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

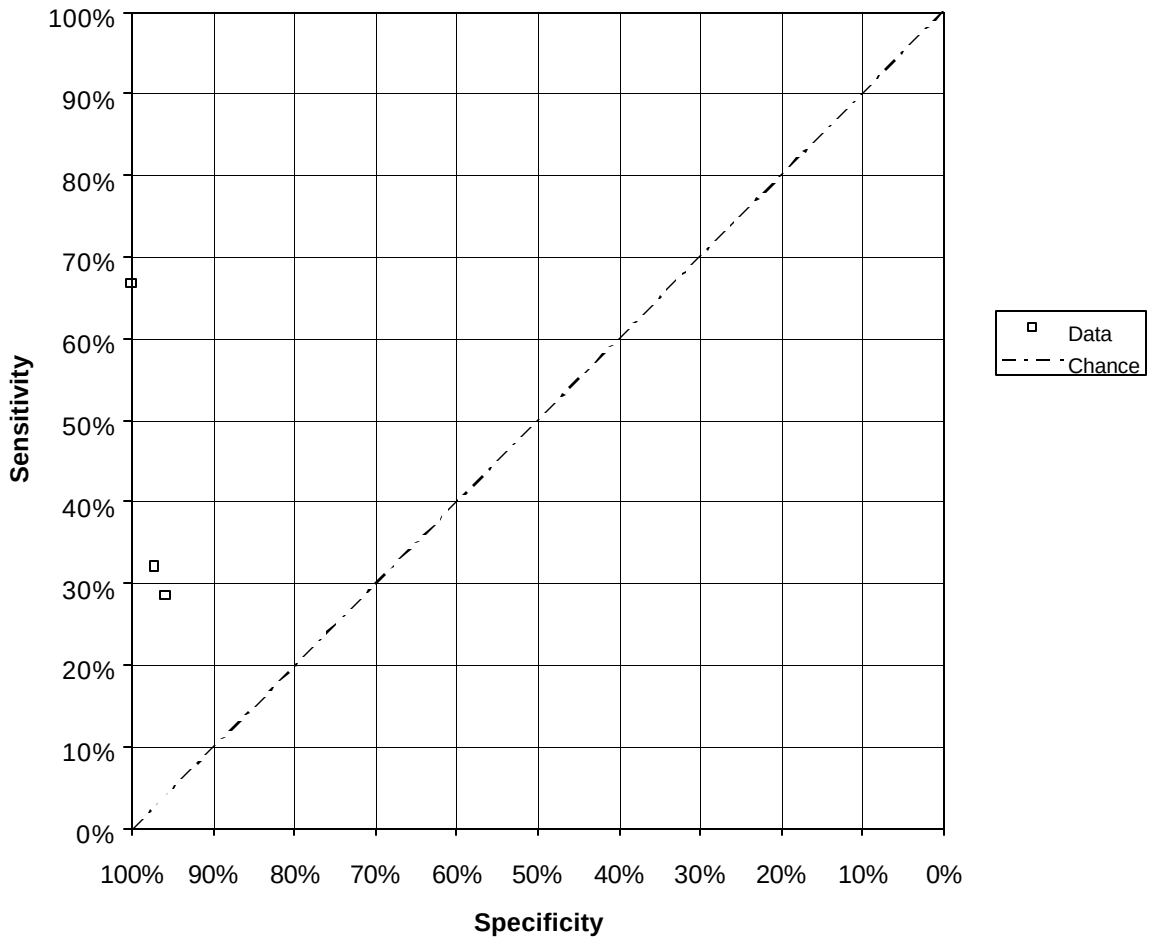

Table 180. Cubital Tunnel Syndrome–Test Types Reported

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.

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

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

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.

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

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

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

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.

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.	-

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.

actually reported RWE findings (Table 214). However, it was not possible to determine both sensitivity and specificity of the RWE test for any of these four studies. Two studies[541,542] required positive RWE findings in all patients included in the study, thus they cannot be used to assess the effectiveness of the RWE test because of selection bias. Friedman et al. did not report RWE findings in their control group, so specificity could not be determined. Wright et al. [72] had no control group, so specificity could not be determined.

Thus there were no articles in the evidence base we examined that reported sensitivity and specificity of the RWE test.

Conclusions

For diagnosis of epicondylitis, the evidence base is small and heterogeneous. None of the relevant studies are sufficiently large or well-designed to permit one to draw a strong evidence-based conclusion from them on any individual test for epicondylitis.

Table 206. Excluded Articles

Article	Reason for Exclusion
Pfaler, 1999 [543]	All patients previously treated
Pienimaki, 1998 [544]	All patients previously treated
De Smet, 1997 [545]	All patients previously treated
Pienimaki, 1997 [546]	All patients previously treated
Pienimaki, 1997 [547]	All patients previously treated
Potter, 1995 [548]	All patients previously treated

Table 207. Study Characteristics Relating to Internal Validity

Article	Funded by for-profit institution?	Inclusion criteria reported?	Exclusion criteria reported	Method of diagnosis reported	Patient selection	Comorbidity reported	Sex reported	Possible sex bias	Ages reported	Possible age bias	Duration of condition reported	Test operator blinded	Test reader blinded	Multiple readers	Method for multiple readers	Independent reference standard	Were patients given both test and reference
Benjamin, 1999 [549]	NR	Yes	Yes	Yes	Prospective	No	Yes	NC	Yes	NC	No	No	No	NR	NR	No	No
Bredella, 1999 [74]	NR	Yes	NR	Yes	Prospective	No	Yes	NC	Yes	NC	No	No	No	3	NR	No	No
Steinborn, 1999 [71]	NR	Yes	Yes	Yes	Retrospective	No	Yes	No	Yes	P	Yes	No	No	2	NR	No	No
Bauer, 1998 [550]	NR	Yes	NR	Yes	NR	No	Yes	No	Yes	No	No	No	No	NR	NR	No	No
Friedman, 1998 [73]	No	Yes	Yes	Yes	NR	Yes	Yes	No	Yes	No	Yes	Yes	No	NR	NR	No	No
Martin, 1998 [540]	NR	Yes	NR	Yes	Prospective	No	NR	GNR	Yes	P	Yes	No	Yes	2	Indep	No	No
Smith, 1994 [541]	NR	Yes	Yes	Yes	NR	No	Yes	NC	Yes	NC	Yes	No	Yes	3	Indep	No	No
Wright, 1992 [72]	NR	Yes	Yes	Yes	Prospective	Yes	Yes	NC	Yes	NC	No	Yes	No	NR	NR	No	No
Hyland, 1990 [551]	NR	Yes	Yes	Yes	Prospective	No	Yes	NC	NR	NC	Yes	No	Yes	2	Indep	No	No
Binder, 1984 [542]	NR	Yes	Yes	Yes	NR	Yes	Yes	GNR	Yes	ANR	Yes	No	No	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 208. Study Characteristics Relating to Generalizability of Results

Article	Years in which trial was conducted	Number of centers	Country(s) where trial was conducted	Inclusion criteria reported	Exclusion criteria reported	Are patient comorbidity reported?	Sex reported	Age reported	Duration of condition reported	Did all patients have previous conser-vative treatment?	Did any patients have previous surgical treatment?	Source of patients adequately described and generalizable to broader clinical practice?	Potential selection bias for easy cases?	Potential selection bias for difficult cases?
Benjamin, 1999 [549]	NR	Single	USA	Yes	Yes	No	Yes	Yes	No	No	No	No	Yes	No
Bredella, 1999 [74]	NR	Multiple (<5)	USA	Yes	NR	No	Yes	Yes	No	No	No	No	No	No
Steinborn, 1999 [71]	NR	Single	Germany	Yes	Yes	No	Yes	Yes	Yes	No	No	No	Yes	No
Bauer, 1998 [550]	NR	Single	USA	Yes	NR	No	Yes	Yes	No	No	No	No	Yes	No
Friedman, 1998 [73]	NR	Single	New Zealand	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	Yes	No
Martin, 1998 [540]	NR	Single	USA	Yes	NR	No	NR	Yes	Yes	No	No	No	Yes	No
Smith, 1994 [541]	NR	Single	United Kingdom	Yes	Yes	No	Yes	Yes	Yes	No	No	No	No	No
Wright, 1992 [72]	NR	Single	Australia	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Yes	No
Hyland, 1990 [551]	NR	Multiple (>5)	Australia	Yes	Yes	No	Yes	NR	Yes	No	No	No	No	No
Binder, 1984 [542]	NR	Single	United Kingdom	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	No	No

Key:
NR—not reported

Table 209. Quality of Reporting and Internal Validity of Results

Study characteristic	N studies reporting	Details
Whether trial was funded by a for-profit institution	1 (10%)	No for-profit funding: 1 (10%)
Patient inclusion criteria	10 (100%)	See Table 218
Patient exclusion criteria	7 (70%)	See Table 218
Method of diagnosis	10 (100%)	Clinical: 9 (90%) Non-clinical: 1 (10%)
Was selection of patients prospective or retrospective?	6 (60%)	Prospective: 5 (50%) Retrospective: 1 (10%)
Were patient comorbidities reported?	3 (30%)	Various
Was the sex distribution of patients reported?	9 (90%)	a–Percentage female: 55.5%
Was the percentage of females in the patient group within 20 percentage points of the control group?	3 (30%)	Yes: 3 (30%)
Were patient ages reported?	9 (90%)	a–Mean age: 42.3 years
Was the mean patient age within 5 years of the mean control age?	4 (40%)	Yes: 2 (20%) No, patients were = 5 years older: 2 (20%)
Was the duration of patients' condition reported?	6 (60%)	a–Mean duration: 14.6 months
Was the test operator blinded?	2 (20%)	Yes: 2 (20%)
Was the test reader blinded?	3 (30%)	Yes: 3 (30%)
Were there multiple test readers?	5 (50%)	2 readers: 3 (30%) 3 readers: 2 (20%)
What was the method for multiple test readers?	3 (30%)	Independent: 3 (30%)
Was the test compared to an independent reference standard?	0 (0%)	NA
Were all patients given the study test and the reference standard?	0 (0%)	NA

Key:
NA-not applicable
a–Calculated on a per-patient basis (i.e., weighted by number of patients in each study reporting this characteristic)

Table 210. Quality of Reporting and Generalizability of Results

Study characteristic	N studies reporting	Details
Years in which study was conducted	0 (0%)	NA
Number of centers in which trial was conducted	10 (100%)	Single: 8 (80%) Multiple (<5): 1 (10%) Multiple (>5): 1 (10%)
Country(s) were trial was performed	10 (100%)	USA: 4 (40%) Other: 6 (60%)
Patient inclusion criteria	10 (100%)	See Table 218
Patient exclusion criteria	7 (70%)	See Table 218
Were patient comorbidities reported?	3 (30%)	Various
Was the sex distribution of patients reported?	9 (90%)	a–Percentage female: 55.5%
Were patient ages reported?	9 (90%)	a–Mean age: 42.3 years
Was the duration of patients' condition reported?	6 (60%)	a–Mean duration: 14.6 months
Did all patients have previous conservative treatment?	10 (100%)	No: 10 (100%)
Did any patients have previous surgical treatment?	10 (100%)	No: 10 (100%)
Adequate reporting of study's source of patients	0 (0%)	NA
Was there a potential selection bias for easy cases?	6 (60%)	Yes: 6 (60%)
Was there a potential selection bias for hard cases?	0 (0%)	NA

Key:
NA-not applicable
a–Calculated on a per-patient basis (i.e., weighted by number of patients in each study reporting this characteristic)

Table 211. Patient and Control Group Selection in Epicondylitis Diagnosis

Type of controls	Patient selection (number of articles)		
	Symptoms/ presented	Unspecified diagnosis	Total
0	4		4
0	1		1
1	2		3
2	0		2
3	7		10

Table 212. Epicondylitis Tests and Patient Groups

Legend:

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

Tests Reported	Patient selection	
	Symptoms/presented	Unspecified diagnosis
Nerve Conduction	0, 0	0, 0
Composite Nerve Conduction	0, 0	0, 0
Imaging	1, 0	2, 2
Sensory	1, 0	0, 0
Signs/Symptoms	2, 0	3, 1
Other	0, 0	3, 2

See **Table 3** for the definition of these groups

Table 213. Reported Clinical Inclusion Criteria in Studies of Lateral Epicondylitis

Article	Signs and symptoms used in diagnosis								
	RWE	RS	GR	RFE	WT	SE	MW	EA	Other
Benjamin, 1999 [549]									Clinical diagnosis
Bredella, 1999 [74]									MRI signal intensity
Steinborn, 1999 [71]	✓	✓			✓		✓		
Bauer, 1998 [550]									Clinical diagnosis
Friedman, 1998 [73]	✓	✓		✓					
Martin, 1998 [540]									Clinical diagnosis
Smith, 1994 [541]	✓								
Wright, 1992 [72]	✓		✓	✓		✓			
Hyland, 1990 [551]	✓		✓			✓		✓	
Binder, 1984 [542]	✓	✓	✓		✓				
Totals	6	3	3	2	2	2	1	1	4

Key:
RWE-pain or tenderness upon resisted wrist extension
RS-pain or tenderness upon resisted supination of forearm (also called Mill's test)
GR-grip strength
RFE-pain or tenderness upon resisted extension of middle finger
WT- weights test
SE-stretching of extensors
MW-muscle weakness
EA-pain or tenderness with extension adduction test

Table 214. Resisted Wrist Extension for the Diagnosis of Lateral Epicondylitis

Article	N	Was positive RWE a criterion for inclusion of patients in the study?	How many patients had pain or tenderness upon RWE?	Could sensitivity and specificity be derived from the published results?
Steinborn, 1999 [71]	23	No	NR	No
Friedman, 1998 [73]	17	No	4 (24%)	No
Smith, 1994 [541]	40	Yes	40 (100%)	No
Wright, 1992 [72]	17	No	16 (94%)	No
Hyland, 1990 [551]	25	No	NR	No
Binder, 1983 [542]	50	Yes	50 (100%)	No

