	Stratification
Kleinman 1989 [526]	Yes	Stratification
Friedman 1986 [527]	Yes	Stratification
Manske 1992 [519]	Yes	Multiple regression[a]
Mannerfelt 1997 [538]	Yes	Multiple regression[a]
Bimmler 1996 [539]	Yes	Stratification
Chan 1980 [530]	No	Stratification
Foster 1981 [529]	No	Multiple regression[a]

[a] performed by ECRI

Results

The relationship of specific patient characteristics to treatment outcomes in those studies that used regression to identify predictor variables are shown in Table 204. There are five such studies of a total of 183 patients. Also presented in Table 204 are all of the variables used in each multiple regression.

One out of four studies of age found a statistically significant correlation between age and patient outcomes. This study (Foster 1981) was the only retrospective multiple regression study. None of the three studies that examined the relationship between gender and patient outcomes found a statistically significant correlation. Both studies that looked for a relationship between traumatic causes of cubital tunnel syndrome and higher scores on global outcomes after treatment found a statistically significant relationship. One study reported that there was no statistically significant relationship between workers' compensation status and patient outcomes.

We further investigated these possible relationships further by examining the results of studies that stratified their patients according to patient characteristics (see Table 205). Six out of nine studies of age found no statistically significant relationship between this variable and patient outcomes. In these studies, there was no apparent relationship between study size or whether the study was prospective and whether it obtained statistical significance. None of the three studies that looked at the relationship between sex and global outcomes found a statistically significant correlation. Four out of five studies that looked for a relationship between workers' compensation status and patient outcomes found no statistically significant correlation. Three out of three studies reported no statistically significant relationship between etiology and patient outcomes.

Table 204. Relationship between patient characteristics and treatment outcomes among patients with cubital tunnel syndrome (multiple regression analysis)

Study	N	Type of surgical treatment	Outcomes	Variables examined by at least two studies – is there a significant correlation with the outcome?						Unique study variables
				Age	**Gender**	Duration of symptoms before treatment	Severity of symptoms	Nerve conduction velocity	**Etiology**	
Tada 1997 [513]	40	Epicondylectomy	Global outcome (success of surgery)	**NS**	**-**	NS	Sig.	-	**-**	Range of motion (NS)
Caputo 2000 [506]	20	Anterior transposition	Global outcome (success of surgery)	**NS**	**NS**	NS	NS	-	**Sig.**	**Workers' compensation (NS)**, muscle atrophy (NS)
Mannerfelt 1997 [538]	48	Mixed types	Global outcome (success of surgery)	**NS**	**NS**	NS	-	-	**-**	
Manske 1992 [519]	27	Decompression	Global outcome (success of surgery)	**-**	**-**	NS	-	NS	**Sig.**	
Foster 1981 [529]	48	Mixture of types	Global outcome (success of surgery)	**Sig.**	**NS**	NS	NS	-	**-**	

Bolded text indicates variables that address the curent question

Table 205. Relationship between patient characteristics and success of surgical treatment of cubital tunnel syndrome-stratified studies

Study	Treatment	N patients	Age	Sex	Workers' compensation	Etiology
Seradge 1998 [510]	Epicondylectomy	160	<41 and >50	-	-	-
Goldberg 1989 [524]	Epicondylectomy	46	NS	NS	NS	NS
Lascar 2000 [425]	Anterior transposition	53	Younger	-	-	-
Glowacki 1997 [511]	Anterior transposition	45	Younger	-	NS	-
Nouhan 1997 [512]	Anterior transposition	31	-	-	NS	-
Pasque 1995 [518]	Anterior transposition	48	NS	NS	NS	NS
Kleinman 1989 [526]	Anterior transposition	40	NS	-	Not on workers' compensation	-
Friedman 1986 [527]	Anterior transposition	22	NS	-	-	NS
Bimmler 1996 [539]	Surgery, mixed types	79	NS	-	-	-
Chan 1980 [530]	Surgery, mixed types	235	NS	NS	-	-

Conclusions

Seventeen studies were identified that addressed the relationship between various patient characteristics and specific treatment outcomes. The available data do not suggest a substantial correlation between the age, sex, or workers' compensation status of the patient and the success of surgery. Two studies that used multiple regression found that patients whose cubital tunnel syndrome is caused by an acute trauma have better global outcomes after surgical treatment than patients with cubital tunnel syndrome from other causes. However, three studies that stratified by etiology found no statistically significant relationship between cause and patient outcomes. The studies that used multiple regression techniques are of better quality than the stratified studies; thus, current data suggest that there may be a correlation between etiology and patient outcomes, but this cannot be regarded as definitive.

Question #7: What are the surgical and nonsurgical costs or charges for treatment of cubital tunnel syndrome?

According to Medicare Provider Analysis and Review (MEDPAR), average total charges per patient for the DRG (diagnosis-related group) of major shoulder/elbow procedures with comorbidities or complications are $9,008.94 (calculated by dividing total charges by number of discharges). For the DRG shoulder, elbow or forearm procedures, except major joint procedures, without comorbidities or complications, average total charges per patient are $7729.16. For the DRG peripheral and cranial nerve and other nerve procedures without complications or comorbidities, the average total per patient charges are $14,357.65 (with complications or comorbidities the charges are $24,288). These DRGs may include procedures that are used to treat disorders other than cubital tunnel syndrome. The Median Costs for Hospital Outpatient Services Dataset contains median costs for services that are reimbursed under Medicare for the hospital outpatient prospective payment system. The reported median cost for a decompression fasciotomy of the forearm and/or wrist is $603.85. The reported median cost for application of a long-arm splint is $80.48.

Question #8. For persons who have had surgery to treat cubital tunnel syndrome, what are the appropriate methods for preventing the recurrence of symptoms, and how does this vary depending on subject characteristics or other underlying health problems?

No studies were identified that addressed this question.

Question #9: What instruments, if any, can accurately assess functional limitations in an individual with cubital tunnel syndrome?

No trials were identified that evaluated instruments to assess functional limitations in patients with cubital tunnel syndrome.

Question #10: What are the functional limitations for an individual with cubital tunnel syndrome before treatment?

There were no studies that addressed this question.

Question #11: What are the functional limitations of an individual with cubital tunnel syndrome after treatment?

There were no studies that addressed this question.