RWE-Resisted wrist extension
NR-Not reported

Table 215. Epicondylitis–Study Design

Article	N centers	Epicon. groups	Epicon. patients	Negative groups	Negative subjects	Was the design prospective or retrospective?	What was the level of reporting?	Could sensitivity and specificity be determined?
Benjamin, 1999 [549]	Single	1	10	0	0	Prospective	Summary	No: only summary statistics reported
Bredella, 1999 [74]	Multiple (<5)	1	35	0	0	Prospective	Counts	No control group
Steinborn, 1999 [71]	Single	1	23	1	7	Retrospective	Counts	Reported by authors
Bauer, 1998 [550]	Single	1	10	1	7	NR	Summary	No: only summary statistics reported
Friedman, 1998 [73]	Single	1	17	1	7	NR	Summary	No: only summary statistics reported
Martin, 1998 [540]	Single	1	24	1	16	Prospective	Counts	Calculated by ECRI
Smith, 1994 [541]	Single	1	40	0	0	NR	Counts	Calculated by ECRI
Wright, 1992 [72]	Single	1	17	0	0	Prospective	Summary	No: only summary statistics reported
Hyland, 1990 [551]	Multiple (>5)	1	25	0	0	Prospective	Counts	No control group
Binder, 1984 [542]	Single	1	50	1	60	NR	Counts	Calculated by ECRI

Table 216. Epicondylitis–Tests Reported

Article	Signs/ Symptoms	Sensory Tests	Nerve Conduction	Composite Nerve Cond.	Imaging	Other
Benjamin, 1999 [549]	☑	☐	☐	☐	☐	☐
Bredella, 1999 [74]	☐	☐	☐	☐	☑	☐
Steinborn, 1999 [71]	☐	☐	☐	☐	☑	☐
Bauer, 1998 [550]	☐	☐	☐	☐	☐	☑
Friedman, 1998 [73]	☑	☐	☐	☐	☐	☐
Martin, 1998 [540]	☐	☐	☐	☐	☑	☐
Smith, 1994 [541]	☐	☐	☐	☐	☐	☑
Wright, 1992 [72]	☑	☑	☐	☐	☐	☐
Hyland, 1990 [551]	☑	☐	☐	☐	☐	☐
Binder, 1984 [542]	☑	☐	☐	☐	☐	☑

Table 217. Epicondylitis–Patient Groups

Article	Disorder type	Patient selection	Number of patients for which results are reported	Percent female	Mean age	Age of youngest	Age of oldest	Duration of condition be-fore treatment (months)	Shortest duration	Longest duration	Are patient comorbidities reported?
Benjamin, 1999 [549]	Epicondylitis	Unspecified diagnosis	10	30	42						No
Bredella, 1999 [74]	Epicondylitis	Symptoms/ presented	35	51	45	22	63		3	36	No
Steinborn, 1999 [71]	Normal	Healthy volunteers	7	71	25	22	29				No
Steinborn, 1999 [71]	Epicondylitis	Unspecified diagnosis	23	65	47	29	58	17.1	1	84	No
Bauer, 1998 [550]	Normal	Healthy volunteers	7	0	38.8						No
Bauer, 1998 [550]	Epicondylitis	Unspecified diagnosis	10	0	40.8						No
Friedman, 1998 [73]	Normal	Healthy volunteers	7	100	34.6						Yes
Friedman, 1998 [73]	Epicondylitis	Unspecified diagnosis	17	100	38.9			26			Yes
Martin, 1998 [540]	Normal	Healthy volunteers	16	NR	31	22	46				No
Martin, 1998 [540]	Epicondylitis	Unspecified diagnosis	24	NR	38	29	62	5.5	1	24	No
Smith, 1994 [541]	Epicondylitis	Unspecified diagnosis	40	55	40			23			No
Wright, 1992 [72]	Epicondylitis	Symptoms/ presented	17	65	44.7	36	54		2	120	Yes
Hyland, 1990 [551]	Epicondylitis	Symptoms/ presented	25	24				21.9	2	156	No
Binder, 1984 [542]	Normal	Healthy volunteers	60	NR							Yes
Binder, 1984 [542]	Epicondylitis	Unspecified diagnosis	50	68	43			4.5	1	12	Yes

Table 218. Epicondylitis–Reported Inclusion and Exclusion Criteria

Article	Reported Patient Inclusion Criteria	Reported Patient Exclusion Criteria
Benjamin, 1999 [549]	Clinical diagnosis of lateral epicondylitis.	Prior elbow surgery, bilateral symptoms
Bredella, 1999 [74]	Patients referred for MRI imaging of the elbow to rule out lateral epicondylitis. All had symptoms. None had corticosteroid injection in the 3 months prior to MRI.	None reported
Steinborn, 1999 [71]	Clinical diagnosis of lateral epicondylitis, based on clinical findings and history including muscle weakness, pain localized to the lateral epicondyle,and aggravation of pain by weight-bearing and resisted supination and wrist extension.	Steroid injections in the 2 months before MRI.
Bauer, 1998 [550]	Clinical diagnosis of tennis elbow.	None reported
Friedman, 1998 [73]	Patients who had been assessed or treated at a rehabilitation clinic. Inclusion criteria were clinical features such as 1) tenderness at the lateral eipcondyle; 2) pain in the elbow or lateral forearm on resisted wrist extension; 3) pain in the elbow or lateral forearm on resisted finger extension; 4) pain in the elbow or lateral forearm on resisted wrist supination.	Bilateral symptoms, history of fibromyalgia or other disability involving upper extremity.
Martin, 1998 [540]	Diagnosis of either lateral or medial epicondylitis based on history and physical exam.	None reported
Smith, 1994 [541]	Patients with unilateral epicondylitis recruited from rheumatology outpatient clinics. Localized pain and lateral epicondylar tenderness, increased pain on wrist extension.	Bilateral symptoms, cervical spine symptoms.
Wright, 1992 [72]	Patients reported lateral elbow pain of at least 6 weeks duration, and if they experienced pain during two or more of the following five tests: 1) Palpation of the lateral epicondyle; 2) Resisted wrist extension; 3) Passive stretching of the extensor muscle group; 4) Pain on gripping a hand dynamometer; 5) Pain on resisted extension of the middle finger.	Bilateral symptoms, neurological impairment, serious injury or fracture to the upper limbs, cervical or thoracic spine, history of any arthritic condition.
Hyland, 1990 [551]	Lateral elbow pain. Non-irritable symptomatic elbows in which pain provoked by activity or examination was quickly relieved with a short period of rest. Positive extension-adduction test with the forearm in supination position, and at least one of the following: pain upon resisted wrist extension, or pain upon passive stretch of the forearm extensors.	Pain of cervical origin or contribution.
Binder, 1984 [542]	Localized tenderness near the lateral epicondyle and pain on resisted wrist dorsiflexion.	Localized or generalized arthritis, abnormal ESR (undefined), positive Rose-Waaler, or neuro-logical symptoms or signs in the affected limb.

Table 219. Age and sex of patients receiving surgery for epicondylitis

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
Grundberg 2000 [552]	34	17	17	50.0	Mean	43	27	64
Almquist 1998 [83]	61	37	24	39.3	Mean	43.3	27	63
Bankes 1998 [553]	24	11	13	54.2	Mean	45.3	32	54
Organ 1997 [554]	34	16	18	52.9	Mean	40	28	70
Wilhelm 1996 [84]	166	70	96	57.8	Mean	44.5	21	62
Gabel 1995 [555]	26	18	8	30.8	Mean	43	17	64
Kurvers 1995 [556]	40	28	12	30.0	Mean	42	22	56
Ollivierre 1995 [557]	48	38	10	20.8	Mean	42	16	66
Newey 1994 [558]	28	13	15	53.6	Mean	44.8	NR	NR
Verhaar 1993 [559]	63	42	21	33.3	Mean	45	25	67
Wittenberg 1992 [560]	86	60	26	30.2	Mean	47.5	25	67
Vangsness 1991 [561]	38	35	3	7.9	Mean	43	21	65
Tan 1989 [562]	25	8	17	68.0	NR	NR	NR	NR
Goldberg 1988 [563]	30	8	22	73.3	NR	NR	NR	NR
Chotigavanich 1986 [564]	50	12	38	76.0	NR	NR	NR	NR
Calvert 1985 [565]	37	21	16	43.2	Mean	43.7	NR	NR
Baumgard 1982 [566]	34	22	12	35.3	Mean	48	30	67
O'Neil 1980 [567]	50	27	23	46.0	NR	NR	NR	NR
Rosen 1980 [568]	50	38	12	24.0	Mean	49	18	64

NR = not reported

Table 220. Reporting of signs and symptoms in studies of surgical treatment for epicondylitis

Sign or symptom	Number of studies reporting
Clumsiness	0
Lifting test	0
Middle finger test	0
Pain	2
Resisted pronation	3
Resisted supination	1
Resisted wrist extension	1
Restricted range of motion	0
Stiffness	0
Swelling	1
Symptoms with ADLs	0
Tenderness	3
Weakness	0
Weakness of grip	0

ADL = activities of daily living

Figure 59. Reporting of symptoms and signs in studies of surgical treatment for epicondylitis

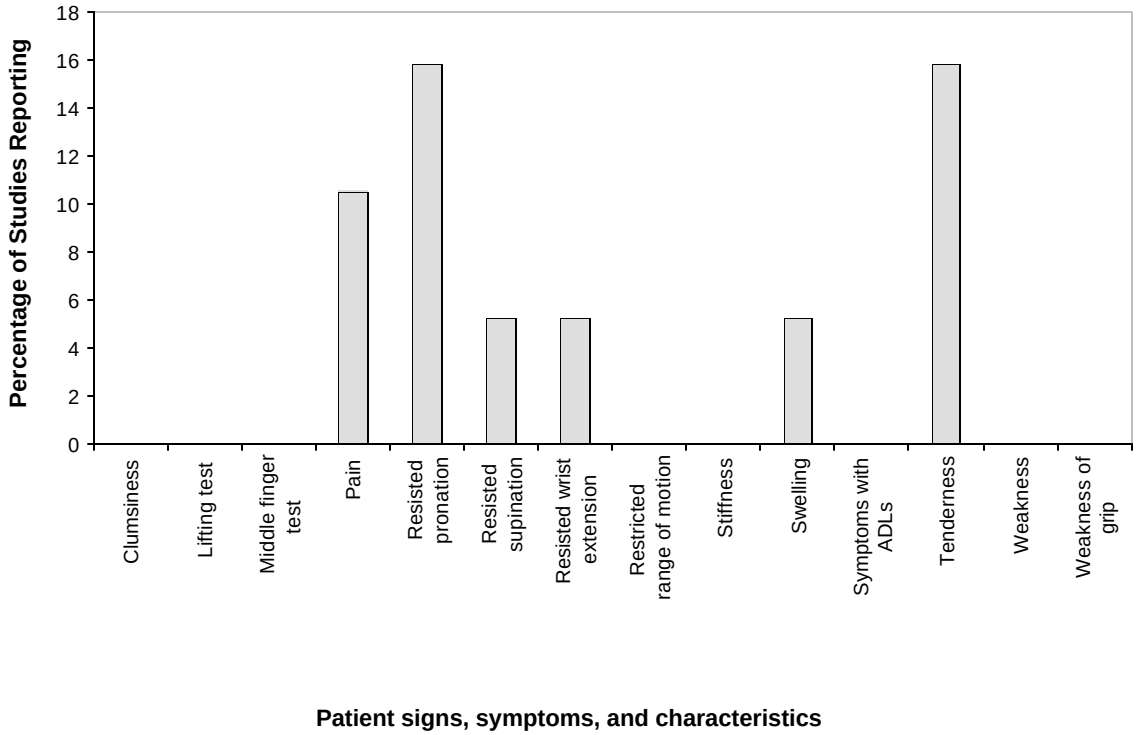

Table 221. Signs and symptoms of patients treated with surgery for epicondylitis

Study	Number of patients	Sign or symptom	Number of patients with sign or symptom	Percentage of patients
Almquist 1998 [83]	61	Pain	61	100.0
Goldberg 1988 [563]	30	Pain	30	100.0
Gabel 1995 [555]	26	Resisted pronation	26	100.0
Verhaar 1993 [559]	63	Resisted pronation	34	54.0
Baumgard 1982 [566]	34	Resisted pronation	34	100.0
Verhaar 1993 [559]	63	Resisted supination	31	49.2
Verhaar 1993 [559]	63	Resisted wrist extension	63	100.0
Goldberg 1988 [563]	30	Swelling	3	10.0
Almquist 1998 [83]	61	Tenderness	61	100.0
Gabel 1995 [555]	26	Tenderness	26	100.0
Verhaar 1993 [559]	63	Tenderness	63	100.0

Figure 60. Symptoms of patients with epicondylitis

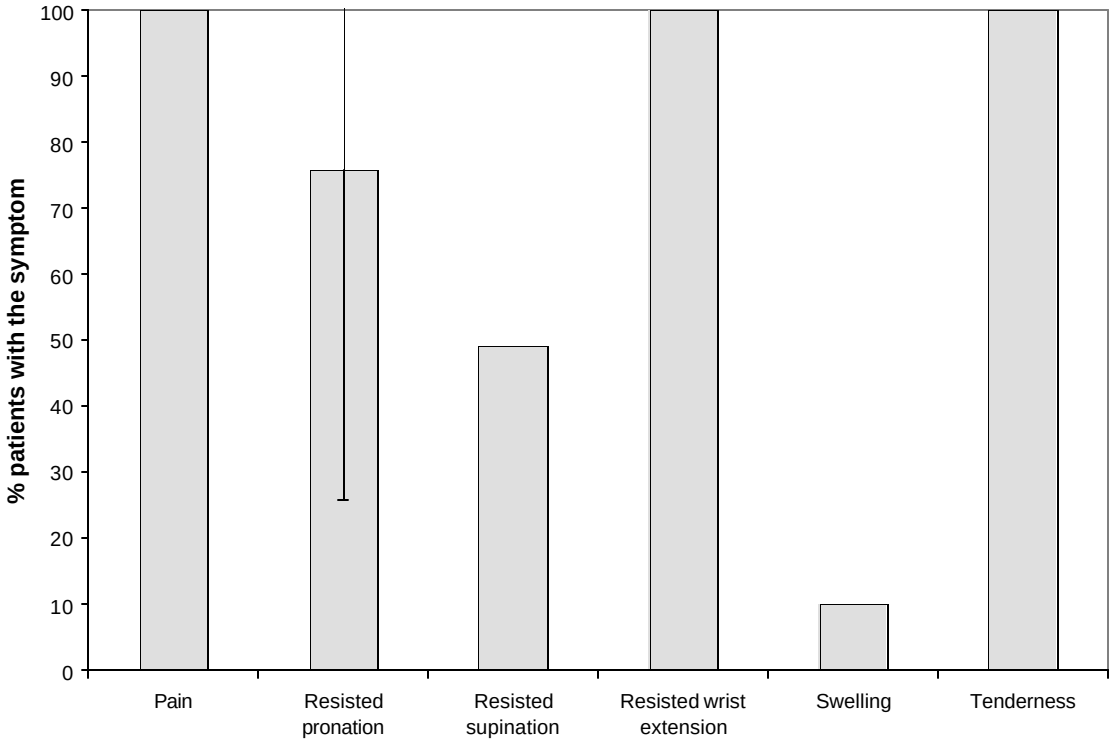

Table 222. Duration of symptoms before surgical treatment for epicondylitis

Study	Number of patients	Mean duration, months	Shortest duration, months	Longest duration, months
Grundberg 2000 [552]	34	18	3	66
Almquist 1998 [83]	61	31.3	6	72
Bankes 1998 [553]	24	32.2	11	126

Employment characteristics

Only five of the 19 studies reported employment-related data on their patients. The occupations of patients receiving surgery for epicondylitis and the percentage of patients in each study with that occupation are listed in Table 223. The number of studies reporting each occupational category are shown in Figure 61, and the reported percentages of patients with each occupation are shown in Figure 62.

Table 223. Reported occupations of patients receiving surgery for epicondylitis

Study	Occupation	Number of Patients	Number of patients with occupation	Percent of patients with occupation
Verhaar 1993 [559]	Assistive living services	63	4	6.3
Kurvers 1995 [556]	Beauty specialist	40	1	2.5
Chotigavanich 1986 [564]	Businessman	50	9	18.0
Verhaar 1993 [559]	Cleaning services	63	4	6.3
Kurvers 1995 [556]	Clerical and administrative support	40	4	10.0
Tan 1989 [562]	Clerical and administrative support	25	3	12.0
Verhaar 1993 [559]	Clerk	63	1	1.6
Verhaar 1993 [559]	Construction	63	7	11.1
Wittenberg 1992 [560]	Domestic workers	86	12	14.0
Tan 1989 [562]	Factory operator	25	3	12.0
Verhaar 1993 [559]	Farmer/gardener	63	4	6.3
Chotigavanich1986 [564]	Government officer	50	10	20.0
Kurvers 1995 [556]	Homemaker	40	8	20.0
Verhaar 1993 [559]	Homemaker	63	10	15.9
Tan 1989 [562]	Homemaker	25	7	28.0
Chotigavanich 1986 [564]	Homemaker	50	27	54.0
Tan 1989 [562]	Laborer	25	2	8.0
Chotigavanich 1986 [564]	Laborer	50	4	8.0
Verhaar 1993 [559]	Machine operator/mechanic	63	11	17.5
Kurvers 1995 [556]	Manual Worker	40	15	37.5
Wittenberg 1992 [560]	Manual Worker	86	31	36.0
Kurvers 1995 [556]	Music (organ) student	40	1	2.5
Kurvers 1995 [556]	Nurse	40	4	10.0
Tan 1989 [562]	Nurse	25	3	12.0
Verhaar 1993 [559]	Piano player	63	1	1.6
Kurvers 1995 [556]	Psychologist	40	1	2.5
Kurvers 1995 [556]	Sales workers - manager/supervisors	40	1	2.5
Wittenberg 1992 [560]	Sales workers - manager/supervisors	86	12	14.0
Verhaar 1993 [559]	Sculptor	63	1	1.6
Kurvers 1995 [556]	Teacher	40	1	2.5
Verhaar 1993 [559]	Teacher	63	1	1.6
Tan 1989 [562]	Teacher	25	4	16.0
Tan 1989 [562]	Technical	25	3	12.0
Wittenberg 1992 [560]	Typists	86	13	15.1
Kurvers 1995 [556]	Unemployed	40	2	5.0
Wittenberg 1992 [560]	Unemployed	86	6	7.0

Question #3. What are the relative benefits and harms of various surgical and nonsurgical interventions for persons with epicondylitis?

Evidence base

We considered only controlled trials that evaluated therapies as treatments for patients with epicondylitis for this section of the report. We retrieved 57 studies that met the inclusion criteria (see the section Inclusion Criteria). Six were excluded because they contained reporting or design difficulties serious enough to preclude interpretation of the results. These studies, and the reasons for their exclusion, are shown in Table 224. Thirty-eight randomized controlled trials, four randomized crossover trials, and eight controlled trials that evaluated eighteen different types of therapies as treatments for epicondylitis were included in the answer to this question. These trials are listed in Table 225. All of the trials studied only patients with lateral epicondylitis except for that of Stahl 1997, who studied patients with medial epicondylitis, and Brattberg 1983, who studied a mixed population of patients with lateral or medial epicondylitis. We have organized our answer to this question into sub-sections, one for each type of treatment.

Table 224. Excluded studies

Study	Reason for exclusion
Simunovic 1998 [569]	Patients were treated until they improved, and only then were they crossed over to the placebo treatment. This creates a bias in favor of improvement.
Burton 1985 [570]	Insufficient details to allow comparison of patient groups. Data from control group not reported.
Heyse-Moore 1984 [571]	Patients were allocated into different treatment groups on the basis of what symptoms they presented with, and thus the treatment groups cannot be directly compared.
Rosenthal 1982 [572]	It is unclear from the few details provided whether the patients actually had lateral epicondylitis.
Day 1978 [573]	Patients were treated until they improved. This creates a bias in favor of improvement.
Baily 1957 [574]	Many patients received confounding co-interventions, such as extra injections, physiotherapy, etc. that are incompletely described.

Table 225. Trials evaluating interventions for epicondylitis

Therapies evaluated	Study	Trial Design
Acupuncture	Molsberger 1994 [575]	Randomized controlled trial
	Haker 1990 [576]	Randomized controlled trial
Bracing	Wuori 1998 [577]	Randomized controlled crossover
	Forbes 1990 [578]	Crossover
Bracing compared to physiotherapy	Solveborn 1997 [579]	Controlled trial
Bracing plus physiotherapy	Clements 1993 [580]	Controlled trial
ESWT	Rompe 1996 [581,582]	Randomized controlled trial
GAGPs injections	Akermark 1995 [583]	Randomized controlled trial
Laser	Basford 2000 [584]	Randomized controlled trial
	Papadopoulos 1996 [585]	Randomized controlled trial
	Krasheninnikoff 1994 [586]	Randomized controlled trial
	Vasseljen 1992 [587]	Randomized controlled trial
	Haker 1991 [588]	Randomized controlled trial
	Haker 1991 [589]	Randomized controlled trial
	Haker 1990 [590]	Randomized controlled trial
Laser compared to ultrasound plus massage	Vasseljen 1992 [591]	Randomized controlled trial
Manipulations	Vicenzino 1996 [592]	Randomized controlled crossover
Manipulations compared to Ultrasound plus physiotherapy	Drechsler 1997 [593]	Randomized controlled trial
Manipulations Manipulations plus bracing Manipulations plus topical NSAIDs Manipulations plus topical NSAIDs plus bracing	Burton 1988 [594]	Randomized controlled trial
Oral NSAIDs	Labelle 1997 [595]	Randomized controlled trial
	Adelaar 1987 [596]	Randomized controlled trial
	Stull 1986 [597]	Randomized controlled trial
PEMF	Devereaux 1985 [598]	Randomized controlled trial
Physiotherapy compared to ultrasound	Pienimaki 1996 [599 600]	Randomized controlled trial
Steroid injections	Stahl 1997 [601]	Randomized controlled trial
	Solveborn 1995 [602]	Randomized controlled trial
	Price 1991 [603]	Randomized controlled trial
	Kivi 1982 [604]	A-B trial
	Clarke 1975 [605]	Controlled trial

Therapies evaluated	Study	Trial Design
Steroid injection TENS Ultrasound Phonophoresis	Halle 1986 [606]	Randomized controlled trial
Steroid injections compared to manipulation	Verhaar 1995 [607]	Randomized controlled trial
Steroid injections compared to acupuncture	Brattberg 1983 [608]	Controlled trial
Steroid injection compared to Oral NSAIDs	Hay 1999 [609]	Randomized controlled trial
	Saartok 1986 [610]	Randomized controlled trial
Steroid injections Bracing Immobilization	Haker 1993 [611]	Randomized controlled trial
Surgery	Almquist 1998 [83]	Controlled trial
	Wilhelm 1996 [84]	Controlled trial
TENS	Johannsen 1993 [612]	Randomized controlled trial
Topical DMSO	Percy 1981 [613]	Randomized controlled trial
Topical NSAIDs	Demirtas 1998 [614]	Randomized controlled trial
	Schapira 1991 [615]	Randomized controlled trial
	Burnham 1998 [616]	Randomized controlled crossover
Ultrasound	Lundeberg 1988 [617]	Randomized controlled trial
	Binder 1985 [618]	Randomized controlled trial
	Haker 1991 [619]	Randomized controlled trial
Ultrasound Phonophoresis Ultrasound plus bracing Phonphoresis plus bracing	Holdsworth 1993 [620]	Randomized controlled trial
Ultrasound Phonophoresis Ultrasound plus massage Phonophoresis plus massage	Stratford 1989 [621]	Randomized controlled trial

ESWT = extracorporal shock wave therapy
GAGPs = glucosaminoglycan polysulfate
NSAID = non steroidal anti -inflammatory drug
PEMF = pulsed electromagnetic field
TENS = transcutaneous electrical nerve stimulation
DMSO = dimethylsulfoxide

Table 226. Internal validity

Study	Number of patients	Number of centers	Funded by a for-profit agency?	Study design	Prospective?	Blinding	%Attrition	Intent to treat analysis	Compliance
Basford 2000 [584]	52	1	No	RCT	Yes	Double	9.6	No	NA
Papadopoulos 1996 [585]	29	1	No	RCT[a]	Yes	Double	0	Yes	NA
Krasheninnikoff 1994 [586]	48	1	NR	RCT	Yes	Double	4.2	Yes	NA
Vasseljen 1992 [587]	30	1	NR	RCT	Yes	Double	3.3	Yes	NA
Haker 1991 [588]	52	1	NR	RCT	Yes	Double	26.9	No	NA
Haker 1991 [589]	60	1	NR	RCT[a]	Yes	Double	28.3	No	NA
Haker 1990 [590]	49	1	NR	RCT	Yes	Double	20.4	No	NA

[a] may have been improperly randomized
NA = not applicable
NR = not reported
RCT = randomized controlled trial

Generalizability

Details about the patients enrolled in these trials are shown in Table 227. The mean patient age in these trials ranged from 44.3 to 48.5. Krasheninnikoff 1994 did not report the gender composition of the patient groups; the other studies reported that their patient groups were 25.0% to 72.4% female. These patient characteristics approximate those reported in published studies of the epidemiology of epicondylitis (see the Introduction), suggesting that the results of the studies are broadly generalizable beyond their particular patient groups.

The presence of various co-morbidities is incompletely reported in these studies. Some studies excluded patients with co-morbidities, indicated in Table 227 by a zero under that comorbidity. This somewhat limits the generalizability of these studies, as comorbidities are not exclusion criteria for laser treatment.

None of the studies reported any information about the occupations or employment status of the patients. The extent to which the employment characteristics of these patients may be generalized to the overall population of epicondylitis patients cannot be determined.

Table 227. Generalizability: patient characteristics

Study	Number of patients	Mean age and range	% female	Duration of condition mean and range	% Patients with diabetes	% Patients with arthritis	% Patients with previous relevant injuries	% Patients with other relevant nerve impingement conditions	% Patients with peripheral neuropathy	% Patients pregnant	% Patients on kidney dialysis	Did the study exclude patients with severe disease?	Did the study exclude patients with mild disease?
Basford 2000 [584]	52	45.1	51.9	6.4	NR	NR	NR	NR	NR	NR	NR	No	No
Papadopoulos 1996 [585]	29	45	72.4	5.8	NR	0	0	0	0	0	0	No	No
Krasheninnikoff 1994 [586]	48	48.5 (37-64)	NR	3 (1-12)	NR	0	0	NR	0	0	NR	No	No
Vasseljen 1992 [587]	30	45.5 (25-63)	50.0	3.5 (1-12)	NR	0	NR	NR	NR	NR	NR	No	No
Haker 1991 [589]	60	45.3 (33-65)	25.0	5.5 (1-60)	NR	0	NR	0	0	NR	NR	No	No
Haker 1991 [588]	52	44.3 (22-66)	34.6	9.5 (1-60)	NR	NR	NR	NR	NR	NR	NR	No	No
Haker 1990 [590]	49	46.7 (24-70)	42.8	7 (1-36)	NR	0	NR	0	0	NR	NR	No	No

NR = not reported

Table 228. Results of the success of treatment with laser therapy

Study	Number of patients	Global outcome, patient-rated	Statistical significance of the difference between groups[a]
Krasheninnikoff 1994 [586]	18 sham 18 laser	Sham- at one month, 3 cured, 7 more effective, 8 unchanged. At 2.5 months, 6 cured, 5 more effective, 7 unchanged. Laser- at one month, 2 cured, 9 more effective, 7 unchanged. At 2.5 months, 6 cured, 4 more effective, 8 unchanged.	Chi-squared test At one month, p = 0.772338 At 2.5 months, p = 0.914947 Not statistically significantly different
Vasseljen 1992 [587]	13 sham 15 laser	Sham- at two weeks, 0 cured, 8 more effective, 5 no change, 2 worse. At 1.5 months, 3 cured, 5 more effective, 5 no change, 2 worse. At 5.5 months, 4 (30.7%) were successfully treated. Laser- at two weeks, 3 cured, 7 more effective, 3 no change, 2 worse. At 1.5 months, 7 cured, 5 more effective, 1 no change, 2 worse. At 5.5 months, 8 (53.3%) were successfully treated.	Chi-squared test At 2 weeks, p = 0.456057 At 1.5 months, p = 0.121335 At 5.5 months, p = 0.136037 Not statistically significantly different
Haker 1991 [589]	29 sham 29 laser	Sham: at 1.5 months, 0 excellent, 5 good, 17 improved,10 some improvement, 7 unchanged. At 3 months, 4 excellent, 7 good, 8 improved, 2 some improvement, 6 unchanged. At 6 months, 3 excellent, 6 good, 10 improved, 4 some improvement, 0 unchanged. Laser- at 1.5 months, 1 excellent, 7 good, 16 improved, 9 some improvement, 5 unchanged. At 3 months, 2 excellent, 11 good, 10 improved, 1 some improvement, 4 unchanged. At 6 months, 3 excellent, 15 good, 5 improved, 1 some improvement, 0 unchanged.	Chi-squared test At 1.5 months, p = 0.097781 At 3 months, p = 0.023323 At 6 months, p = 0.006687 Difference is statistically significant for 3 and 6 months of followup
Haker 1990 [590]	26 sham 23 laser	Sham: at 1.5 months, 1 excellent, 11 good, 9 improved, 4 some improvement, 5 unchanged. At 3 months, 1 excellent, 12 good, 6 improved, 1 some improvement, 6 unchanged. At one year, 8 excellent, 6 good, 6 improved, 3 some improvement, and 1 unchanged. Laser: at 1.5 months, 1 excellent, 4 good, 12 improved, 7 some improvement, 6 unchanged. At 3 months, 5 excellent, 7 good, 8 improved, 3 some improvement, 2 unchanged. At one year, 6 excellent, 8 good, 4 improved, 2 some improvement, 8 unchanged.	Chi-squared test At 1.5 months, p = 0.065075 At 3 months, p = 0.015251 At one year, p = 0.107943 Difference is statistically significant for 3 months of followup

[a] calculated by ECRI

Table 229. Success of treatment with laser therapy for epicondylitis

Study	Number of patients	Followup time	Which procedure was more effective?	Was the difference statistically significant?	Effect size d (95% CI)[a]
Krasheninnikoff 1994 [586]	18 sham 18 laser	1 month	Laser	No	0.19 (-0.46 to 0.85)
		2.5 months	Sham	No	-0.11 (-0.77 to 0.54)
Vasseljen 1992 [587]	15 sham 15 laser	2 weeks	Laser	No	0.64 (-0.09 to 1.38)
		1.5 months	Laser	No	0.73 (-0.01 to 1.47)
		5.5 months	Laser	No	0.61 (-0.23 to 1.46)
Haker 1991 [589]	29 sham 29 laser	1.5 months	Laser	No	0.28 (-0.24 to 0.80)
		3 months	Laser	Yes	0.24 (-0.28 to 0.76)
		6 months	Laser	Yes	0.50 (-0.03 to 1.02)
Haker 1990 [590]	26 sham 23 laser	1.5 months	Sham	No	-0.44 (-1.01 to 0.13)
		3 months	Laser	Yes	0.43 (-0.13 to 1.00)
		12 months	Sham	No	-0.01 (-0.58 to 0.55)

[a] calculated by ECRI

Table 230. Results of meta-analysis of effect of laser therapy vs. sham therapy on global outcome

Analysis	Study	N	Effect size	95% CI	P value	Standardized residual	Outlier by std. Residual?
One to 1.5 months	Krasheninnikoff 1994 [586]	36	0.19	-0.46 to 0.85	0.56	0.20	No
	Vasseljen 1992 [587]	30	0.73	-0.01 to 1.47	0.053	1.74	No
	Haker 1991 [589]	58	0.28	-0.24 to 0.80	0.29	0.68	No
	Haker 1990 [590]	49	-0.44	-1.01 to 0.13	0.13	-2.34	Yes
Longest followup time, conservative correction for attrition	Krasheninnikoff 1994 [586]	36	-0.11	-0.77 to 0.54	0.73	-1.15	No
	Vasseljen 1992 [587]	30	0.61	-0.23 to 1.46	0.15	0.98	No
	Haker 1991 [589]	58	0.50	-0.03 to 1.02	0.062	1.26	No
	Haker 1990 [590]	49	-0.01	-0.58 to 0.55	0.96	-1.00	No
Longest followup time, opposite correction for attrition	Krasheninnikoff 1994 [586]	36	-0.11	-0.77 to 0.54	0.73	0.15	No
	Vasseljen 1992 [587]	30	-0.51	-0.51 to 1.09	0.48	1.19	No
	Haker 1991 [589]	58	-0.85	-0.85 to 0.19	0.21	-0.81	No
	Haker 1990 [590]	49	-0.77	-0.77 to 0.35	0.47	-0.21	No
Summary 1 to 1.5 months	4 RCT's	173	0.13	-0.17 to 0.43	0.39	Q = 6.77	P of Q = 0.079
Summary, longest, conservative	4 RCT's	173	0.22	-0.08 to 0.53	0.15	Q = 3.59	P of Q = 0.31
Summary longest, opposite	4 RCT's	173	-0.16	-0.46 to 0.15	0.31	Q = 1.68	P of Q = 0.64

Table 231. Results of work status after treatment with laser therapy

Study	N patients	Time of followup	Number of patients working	Statistical significance of the difference between groups
Vasseljen 1992 [587]	13 Sham 15 Laser	5.5 months	9 sham treated patients were working and 13 laser treated patients were working	Chi-squared test [a] p = 0.262

[a] calculated by ECRI

Table 232. Work status after treatment with laser therapy

Study	Number of patients	Which procedure had more patients working?	Was the difference statistically significant?	Effect size d (95% CI)[a]	What is the minimal difference between groups the study had the statistical power to detect?
Vasseljen 1992 [587]	Sham 13 Laser 15	Laser	No	0.57 (-0.48 to 1.61)	26%

[a] calculated by ECRI

Pain

The effect of laser treatment on pain was reported by four studies of 143 patients in total. All four studies reported pain rated by the patients on visual analog scales (VAS). The data reported by the studies is shown in Table 233 and summarized in Table 234. The reported results of the studies are shown graphically in Figure 67 and the effect sizes (Hedges' d) of the longest followup times are shown graphically in Figure 68. The results for all other time points are similar to that found for the longest followup times.

Because an effect size could be calculated for only three of the studies, we did not perform a meta-analysis. None of the studies reported a statistically significant difference in pain outcomes between the two groups. However, all of the studies are small. Due to limitations in the reported data, we were only able to perform a power analysis for one of the studies. Our calculations show that the study by Vasseljen 1992 could have detected only an 86% or larger difference between the treatment groups. The other studies are of similar sizes. Thus, it is unlikely that they would have found a statistically significant difference even if the difference between groups were rather large. Therefore, these studies cannot be taken as proof that laser therapy provides no pain relief.

Table 233. Results of the effect of laser treatment on pain

Study	N patients	Pain measurements	Statistical significance of the difference between groups
Basford 2000 [584]	24 sham 23 laser	No data reported	Wilcoxon's rank sum test At 2 weeks, p = 0.551 At 1 month, p = 0.371 At 2 months, p = 0.488
Papadopoulos 1994 [585]	15 sham 14 laser	No data reported	Test not reported NS
Krasheninnikoff 1994 [586]	18 sham 18 laser	At one month, Sham- 22 median 95% CI (12 to 63) Laser- 27 median 95% CI (5 to 50)	Mann-Whitney rank sum test p >0.05
Vasseljen 1992 [587]	15 sham 15 laser	Mean (95% CI) Sham- at time 0, 3.8 (2.75 to 4.8). At 2 weeks, 3.8 (2.75 to 4.7). At 1.5 months, 3.2 (2.4 to 4.2). At 5.5 months, 0.7 (0.4 to 1.0) Laser- at time 0, 4.2 (3.2 to 5.2). At 2 weeks, 3.6 (2.2 to 4.95). At 1.5 months, 2.65 (1.5 to 3.8). At 5.5 months, 0.49 (0.2 to 0.75)	t-test at time 0, p = 0.591 at 2 weeks, p = 0.814 at 1.5 months, p = 0.504 at 5.5 months, p = 0.317

Table 234. Summary of the effect of laser treatment on pain

Study	N patients	Which procedure was most effective at treating pain?	Was the difference statistically significant?	Effect size d (95% CI)[a]	What is the minimal difference between groups that the study had the statistical power to detect?
Basford 2000 [584]	24 Sham 23 Laser	No difference	No at all followup times	0.20 (-0.37 to 0.77)[b]	NC
Papadopoulos 1994 [585]	15 Sham 14 Laser	No difference	No at all followup times	NC	NC
Krasheninnikoff 1994 [586]	18 Sham 18 Laser	Sham	No at all followup times	-0.66 (-1.33 to 0.01)	NC
Vasseljen 1992 [587]	15 Sham 15 Laser	Laser	No at all followup times	1.41 (0.61 to 2.21)	86%

[a] calculated by ECRI
[b] the direction of this effect size was chosen at random and is not to be interpreted as supporting one treatment group over the other
NC = could not be calculated from reported data

Table 235. Summary of the treatments evaluated

Study	Group 1	Group 2
Burnham 1998 [616]	Topical diclofenac	Placebo
Schapira 1991 [615]	Topical diclofenac	Placebo
Demirtas 1998 [614]	Topical diclofenac	Topical salicylate
Labelle 1997 [595]	Oral diclofenac	Placebo
Adelaar 1987 [596]	Oral diflunisal	Oral naproxen
Stull 1986 [597]	Oral dilfunisal	Oral naproxen
Percy 1981 [613]	Topical DMSO	Placebo

Table 236. Internal validity

Study	Number of patients	Number of centers	Funded by a for-profit agency?	Study design	Prospective?	Blinding	%Attrition	Intent to treat analysis	Compliance
Demirtas 1998 [614]	40	1	NR	RCT	Yes	No	0	Yes	NR
Burnham 1998 [616]	14	1	NR	RCT Xover	Yes	Double	0	Yes	NR
Labelle 1997 [595]	206	Multiple	Yes	RCT	Yes	Double	0.49	Yes	49.5
Schapira 1991 [615]	32	1	Yes	CT	Yes	Double	0	Yes	NR
Adelaar 1987 [596]	22	1	NR	RCT	Yes	No	18.2	No	NR
Stull 1986 [597]	40	1	Yes	RCT	Yes	No	5.0	No	NR
Percy 1981 [613]	51	1	Yes	RCT	Yes	Double	21.6	No	NR

RCT = randomized controlled trial
Xover = crossover
CT = controlled trial
NR = not reported

Generalizability

Characteristics of the patients are shown in Table 237. Studies of the epidemiology of epicondylitis (see the Introduction) have found that typical patients are in their mid-forties and are equally likely to be of either sex. All of the trials included patients that are similar to these characteristics except the trials by Stull 1986 and Schapira 1991 which did not report the mean age of their patient groups and the trial by Adelaar 1987 which had a mean age of 34.5 years (This is younger than the general population of patients with epicondylitis; see the epidemiology subsection of the introduction to this evidence report, as well as the answer to question two regarding epicondylitis).

The presence of various comorbidities associated with epicondylitis is incompletely reported in these studies. Some studies excluded patients with some comorbidities, indicated by a zero in Table 237 under that comorbidity. This somewhat limits the generalizability of these studies, as comborbidites may not be exclusion criteria for treatment with anti-inflammatories.

Table 237. Generalizability: patient characteristics

Study	Number of patients	Mean age and range	% female	Duration of condition mean and range	% Patients with diabetes	% Patients with arthritis	% Patients with previous relevant injuries	% Patients with other relevant nerve impingement conditions	% Patients with peripheral neuropathy	% Patients pregnant	% Patients on kidney dialysis	Did the study exclude patients with severe disease?	Did the study exclude patients with mild disease?
Burnham 1998 [616]	14	42.5	42.8	8.3 (2-24)	NR	NR	NR	NR	NR	NR	NR	No	No
Demirtas 1998 [614]	40	45.0 (25-61)	65	5.0 (2-13)	NR	NR	NR	NR	NR	NR	NR	No	No
Labelle 1997 [595]	206	43.7	59	NR		0	NR	0	0	NR	NR	No	No
Schapira 1991 [615]	32	(34-78)	65.6	NR	NR	NR	NR	NR	NR	NR	0	No	No
Adelaar 1987 [596]	22	34.5 (20-49)	54.5	NR	NR	NR	0	NR	NR	0	0	No	No
Stull 1986 [597]	40	NR	42.5	NR	NR	NR	NR	NR	NR	NR	NR	No	No
Percy 1981 [613]	51	47.9 (28-64)	29.4	NR	NR	NR	NR	NR	NR	NR	0	No	No

NR = not reported

Table 238. Generalizability: patient occupations

Study	Number of patients	% Patients employed	% Patients on Workers' compensatio	% Patients retired	% Patients homemakers	Reported occupations
Burnham 1998 [616]	14	NR	NR	NR	NR	NR
Demirtas 1998 [614]	40	NR	NR	NR	NR	NR
Labelle 1997 [595]	206	NR	NR	NR	NR	NR
Schapira 1991 [615]	32	NR	NR	NR	NR	NR
Adelaar 1987 [596]	22	NR	NR	NR	9.1	13.6% blue-collar worker 13.6% custodial worker 9.1% student 9.1% nurse 9.1% clerical worker 9.1% health care worker 4.5% broker 4.5% computer programmer
Stull 1986 [597]	40	NR	NR	NR	NR	NR
Percy 1981 [613]	51	NR	NR	NR	NR	NR

NR = not reported

Results

Success of Treatment-NSAIDs

Three studies reported on the success of treatment as rated by patients. The results of these trials are summarized in Table 239. Because there were two or fewer studies comparing the same NSAID treatments, no meta-analysis could be performed. The conclusions of the trials are summarized in Table 240. Two trials of a total of 51 patients reported on the relative success of treating with naproxen as compared to diflunisal. Both trials measured success by asking the patients to rate their symptoms after the course of drugs. Neither trial found a statistically significant difference between the treatment groups. However one study reported a slight advantage to taking naproxen, while the other study reported a slight advantage to taking diflunisal (Figure 69 and Figure 70). One trial of a total of 128 patients reported on the recurrence of symptoms three months after taking a course of diclofenac or placebo. There was no statistically significant difference in the rates of recurrence of symptoms between-treatment groups. The statistical power of these studies suggest that they could have detected, depending on the trial, a 17% or 22% difference between groups. Therefore, if there is a difference between any of the treatments, it is unlikely to be large.

The trial by Demirtas 1998 compared topical salicylate treatments to topical diclofenac treatments. This trial did not report any patient-oriented outcomes, and for this reason we have not tabled any of its results. Demirtas 1998 reported that topical diclofenac was more effective at treating the symptoms of epicondylitis than was topical salicylate.

Table 239. Results of the success of treatment with NSAIDs

Study	Number of patients	Success of treatment	Statistical significance of difference between groups
Labelle 1997 [595]	64 Placebo 64 NSAIDs	At 3 months: Placebo: 27 patients still had symptoms NSAIDs: 23 patients still had symptoms	Test NR P = 0.52
Adelaar 1987 [596]	9 naproxen 9 diflunisal	At 0.5 months, patient-rated global outcome: Naproxen- 0 excellent, 7 improved, 2 no change, 0 worse Diflunisal- 0 excellent, 7improved, 1 no change, 1 worse	Exact chi-squared t test NS
Stull 1986 [597]	16 naproxen 17 diflunisal	At 0.5 months, patient-rated global outcome: Naproxen- 1 excellent, 11 improved, 3 no change, 1 worse Diflunisal- 3 excellent, 13 improved, 1 no change, 0 worse	Pearson chi-squared P = 0.368

Table 240. Success of treating epicondylitis with NSAIDs

Study	Number of patients	Time of follow-up	Which treatment was more successful?	Was the difference statistically significant?	What is the minimal difference between groups the study had the power to detect?	Effect size d (95% CI)[a]
Labelle 1997 [595]	64 oral diclofenac 64 placebo	3 months	diclofenac	No	17%	1.44 (1.05 to 1.83)
Adelaar 1987 [596]	9 oral diflunisal 9 oral naproxen	0.5 months	naproxen	No	22%	0.70 (-0.20 to 1.6)
Stull 1986 [597]	17 oral diflunisal 16 oral naproxen	0.5 months	diflunisal	No	22%	-0.40 (-1.09 to 0.29)

[a] calculated by ECRI

Table 241. Effect of NSAID treatment on work status

Study	N patients	Which treatment resulted in fewer sick days?	Was the difference significant?	Did the study have sufficient power?	Effect size d (95% CI)
Labelle 1997 [595]	64 oral diclofenac 64 placebo	No difference	No t-test	Could not calculate from reported information	Could not calculate from reported information

Pain

Four trials reported on pain. These studies are shown in Table 242. One of the trials, including 28 patients, compared topical diclofenac to a placebo. Two studies of a total of 62 patients compared oral naproxen to oral diflunisal. One study of 128 patients compared oral diclofenac to placebo. Because there were two or fewer trials of each combination of NSAIDs, no meta-analysis could be performed. The results reported by the studies are summarized in Table 243. Diclofenac, either topically applied or taken orally, was found to relieve pain more effectively than placebo. There was a tendency for diflunisal to relieve pain more effectively than naproxen, but only the results of the Stull study were statistically significant.

Table 242. Results of the effect of NSAIDs on pain

Study	Number of patients	Pain	Statistical significance of difference between groups
Burnham 1998 [616]	14 topical diclofenac 14 placebo	Patient-rated by VAS, mean (SD) At time 0, NSAIDs = 3.5 (1.7) Placebo = 3.5 (1.7) At 1 week, NSAIDs = 2.1 (2.1) Placebo = 3.6 (2.0)	ANOVA NS at time 0 P = 0.007 at 1 week
Labelle 1997 [595]	64 oral diclofenac 64 placebo	Patient-rated pain by VAS, mean (SD) At 1 month NSAIDs = 29.9 (26.3) Placebo = 16 (27.4)	Student t test p <0.005
Adelaar 1987 [596]	9 diflunisal 9 naproxen	Patient-rated pain, mean At time 0, diflunisal = 1.9 Naproxen = 2.1 At 2 weeks, diflunisal = 0.9 Naproxen = 1.1	Exact chi-squared t-test NS
Stull 1986 [597]	16 diflunisal 17 naproxen	Patient-rated pain relief At 2 weeks Diflunisal: 4 no pain, 9 mild pain, 3 moderate pain, 0 severe pain Naproxen: 5 no pain, 8 mild pain, 3 moderate pain, 1 severe pain	Pearson chi-squared P = 0.019

Table 243. Effect of treatment with NSAIDs on pain related to epicondylitis

Study	Number of patients	Time of follow up	Which treatment resulted in less pain?	Was the difference significant?	Minimal difference between groups the study had the power to detect	Effect size d (95% CI)[a]
Burnham 1998 [616]	14 topical diclofenac 14 placebo	1 week	Topical diclofenac	Yes	NA	0.71 (-0.05 to -1.47)
Labelle 1997 [595]	64 oral diclofenac 64 placebo	1 month	Oral diclofenac	Yes	NA	0.51 (0.16 to 0.87)
Adelaar 1987 [596]	9 oral diflunisal 9 oral naproxen	2 weeks	Oral diflunisal	No	Cannot calculate from the reported data	Cannot calculate from the reported data
Stull 1986 [597]	17 oral diflunisal 17 oral naproxen	2 weeks	Oral diflunisal	Yes	NA	0.02 (-0.66 to 0.71)

[a] calculated by ECRI

Function

Three studies of 180 patients in total reported data relevant on patient function. The results of the studies are shown in Table 244. The results reported by the studies are summarized in Table 245. One study reported a trend, that did not reach statistical significance, towards fewer functional limitations when patients were treated with oral diclofenac as compared to placebo. The low statistical power of this study may have contributed to its failure to detect a statistically significant difference. Only large (>68.7%) differences could be detected. Two studies compared oral diflunisal to oral naproxen. One study reported no difference in functional limitations, while the other reported a statistically significant advantage in function after treatment with diflunisal.

Table 244. Results of function

Study	Number of patients	Functional assessment	Statistical significance of difference between groups
Labelle 1997 [595]	64 Placebo 64 Oral diclofenac	At one month, mean (SD) ADL: placebo -2.4 (2.8) Diclofenac- -3.3 (2.8) Arm function by VAS: placebo 21.8 (27.6) Diclofenac 18.5 (29.1)	Student t-test ADL, p = 0.52 VAS, p = 0.1
Adelaar 1987 [596]	9 Oral diflunisal 9 Oral naproxen	Patient rated function mean At time zero, dilfunisal 1.7 Naproxen 1.7 At 2 weeks, dilfunisal 0.4 Naproxen 0.4	Exact chi-squared t-test NS
Stull 1986 [597]	17 Oral naproxen 17 Oral diflunisal	Number of patients with self-reported functional limitations at 2 weeks Naproxen = 11 Diflunisal = 5	Chi-squared test[a] P = 0.039

[a] calculated by ECRI
ADL = activities of daily living

Table 245. Effect of NSAIDs on hand/arm function

Study	Number of patients	Which treatment resulted in fewer functional limitations?	Was the difference significant?	Minimal difference between groups the study had the power to detect	Effect size d (95% CI)[a]
Labelle 1997 [595]	64 oral diclofenac 64 placebo	Oral diclofenac	No	68.7%	ADL: 0.32 (-0.03 to 0.67) VAS: 0.12 (-0.23 to 0.46)
Adelaar 1987 [596]	9 oral diflunisal 9 oral naproxen	No difference	No difference	Cannot calculate from the reported data	Cannot calculate from the reported data
Stull 1986 [597]	17 oral diflunisal 17 oral naproxen	Oral diflunisal	Yes	NA	0.80 (0.00 to 1.59)

[a] calculated by ECRI

Quality of life

None of the studies reported this outcome.

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 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. Due to incomplete data reporting, we were unable to compensate for attrition in any of these trials.

Table 246. Summary of the treatments

Study	Injections group 1	Injections group 2
Akermark 1995 [583]	glucosamines	Placebo injection
Clarke 1975 [605]	hydrocortisone	methylprednisolone
Stahl 1997 [601]	methylprednisolone plus lidocaine	lidocaine
Solveborn 1995 [602]	triamcinolone plus lidocaine	triamcinolone plus bupivacaine
Price 1991 [603]	lignocaine plus triamcinolone or lignocaine plus hydrocortisone	lignocaine
Kivi 1982 [604]	methylprednisolone	lidocaine plus betamethasone

Table 247. Internal validity

Study	Number of patients	Number of centers	Funded by a for-profit agency?	Study design	Prospective?	Blinding	%Attrition	Intent to treat analysis	Compliance
Akermark 1995 [583]	65	Multiple	NR	RCT	Yes	Double	7.7	No	NA
Stahl 1997 [601]	58	1	No	RCT	Yes	Double	0	Yes	NA
Solveborn 1995 [602]	109	1	NR	RCT	Yes	Double	42.2	No	NA
Price 1991 [603]	145	1	Yes	RCT	Yes	Double	0	Yes	51.7
Kivi 1982 [604]	88	1	NR	A-B	Yes	No	13.6	No	NA
Clarke 1975 [605]	46	1	Yes	CT	Yes	Double	0	Yes	NA

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

Generalizability

Characteristics of the patients included in these studies are shown in Table 248. Studies of the epidemiology of epicondylitis (see the Introduction) have found that typical patients are in their mid-forties and are equally likely to be of either sex. All

Table 248. Generalizability: patient characteristics

Study	Number of patients	Mean age and range	% female	Duration of condition mean and range	% Patients with diabetes	% Patients with arthritis	% Patients with previous relevant injuries	% Patients with other relevant nerve impingement conditions	% Patients with peripheral neuropathy	% Patients pregnant	% Patients on kidney dialysis	Did the study exclude patients with severe disease?	Did the study exclude patients with mild disease?
Stahl 1997 [601]	58	42	24.1	4.5	NR	0	0	0	0	NR	NR	No	No
Akermark 1995 [583]	65	44 (27-60)	44.6	11 (3-36)	NR	NR	NR	NR	NR	0	NR	No	No
Solveborn 1995 [602]	109	43.8	NR	8.2	NR	NR	NR	NR	NR	NR	NR	No	No
Price 1991 [603]	145	46 (19-65)	48.9	6 (2-38)	NR	NR	NR	NR	NR	NR	NR	No	No
Kivi 1982 [604]	88	43 (22-64)	43.2	NR	NR	NR	NR	NR	NR	NR	NR	No	No
Clarke 1975 [605]	46	NR	NR	NR	NR	0	NR	NR	NR	NR	NR	No	No

NR = not reported

Table 249. Generalizability: patient occupations

Study	Number of patients	% Patients employed	% Patients on Workers' compensatio	% Patients retired	% Patients homemakers	Reported occupations
Stahl 1997 [601]	58	NR	NR	NR	NR	46.6% white collar workers 29.3% manual laborers
Akermark 1995 [583]	65	NR	NR	NR	NR	NR
Solveborn 1995 [602]	109	NR	NR	NR	NR	NR
Price 1991 [603]	145	NR	NR	NR	NR	NR
Kivi 1982 [604]	88	NR	NR	NR	18.1	18.1% heavy manual labor 29.5% office work
Clarke 1975 [605]	46	NR	NR	NR	NR	NR

NR = not reported

Results

Glucosamines

One double-blinded randomized controlled trial of a total of 65 patients evaluated the effect of injections of glucosamines as compared to placebo injections on epicondylitis. The patients received weekly injections for five weeks. The study evaluated two different patient-oriented outcomes: success of the treatment, and pain when carrying out activities of daily living (ADL), as rated by the patient on a visual analog scale (VAS). The reported data are shown in Table 250 and summarized in Table 251. For both outcomes, glucosamine injections had a statistically significant effect 1 to 3 months after treatment, but by six months the differences between the two groups had become statistically insignificant.

The study reported that 40.6% of the patients treated with glucosamines experienced pain at the site of the injection and 6.3% developed hematomas at the site of injection, compared to 17.9% of the placebo group who experienced pain, and 0% who developed hematomas at the site.

Table 250. Results of treating epicondylitis with injections of glucosamines

Study	Outcome measurement	Treatment group	N patients	Time in months	Number of failures (%)		Statistical test	P value
Akermark 1995 [583]	Number of treatment failures	GAGPS	32	1	11 (34.4%)		Mantel-Haenszel	0.12
		placebo	28	1	17 (60.7%)			
		GAGPS	32	1.5	4 (12.5%)			0.011
		placebo	28	1.5	12 (42.9%)			
		GAGPS	32	3	6 (18.8%)			0.051
		placebo	28	3	12 (10.7%)			
		GAGPS	32	6	9 (28.1%)			0.22
		placebo	28	6	13 (46.4%)			
	Pain-patient rated	**Treatment group**	**N**	**Months**	**Mean**	**SD**	**Statistical test**	**P value**
		GAGPS	32	0	62.8	15.4	ANOVA	NS
		placebo	28	0	58.6	17.9		
		GAGPS	32	1	44.1	19.9		0.051
		placebo	28	1	48.4	20.8		
		GAGPS	32	1.5	30.3	20.7		0.0053
		placebo	28	1.5	40.5	25.6		
		GAGPS	32	3	30.7	24.7		0.021
		placebo	28	3	40.8	27.7		
		GAGPS	32	6	33	25.3		0.18
		placebo	28	6	37.3	30.1		

[a] calculated by ECRI

Table 251. Results of treating epicondylitis with injections of glucosamines

Study	Number of patients	Outcome	Followup time	Which treatment was more effective?	Was the difference statistically significant?	Effect size d (95% CI)[a]
Akermark 1995 [583]	32 GAGPS 28 placebo	Number of treatment failures	1 month	GAGPs	No	0.59 (0.01 to 1.17)
			1.5 months	GAGPs	Yes	0.90 (0.19 to 1.61)
			3 months	GAGPs	No	0.64 (0.00 to 1.28)
			6 months	GAGPs	No	0.43 (-0.16 to 1.02)
	32 GAGPS 28 placebo	Patient rated pain	1 month	GAGPs	No	0.21 (-0.08 to 0.95)
			1.5 months	GAGPs	Yes	0.44 (-0.08 to 0.95)
			3 months	GAGPs	Yes	0.38 (-0.13 to 0.89)
			6 months	GAGPs	No	0.15 (-0.35 to 0.66)

GAGPS = glucosaminoglycan polysulfate
[a] calculated by ECRI

Different types of steroids

One double-blinded controlled trial of 46 patients compared injections of hydrocortisone to injections of methylprednisolone for treating epicondylitis. The data reported from this trial are shown in Table 252 and summarized in Table 253. The trial reported on whether the treatments were successful in treating the pain of epicondylitis, and on whether the pain recurred after six months. No statistically significant difference in either of these outcomes was found between treatment with the two different steroids. Injections of these steroids were reported to cause pain and bruising in a low percentage of patients. There was no statistically significant difference in the rates of such side effects between the two steroids. The study had the statisticaly power to detect fairly small (19-23%) differences between groups. This suggests that if there is a difference between groups, it is not large.

Table 252. Hydrocortisone compared to methylprednisone for treating epicondylitis

Study	Outcome measured	Number of patients	Number of patients considered to have a successful treatment	Statistical signficance of the difference between groups
Clarke 1975 [605]	A success was two pain-free visits; a failure was three injections without improvement over the course of 2 months	48 methylprednisone 55 hydrocortisone	21 methylprednisone 20 hdrocortisone	Test NR NS
	Recurrence of symptoms by mailed questionnaire 6 months later	24 methylprednisone 23 hydrocortisone	16 methylprednisone 10 hydrocortisone	Test NR NS

Table 253. Hydrocortisone compared to methylprednisone for treating epicondylitis

Study	Outcome measured	Number of patients	Which steroid was more effective?	Was the difference statistically significant?	Minimal difference between groups the study had the power to detect	Effect size d (95% CI)[a]
Clarke 1975 [605]	Success of treatment	48 methylprednisone 55 hydrocortisone	methylprednisone	No	19%	0.17 (-0.27 to 0.61)
	Recurrence of symptoms by mailed questionnaire	24 methylprednisone 23 hydrocortisone	methylprednisone	No	23%	0.52 (-0.13 to 1.2)

[a] calculated by ECRI

Glucocorticoids plus anesthetics compared to anesthetics

One randomized double-blinded controlled trial of 58 patients compared a combination of methylprednisolone plus lidocaine to lidocaine alone. In addition to the injections, all patients in this trial received oral NSAIDs, physical therapy, and were advised to rest the affected arm. The patients each received a single injection. The trial evaluated the pain the patients were experiencing as rated by the patient.

The data are shown in Table 254 and summarized in Table 255. The patients treated with the steroid plus the anesthetic had statistically significantly less pain at 1.5 months, but not at longer followup times, than did patients treated only with an anesthetic.

Table 254. Results of treating epicondylitis with anesthetics compared to anesthetics plus glucocorticoids

Study	Outcome measured	Treatment group	N patients	Time in months	Outcome mean (SE)	Statistical significance of difference between groups
Stahl 1997 [601]	Patient-rated pain	Methylprednisolone plus lidocaine	43	0	3.7 (0.26)	T test p >0.5
		lidocaine	30	0	3.5 (0.24)	
		Methylprednisolone plus lidocaine	43	1.5	1.5 (0.3)	T test p <0.03
		lidocaine	30	1.5	2.2 (0.29)	
		Methylprednisolone plus lidocaine	43	12	0.5 (0.18)	T test p >0.5
		lidocaine	30	12	0.6 (0.17)	

Table 255. Effectiveness of treating epicondylitis with anesthetics compared to anesthetics plus glucocorticoids

Study	Number of patients	Time of followup	Which treatment was most effective?	Was the difference statistically significant?	Effect size d (95% CI)[a]
Stahl 1997 [601]	43 Methylprednisolone plus lidocaine 30 lidocaine	0 months	No difference	No	-0.13 (-0.60 to 0.33)
		1.5 months	Methylprednisolone plus lidocaine	Yes	0.39 (-0.08 to 0.86)
		12 months	Methylprednisolone plus lidocaine	No	0.09 (-0.37 to 0.56)

[a] calculated by ECRI

Glucocorticoids plus anesthetics compared to glucocorticoids

One A-B trial compared injections of lidocaine plus betamethasone to injections of methylprednisolone. The data reported by the trial are shown in Table 256 and summarized in Table 257. The trial reported the success of the treatment as rated by the patient (global outcome). Steroids plus anesthetics were found to be more effective than steroids alone, but the difference did not reach statistical significance. The study was large enough to detect fairly small differences in outcomes between the groups. The trial also reported the number of work-days the patients missed due to their epicondylitis. There was insufficient data reported about work status to determine if the difference was statistically significant.

Table 256. Results of trials comparing steroids to steroids plus anesthetics as a treatment for epicondylitis

Study	Outcome measured	Number of patients	Reported data	Statistical signficance of the difference between groups
Kivi 1982 [604]	Success of treatment, at 12 months	47 Betamethasone and lidocaine 21 methylprednisolone	Steroid plus lidocaine: 36 excellent, 7 good, 3 same, 1 worse Steroid: 16 excellent, 3 good, 2 same, 0 worse	Chi-squared test p = 0.057
	Days off work, at 12 months	47 Betamethasone plus lidocaine 21 Methylprednisone	Steroid plus lidocaine: Mean 16.4 days off Steroid: Mean 12.2 days off	Cannot calculated from the reported data

NC = could not calculate from the reported data

Table 257. Effectiveness of steroids compared to steroids plus anesthetics as a treatment for epicondylitis

Study	Outcome measured	Number of patients	Which treatment was most effective?	Was the difference statistically significant?	What was the minimal difference between groups the study had the power to detect?	Effect size d (95% CI)[a]
Kivi 1982 [604]	Success of treatment	47 Betamethasone plus lidocaine 21 Methylprednisone	Betamethasone plus lidocaine	No	8%	0.13 (-0.39 to 0.64)
	Days off work	47 Betamethasone plus lidocaine 21 Methylprednisone	Methylprednisone	Not reported; cannot determine from reported data	Cannot calculated from the reported data	Cannot calculate from the reported data

[a] calculated by ECRI

Different combinations of glucocorticoids plus anesthetics

Two double-blinded randomized controlled trials of a total of 254 patients compared different combinations of steroids plus local anesthetics as a treatment for epicondylitis. One of the trials compared triamcinolone plus lidocaine to triamcinolone plus bupivacaine (Solveborn 1995). The other trial compared lignocaine alone to lignocaine plus hydrocortisone, lignocaine plus 10 mg of triamcinolone, and lignocaine plus 20 mg of triamcinolone (Price 1991). The trial by Solveborne 1995 did not report any data or statistics, but reported only that patients receiving bupivacaine had a better outcome two weeks after the injection than did patients receiving the lidocaine. The data reported by Price 1991 are shown in Table 258 and summarized in Table 259. Price 1991 reported that at one month, the group treated only with lignocaine had significantly less improvement than did the other groups, but that this difference was not statistically significant by 6 months. Price 1991 reported that some of the patients who received injections of triamcinolone experienced skin atrophy at the site of injection.

Table 258. Results of the study by Price 1991: patient-reported pain on VAS

Study	Treatment group	N patients	Months	Outcome mean (95% CI)	Effect size d (95% CI)[a]
Price 1991 [603]	Ligno	29	1	46 (37-55)	
	Ligno +hydro	29	1	28 (18-38)	3.66 (2.82 to 4.50)
	Ligno + triam	29	1	17 (10-25)	6.78 (5.44 to 8.12)
	Ligno + 10 triam	23	1	27 (18-37)	3.99 (3.05 to 4.93)
	Ligno + 20 triam	28	1	28 (19-37)	3.86 (2.98 to 4.74)
	Ligno	27	2	35 (26-43)	
	Ligno +hydro	27	2	30 (19-41)	0.99 (0.42 to 1.55)
	Ligno + triam	27	2	20 (10-30)	3.13 (2.34 to 3.93)
	Ligno + 10 triam	22	2	29 (17-40)	1.16 (0.55 to 1.77)
	Ligno + 20 triam	24	2	22 (14-31)	2.98 (2.18 to 3.77)
	Ligno	25	6	12 (8-17)	
	Ligno +hydro	26	6	24 (14-35)	-2.83 (-3.60 to -2.05)
	Ligno + triam	27	6	18 (7-28)	-1.40 (-2.01 to -0.80)
	Ligno + 10 triam	22	6	35 (21-48)	-4.52 (-5.60 to -3.44)
	Ligno + 20 triam	27	6	33 (22-45)	-4.55 (-5.58 to -3.52)

[a] calculated by ECRI, using lignocaine as the control group in each case. A positive effect size indicates the treatment group had less pain than the control group

Table 259. Summary of the study by Price 1991

Study	Number of patients	Time of followup	Which treatment was more successful?	Was the difference statistically significant?	Relevant effect size d (95% CI)
Price 1991 [603]	29 Ligno 29 Ligno +hydro 30 Ligno + triam 27 Ligno + 10 triam 29 Ligno + 20 triam	1 month	Lignocaine plus triamcinolone	Yes	6.78 (5.44 to 8.12)
		2 months	Lignocaine plus triamcinolone	No	3.13 (2.34 to 3.93)
		6 months	Lignocaine	No	NA

Ligno = lignocaine
Hydro = hydrocortisone
Triam = triamcinolone

Conclusions

One randomized double-blinded study reported that injections of glucosamines are effective in treating the symptoms of epicondylitis in the short term (less than 6 months) as measured by global outcome and patient-reported pain. However, injections of glucosamines were found to have a high rate of side effects- 40% of patients experienced pain at the site of injection, and 6% developed hematomas at the site of injection.

One randomized double-blinded study reported that injections of methylprednisolone plus lidocaine were statistically significantly more effective at treating pain than were injections of lidocaine.

One randomized double-blinded study reported that injections of lignocaine plus triamcinolone were statistically significantly more effective at treating pain than were injections of lignocaine or injections of lignocaine plus hydrocortisone.

One randomized double-blinded study reported that injections of triamcinolone plus bupivacaine were more successful at treating epicondylitis than were injections of triamcinolone plus lidocaine.

Table 260. Internal validity

Study	Number of patients	Number of centers	Funded by a for-profit agency?	Study design	Prospective?	Blinding	%Attrition	Intent to treat analysis	Compliance
Holdsworth 1993 [620]	42	1	NR	RCT	Yes	Patients	14.3	No	NA
Haker 1991 [619]	45	1	NR	RCT	Yes	Double	28.9	No	NA
Stratford 1989 [621]	40	1	No	RCT	Yes	Double	0	Yes	NA
Lundeberg 1988 [617]	99	1	NR	RCT	Yes	Double	0	Yes	NR
Binder 1985 [618]	76	1	NR	RCT	Yes	Double	0	Yes	NA

RCT = randomized controlled trial
NA = not applicable
NR = not reported

Generalizability

Details of the patient groups are shown in Table 261. Studies of the epidemiology of epicondylitis (see the Introduction) have found that the typical patient with epicondylitis is in the mid-forties and equally likely to be male or female. All of the patient groups enrolled in these trials are similar in mean age and gender composition to the typical patients.

The presence of various comorbidities associated with epicondylitis is incompletely reported in these studies. Some studies excluded patients with some comorbidities, indicated in Table 261 by a zero under that comorbidity. This limits the generalizability of these studies, as combordities are not usually an exclusion criterion for treatment with ultrasound or phonophoresis.

None of the studies reported any information on patient employment characteristics. Therefore, the extent to which the employment characteristics of these patients may be generalized to the overall epicondylitis population cannot be determined from the information available.

Table 261. Generalizability: patient characteristics

Study	Number of patients	Mean age and range	% female	Duration of condition mean and range	% Patients with diabetes	% Patients with arthritis	% Patients with previous relevant injuries	% Patients with other relevant nerve impingement conditions	% Patients with peripheral neuropathy	% Patients pregnant	% Patients on kidney dialysis	Did the study exclude patients with severe disease?	Did the study exclude patients with mild disease?
Holdsworth 1993 [620]	42	45.3 (22-62)	35.7	NR	NR	0	0	0	0	NR	NR	No	No
Haker 1991 [619]	45	49.3 (34-67)	44.4	8.5 (1-60)	NR	NR	NR	NR	NR	NR	NR	No	No
Stratford 1989 [621]	40	43.3	50.0	4.3	NR	NR	NR	0	NR	NR	NR	No	No
Lundeberg 1988 [617]	99	38 (21-68)	43.4	NR	NR	0	NR	0	0	NR	NR	No	No
Binder 1985 [618]	76	43.3 (29-65)	63.2	4.6 (1-12)	NR	0	NR	0	0	NR	NR	No	No

NR = not reported

Table 262. Results of treating epicondylitis with ultrasound

Study	Number of patients	Reported outcome	Statistical significance of difference between groups
Holdsworth 1993 [620]	7 Phonophoresis 9 Ultrasound	At 1.5 months, mean (SE) patient-rated global outcome on VAS Phonophoresis: 49.6 (12.4) Ultrasound: 63 (12.2)	ANOVA p >0.05
Haker 1991 [619]	21 Ultrasound 22 Sham	At 3 months, patient-rated global outcome Ultrasound: 8 excellent, 8 improved, 5 same or worse Sham: 10 excellent, 7 improved, 5 same or worse	Mann-Whitney U-test NS

Table 263. Success of treating epicondylitis with ultrasound

Study	Number of patients	Time of followup	Which treatment was more successful?	Was the difference statistically significant?	Minimal difference between groups the study had the power to detect	Effect size d (95% CI)
Holdsworth 1993 [620]	7 phonophoresis 9 ultrasound	1.5 months	Ultrasound	No	82.5%	0.33 (-0.55 to 1.20)
Haker 1991 [619]	22 sham 21 ultrasound	3 months	Sham	No	20%	-0.19 (-0.79 to 0.41)

Work Status

None of the studies reported data applicable to this outcome.

Pain

Three studies of a total of 161 patients reported pain after treating epicondylitis with ultrasound. One of these studies compared ultrasound alone to phonophoresis, while the other two studies compared ultrasound to sham or no treatment. The data from these studies are shown in Table 264 and summarized in Table 265. The study comparing ultrasound to phonophoresis reported no statistically significant difference in pain between the two treatment groups. It was, however, too small to detect differences between the treatment groups of less than 50%.

One of the studies comparing ultrasound to sham or no treatment reported no statistically significant difference in pain between-treatment groups, while the other study reported a significant decrease in pain experienced by the group treated with ultrasound as compared to the untreated group. However, the effect sizes we calculated for both of these studies suggested a statistically significant effect of ultrasound as compared to no or sham treatment.

Table 264. Effect of ultrasound treatment on pain related to epicondylitis

Study	Number of patients	Reported outcome: patient-reported pain on VAS	Statistical signficance of difference between groups
Stratford 1989 [621]	10 phonophoresis 9 ultrasound	At 2.5 months, mean (SD) Phonophoresis: 21.8 (30.4) Ultrasound: :28.3 (17)	ANCOVA P = 0.87
Lundeberg 1988 [617]	33 ultrasound 33 No treatment 33 sham	At 3 months, mean (SD) Ultrasound 2.8 (0.3) No treatment 2.1 (0.5) Sham 2.4 (0.3)	Wilcoxon's rank sum test NS
Binder 1985 [618]	38 Ultrasound 38 No treatment	0.5 months, mean Utlrasound 0.75 No treatment 2.2 1 months, mean Ultrasound 3.4 No treatment 1.5 2 months, mean Ultrasound 4 No treatment 1.7	Wilcoxon's rank sum test At 1 month p <0.01 At 2 months p <0.005

Table 265. Pain experienced by patients treated with ultrasound

Study	Number of patients	Time of followup	Which treatment resulted in less pain?	Was the difference statistically significant?	Minimal difference between groups the study had the power to detect	Effect size d (95% CI)[a]
Stratford 1989 [621]	10 phonophoresis 9 ultrasound	2.5 months	Phonophoresis	No	54.3%	0.26 (-0.34 to 0.86)
Lundeberg 1988 [617]	33 ultrasound 33 No treatment 33 sham	3 months	Ultrasound	No	Could not calculate from the reported data	Vs. no: 1.68 (1.12 to 2.24) Vs. sham: 1.32 (0.79 to 1.85)
Binder 1985 [618]	38 Ultrasound 38 No treatment	1 and 2 months	Ultrasound	Yes at both times of followup	NA	1 month: 0.60 (0.14 to 1.06) 2 months: 0.66 (0.20 to 1.12)

[a] calculated by ECRI

Function and Activities

One study reported data on patient-reported function and activities of daily living. This study compared phonophoresis to ultrasound, and measured pain upon performing activities of daily living, function as rated by VAS, and the ability to perform recreational activities. No statistically significant difference for any of the outcomes was reported; however, the study could have detected only a 73.6% or larger difference between the groups, so it could have missed clinically important effects. The reported results are shown in Table 266 and summarized in Table 267.

Table 266. Effect of ultrasound on hand/arm function

Study	Number of patients	Patient-reported hand/arm function- VAS	Statistical signficance of the difference between groups
Stratford 1989 [621]	10 phonophoresis 9 ultrasound	At 2.5 months, mean (SD) Phonophoresis 78.8 (23.7) Ultrasound 66 (25)	ANCOVA p >0.05

Table 267. Function after treatment with ultrasound

Study	Number of patients	Followup time	Which treatment resulted in more effective function?	Was the difference statistically significant?	Minimal difference between groups the study had the power to detect	Effect size d (95% CI)[a]
Stratford 1989 [621]	10 phonophoresis 9 ultrasound	2.5 months	phonophoresis	No	73.6%	0.50 (-0.39 to 1.39)

a: calculated by ECRI

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. We were not able to compensate for attrition in the trial Clements 1993 due to incomplete data reporting, but we were able to compensate for attrition in the trial by Solveborn 1997. Compensating for attrition did not change the conclusions of this trial.

Table 268. Internal validity

Study	Number of patients	Number of centers	Funded by a for-profit agency?	Study design	Prospective?	Blinding	%Attrition	Intent to treat analysis	Compliance
Wuori 1998 [577]	50	1	No	RCT Xover	Yes	No	0	Yes	NA
Solveborn 1997 [579]	185	1	NR	CT	Yes	No	29.2	No	88.1
Vicenzino 1996 [592]	15	1	NR	RCT Xover	Yes	Double	0	Yes	NA
Clements 1993 [580]	19	1	NR	CT	Yes	No	15.8	No	52.6
Forbes 1990 [578]	19	1	Yes	Xover	Yes	No	0	Yes	NA

NR = not reported
RCT = randomized controlled trial
CT = controlled trial
Xover = crossover
NA = not applicable

Generalizability

Details of the patient characteristics are shown in Table 269. Studies of the epidemiology of epicondylitis (see the Introduction) have found that the typical patient is in the mid-forties and is equally likely to be male or female. Forbes 1990 did not report the ages of the patients. The mean ages of the patient groups in the other studies are all in the mid-forties. Solveborn 1997 did not report the sexes of the patients. The trial by Clements 1993 was predominantly male (73.7%), and the trial by Forbes 1990 was predominantly female (84.2%). It is possible these patient groups may be composed of atypical patients.

The presence of various comorbidities associated with epicondylitis is incompletely reported in these studies. Some studies excluded patients with some comorbidities, indicated in Table 269 by a zero under that comborbidity. This somewhat limits the generalizability of these studies, as comorbidities are not exclusion criteria for the treatments evaluated in this section.

The occupations and employment status of the patients are shown in Table 270. Only one study reported any information about the employment status of its patients. Therefore, the extent to which the employment characteristics of these patients may be generalized to the overall epicondylitis patient population cannot be determined from the information available.

Table 269. Generalizability: patient characteristics

Study	Number of patients	Mean age and range	% female	Duration of condition mean and range	% Patients with diabetes	% Patients with arthritis	% Patients with previous relevant injuries	% Patients with other relevant nerve impingement conditions	% Patients with peripheral neuropathy	% Patients pregnant	% Patients on kidney dialysis	Did the study exclude patients with severe disease?	Did the study exclude patients with mild disease?
Wuori 1998 [577]	50	44.5	46	7.5	NR	NR	NR	0	NR	NR	NR	No	No
Solveborn 1997 [579]	185	43.5 (19-71)	NR	12.3 (0-72)	NR	NR	NR	NR	NR	NR	NR	No	No
Vicenzino 1996 [592]	15	44 (22-62)	53.3	8 (2-36)	NR	NR	NR	NR	NR	NR	NR	No	No
Clements 1993 [580]	19	42.4 (33-54)	26.3	NR	NR	0	0	NR	NR	NR	NR	No	No
Forbes 1990 [578]	19	NR	84.2	NR	NR	NR	NR	NR	NR	NR	NR	No	No

NR = not reported

Table 270. Generalizability: patient occupations

Study	Number of patients	% Patients employed	% Patients on Workers' compensatio	% Patients retired	% Patients homemakers	Reported occupations
Wuori 1998 [577]	50	NR	NR	NR	NR	NR
Solveborn 1997 [579]	185	NR	NR	NR	NR	NR
Vicenzino 1996 [592]	15	NR	NR	NR	NR	NR
Clements 1993 [580]	19	NR	NR	NR	10.5	21.0% food services 15.7% mechanic/repairman 5.2% nurse 5.2% librarian 5.2% engineer 5.2% office worker
Forbes 1990 [578]	19	NR	NR	NR	NR	NR

NR = not reported

Results

Manipulation

One randomized controlled crossover trial of 15 patients compared a contralateral glide manipulation technique to no manipulation and to a placebo manipulation (Table 271). Patient-reported pain (VAS) and function (activities of daily living; ADL) were measured before treatment, and 24 hours after each treatment. Outcomes after each treatment were not directly compared. Instead, pre-post outcome measurements were compared. There were no statistically significant changes in these patient-oriented outcomes for any of the treatments. Statistical significance was defined as $p < 0.05$, but the test used was not described. The reported data were insufficient for effect size of power calculations.

Table 271. Effect of treatment with manipulation on epicondylitis

Study	Number of patients	Which treatment was more effective?	Was the difference statistically significant?	Was the effect size statistically significant?	Did the study have sufficient power to detect the observed difference?
Vicenzino 1996 [592]	15 manipulation 15 placebo	No difference	No	Could not calculate from the reported data	Could not calculate from reported data

Braces and physiotherapy

Success of Treatment

One trial that compared wearing a brace for several months to receiving regular physiotherapy reported on this outcome. The data are shown in Table 272 and summarized in Table 273. For both followup times, physiotherapy was statistically significantly more successful than was bracing.

Table 272. Results of treating epicondylitis with bracing or physiotherapy

Study	Number of patients	N patients treated successfully (%)	Statistical significance of difference between groups
Solveborn 1997 [579]	91 Bracing 85 Physiotherapy	At 1 month, Bracing 56 (61.5%) Physiotherapy 80 (95%) At 3 months, Bracing 23 (25.3%) Physiotherapy 38 (44.7%)	Chi-squared test At 1 month, p <0.0001 At 3 months, p <0.01

Table 273. Success of treating epicondylitis with bracing or physiotherapy

Study	Number of patients	Time of followup	Which treatment was more successful?	Was the difference statistically significant?	Effect size d (95% CI)[a]
Solveborn 1997 [579]	91 Bracing 84 Physiotherapy	1 and 3 months	Physiotherapy	Yes	At 1 month: -1.39 (-1.99 to -0.79) At 3 months: -0.44 (-0.79 to -0.08)

[a] calculated by ECRI

Work Status

The trial by Solveborn 1997 reported the number of days patients were unable to work due to their condition. These data are shown in Table 274 and summarized in Table 275. At three months and nine months of followup, the group treated with physiotherapy had statistically significantly fewer days of not working than did the group treated with bracing.

Table 274. Results of treating epicondylitis with bracing or physiotherapy on work status

Study	Number of patients	Mean number of days off work	Statistical significance of difference between groups
Solveborn 1997 [579]	91 Bracing 94 Physiotherapy	At 1 month: bracing 14 Physiotherapy 14 At 3 months: Bracing 20 Physiotherapy 13 At 9 months: Bracing 24 Physiotherapy 14	Chi-squared test At 1 month NS At 3 months p <0.01 At 9 months p <0.01

Table 275. Effect of treating epicondylitis with bracing or physiotherapy on work status

Study	Number of patients	Which treatment resulted in fewer days off work?	Was the difference statistically significant?	Effect size
Solveborn 1997 [579]	91 Bracing 94 Physiotherapy	Physiotherapy	No at 1 month Yes at 3 and 9 months	Could not calculate from the reported data

Pain

The crossover trial by Wuori 1998 asked the patients to rate their pain before, during, and after tests of grip strength while wearing various types of braces. There were no statistically significant differences in pain reported from tests wearing the different types of braces (data shown in Table 276 and summarized in Table 277). However, the trial by Wuori 1998 had insufficient power to detect differences between the groups of less than 64%.

The trial by Clements 1993 reported that patients who had been treated with a brace plus physiotherapy for a month had statistically significantly less self-reported pain than did patients treated only with physiotherapy (t-test; $p < 0.05$). The trial by Solveborn 1997 reported that all times of followup the patients treated with physiotherapy reported less pain than did the patients treated by bracing (data shown in Table 276 and summarized in Table 277).

Table 276. Results of treatment with bracing on pain related to epicondylitis

Study	Number of patients	Pain reported by patients	Statistical significance of difference between groups
Wuori 1998 [577]	50 Count'Rforce brace 50 Airprene brace 50 Placebo brace	Mean (SD) Before other tests CountRforce 1.3 (1.7) Airprene1.4 (1.9) Placebo 1.4 (1.8) During other tests CountRforce 3.4 (2.1) Airprene 3.3 (2.3) Placebo 3.4 (2.4) After other tests CountRforce1.5 (1.7) Airprene 1.7 (2.1) Placebo 1.4 (1.8)	ANOVA Before other tests NS During other tests NS After other tests NS
Solveborn 1997 [579]	91 Bracing 94 Physiotherapy	1 month Bracing 39 (22) Physiotherapy 27 (21) 3 months Bracing 32 (21) Physiotherapy 20 (22) 9 months Bracing 19 (19) Physiotherapy 13 (20)	Paired t-test 1 month $p < 0.0001$ 3 months $p < 0.0001$ 9 months $p < 0.045$

Table 277. Effect of treatment with bracing on pain related to epicondylitis

Study	Number of patients	Which treatment resulted in less pain?	Was the difference statistically significant?	Minimal difference between groups the study had the power to detect	Effect size d (95% CI)[a]
Wuori 1998 [577]	50 Count'Rforce brace 50 Airprene brace 50 Placebo brace	Airprene brace	No	64%	Before other tests: CountRforce -0.06 (-0.45 to 0.34) Airprene 0.00 (-0.39 to 0.39) During other tests: CountRforce 0.00 (-0.39 to 0.39) Airprene -0.04 (-0.43 to 0.35) After other tests: CountRforce 0.06 (-0.34 to 0.35) Airprene 0.15 (-0.24 to 0.54)
Clements 1993 [580]	10 bracing plus physiotherapy 9 physiotherapy	Bracing plus physiotherapy	Yes t-test	NA	Could not calculate from the reported data
Solveborn 1997 [579]	91 Bracing 94 Physiotherapy	Physiotherapy	Yes	NA	1 month:056 (0.26 to 0.85) 3 months: 0.56 (0.26 to 0.85) 9 months: 0.31 (0.02 to 0.60)

[a] calculated by ECRI

Function

Clements 1993 reported no statistically significant difference between patients treated with a brace plus physiotherapy and patients treated only with physiotherapy.[580] Although statistical power could not be calculated from the data provided, this study was small (n = 19), suggesting that only large differences could be detected.

Table 278. The Effect of Bracing plus Physiotherapy on Function

Study	Number of patients	Which treatment resulted in greater function?	Was the difference statistically significant?	Was the effect size statistically significant?	Did the study have sufficient power to detect the observed difference?
Clements 1993 [580]	10 bracing plus physiotherapy 9 physiotherapy	Bracing plus physiotherapy	No	Could not calculate from the reported data	Cannot calculate from the reported data

Quality of life

None of the studies reported on this outcome.

Morbidity and Complications

No morbidity or complications were reported by the studies.

Conclusions

Three crossover trials and two controlled trials evaluated the effectiveness of physiotherapy, elbow bracing, and manipulation as treatments for epicondylitis. Because only one study evaluated manipulation, only two evaluated short-term effects of braces, only one evaluated bracing vs. physiotherapy, and only one evaluated bracing plus physiotherapy, it is difficult to draw firm evidence-based conclusions from the available data.

Simply wearing an elbow brace is reported by two studies to have no effect on pain. One study reported that wearing a brace regularly over the course of several months is not as effective in treating epicondylitis as is physiotherapy, but a different study reported that wearing a brace regularly in addition to physiotherapy may be more effective than physiotherapy alone. One manipulative technique, the contralateral glide procedure, may have some benefit for the treatment of epicondylitis. These general trends are drawn from at most two studies per outcome. Confirmatory studies would strengthen confidence in these results.

What are the relative benefits and harms of acupuncture therapy for persons with epicondylitis?

Stimulation of acupuncture points is thought to induce the release of endorphins and thus induce an analgesic effect.[627] The relevant literature that addressed this question consists of two trials that compared acupuncture to sham acupuncture.

Internal validity

We identified two randomized controlled trials of a total of 134 patients that evaluated the effect of acupuncture on epicondylitis. Details of the designs of the trials are shown in Table 279. The trial by Molsberger 1994 was double-blinded. The trial by Haker 1990 was blinded as to rater only, and thus is susceptible to bias from a placebo effect.

One trial (Haker 1990) treated the control group with superficially inserted needles, while the other trial (Molsberger 1994) treated the control group with blunt probes at a different site. The appropriate control group to use in trials of acupuncture is unclear. Attempts at performing sham acupuncture, including inserting needles at other sites, inserting needles only superficially, and only stimulating the skin with a blunt probe, have been reported to have similar physiological effects as true acupuncture.[627] Therefore any comparison of acupuncture to placebo may yield a greater apparent effect than any comparison of acupuncture and sham acupuncture. However, comparing acupuncture to no treatment does not control for any placebo effect.

Table 279. Internal validity

Study	Number of patients	Number of centers	Funded by a for-profit agency?	Study design	Prospective?	Blinding	%Attrition	Intent to treat analysis	Compliance
Molsberger 1994 [575]	48	1	NR	RCT	Yes	Double	0	Yes	NA
Haker 1990 [576]	86	1	NR	RCT	Yes	Rater	4.7[a]	Yes	NA

[a]: Attrition at longest follow up time (12 months)

Generalizability

Details of the patient characteristics are shown in Table 280. Studies of the epidemiology of epicondylitis (see the Introduction) have found that the typical patient is in the mid-forties and that approximately equal proportions of men and women are affected. The patients in both studies are similar to this profile.

The presence of various comorbidities associated with epicondylitis is incompletely reported in these studies. Both studies excluded patients with certain comorbidities, indicated in Table 280 by a zero under that comorbidity. This somewhat limits the

Table 280. Generalizability: patient characteristics

Study	Number of patients	Mean age and range	% female	Duration of condition mean and range	% Patients with diabetes	% Patients with arthritis	% Patients with previous relevant injuries	% Patients with other relevant nerve impingement conditions	% Patients with peripheral neuropathy	% Patients pregnant	% Patients on kidney dialysis	Did the study exclude patients with severe disease?	Did the study exclude patients with mild disease?
Molsberger 1994 [575]	48	47.9	54.2	15.4	NR	0		NR	NR	NR	NR	No	No
Haker 1990 [576]	86	46.9 (25-70)	34.9	9 (1-120)	NR	0	NR	0	0	NR	NR	No	No

Table 281. Results of global assessment of acupuncture

Study	Number of patients	Global assessment patient-reported	Statistical significance of difference between groups
Haker 1990 [576]	44 acupuncture 38 control	Acupuncture- 1 month: 7 excellent, 15 good, 17 well improved, 4 improved, 1 same or worse 3 months: 14 excellent, 19 good, 3 well improved, 4 improved, 3 same or worse 12 months: 26 excellent, 8 good, 3 well improved, 1 improved, 2 same or worse Control- 1 month: 2 excellent, 6 good, 17 well-improved, 3 improved, 10 same or worse 3 months: 7 excellent, 14 good, 9 well improved, 3 improved, 2 same or worse 12 months: 13 excellent, 16 good, 2 well improved, 2 improved, 2 same or worse	Mann-Whitney U test P<0.01 at 1 month, NS at 3 and 12 months
Molsberger 1994 [575]	24 acupuncture 24 control	At 2 weeks Acupuncture- 19 treated successfully Control- 6 treated successfully	Chi-squared p <0.01

Table 282. Success of treating epicondylitis with acupuncture

Study	Number of patients	Time of followup	Which treatment was more successful?	Was the difference statistically significant?	Effect size d (95% CI)[a]
Haker 1990 [576]	44 Acupuncture 38 Control	1 month	Acupuncture	Yes	0.84 (0.39 to 1.29)
		3 months	Acupuncture	No	0.44 (0.00 to 0.88)
		12 months	Acupuncture	No	0.75 (0.30 to 1.20)
Molsberger 1994 [575]	24 Acupuncture 24 Control	2 weeks	Acupuncture	Yes	1.32 (0.58 to 2.06)

[a] calculated by ECRI

Table 283. Results of the effect of acupuncture treatment on pain related to epicondylitis

Study	Pain measured by	Number of patients	Reported outcome	Statistical significance of difference between groups
Molsberger et al. 1994 [575]	Patient-rated relief of pain	24 Acupuncture 24 Control	Acupuncture- mean 55.8 SD 2.95 Control- mean 15 SD 2.77	t-test p <0.01 for both outcomes
	Patient-rated duration of the relief of pain	24 Acupuncture 24 Control	Acupuncture- mean 20.2 SD 21.54 Control- mean 1.4 SD 3.5	

SD = standard deviation

Table 284. Effect of acupuncture treatment on pain related to epicondylitis

Study	Number of patients	Time of followup	Which treatment resulted in less pain?	Was the difference statistically significant?	Effect size d (95% CI)[a]
Molsberger 1994 [575]	24 Acupuncture 24 Control	2 weeks	Acupuncture	Yes	Relief of pain: 14.02 (11.16 to 16.89) Duration of pain relief: 1.20 (0.58 to 1.81)

[a] calculated by ECRI

Function and Activities

Neither of the studies reported either of these outcomes.

Quality of life

Neither of the studies reported this outcome.

Morbidity and Complications

No complications or morbidity were reported by either study.

by Wilhelm 1996, and found that the conclusions of the study did not change after compensation.

Neither study blinded the patients or the evaluating physician to the type of treatment, which can bias the results.

Table 285. Internal validity

Study	Number of patients	Number of centers	Funded by a for-profit agency?	Study design	Prospective?	Blinding	%Attrition	Intent to treat analysis	Compliance
Almquist 1998 [83]	61	1	No	CT	No	No	0	Yes	NA
Wilhelm 1996 [84]	166	1	NR	CT	No	No	11.4	No	NA

CT = controlled trial
NR = not reported
NA = not applicable

Generalizability

Characteristics of the patient groups are shown in Table 286. Our analysis of patients treated with surgery for epicondylitis (see the answer to Question 2) found that the typical patient was of either sex and in their mid-forties. The patients in both studies fit this profile.

Neither study reported on the presence of comorbidities or employment characteristics. Therefore, the extent to which these patient groups can be generalized to the overall epicondylitis population cannot be determined from the information available.

Table 286. Generalizability: patient characteristics

Study	Number of patients	Mean age and range	% female	Duration of condition mean and range	% Patients with diabetes	% Patients with arthritis	% Patients with previous relevant injuries	% Patients with other relevant nerve impingement conditions	% Patients with peripheral neuropathy	% Patients pregnant	% Patients on kidney dialysis	Did the study exclude patients with severe disease?	Did the study exclude patients with mild disease?
Almquist 1998 [83]	61	43.9 (27-63)	39.3	27.3 (6-72)	NR	NR	NR	NR	NR	NR	NR	No	No
Wilhelm 1996 [84]	166	44.5 (21-62)	57.8	NR	NR	NR	NR	NR	NR	NR	NR	No	No

NR = not reported

Results

Success of Treatment

The study by Wilhem 1996 reported that patients treated with denervation alone rated their outcomes more positively than did patients treated with denervation plus decompression or with denervation plus disinsertion. These data are reported in Table 287 and summarized in Table 288. The difference in outcomes was statistically significant between the denervation and denervation plus decompression groups, but was not statistically significant between the denervation and the denervation plus disinsertion groups. The denervation plus decompression group rated their outcomes statistically significantly more positively than did the denervation plus disinsertion group.

Table 287. Results of the success of surgery at treating epicondylitis

Study	Number of patients	Success of treatment	Statistical significance of difference between groups
Wilhem 1996 [84]	39 denervation 46 denervation and disinsertion 81 denervation and decompression	Denervation: 29 excellent, 4 good, 2 fair, 1 poor Disinsertion: 30 excellent, 7 good, 3 fair, 2 poor Decompression: 36 excellent, 13 good, 16 fair, 10 poor	Chi-squared test Denervation vs. disinsertion p = 0.159 Denervation vs. decompression P = 0.0071 Disinsertion vs. decompression p = 0.033

Table 288. Success of surgery at treating picondylitis

Study	Number of patients	Which treatment was most successful?	Was the difference significant?	Effect size d (95% CI)[a]
Wilhem 1996 [84]	39 denervation 46 denervation and disinsertion 81 denervation and decompression	Denervation	Yes, between denervation and decompression Yes, between decompression and disinsertion No, between denervation and disinsertion	Disinsertion: 1.13 (0.71 to 1.55) Denvervation: 0.75 (0.36 to 1.14)

[a] calculated by ECRI using decompression plus denervation as the control group

Work Status

Almquist 1998 reported on the number of patients able to resume normal work after treatment. These data are reported in Table 289 and summarized in Table 290. Wide fasciectomy plus anconeus transfer was reported to have a better outcome than did fasciectomy alone or limited fasciectomy plus anconeus transfer. The difference, however, was not statistically significant, despite the fact that the study

had sufficient power to detect a difference between groups as small as 3%. Hence, this negative finding is probably not the consequence of a small sample size.

Table 289. Results of surgical treatment on work status

Study	N patients	Percentage of patients able to return to normal work	Statistical significance of the difference between groups
Almquist 1998 [83]	16 fasciectomy 31 wide fasciectomy plus anconeus transfer 14 limited fasciectomy plus anconeus transfer	Fasciectomy - 81% Wide fasciectomy plus anconeus transfer - 96% Limited fasciectomy - 86%	Chi-squared test P>0.05

Table 290. Effect of surgical treatment on work status

Study	N patients	Which treatment resulted in more patients returning to work?	Was the difference significant ?	Minimal difference between groups the study had the power to detect	Effect size d (95% CI)[a]
Almquist 1998 [83]	16 fasciectomy 31 wide fasciectomy plus anconeus transfer 14 limited fasciectomy plus anconeus transfer	Wide fasciectomy plus anconeus transfer	No	3%	Wide fasciectomy: 1.05 (-0.25 to 2.35) limited fasciectomy: 0.17 (-0.90 to 1.25)

[a] calculated by ECRI with fasciectomy alone as the control group

Pain

Almquist 1998 reported that patients treated with wide fasciectomy plus anconeus transfer had more pain relief than did patients treated with fasciectomy. This difference was reported to be statistically significant. Patients treated with wide fasciectomy plus anconeus transfer were reported to have more pain relief than patients treated with limited fasciectomy plus anconeus transfer, but the difference in outcomes between these two groups was not statistically significant. These data are reported in Table 291 and summarized in Table 292.

Table 291. Results of surgical treatment on pain

Study	N patients	Percentage of patients with pain relief	Statistical significance of the difference between groups
Almquist 1998 [83]	16 fasciectomy 31 wide fasciectomy plus anconeus transfer 14 limited fasciectomy plus anconeus transfer	Fasciectomy - 62% Wide fasciectomy plus anconeus transfer- 87% Limited fasciectomy - 86%	Chi-squared test P<0.05 between wide plus transfer and fasciectomy only

Table 292. Effect of surgical treatment on pain

Study	N patients	Which treatment resulted in more pain relief?	Was the difference significant?	Effect size d (95% CI)[a]
Almquist 1998 [83]	16 fasciectomy 31 wide fasciectomy plus anconeus transfer 14 limited fasciectomy plus anconeus transfer	Wide fasciectomy plus anconeus transfer	Yes, between wide plus transfer and fasciectomy; No, between wide plus transfer and limited	Wide fasciectomy: 0.76 (-0.05 to 1.56) Limited fasciectomy: 0.69 (-0.31 to 1.68)

[a] calculated by ECRI with fasciectomy alone as the control group

Function and Activities

Neither of the included studies reported patient-oriented measurements of these outcomes.

Quality of Life

Neither of the included studies reported on this outcome.

Morbidity and Complications

Morbidity and complications related to the surgery were not reported by either study. Wilhem 1996 did describe the length of time required to recover from surgery. Denervation required only 2.7 weeks of recovery, as compared to 5.7 weeks to recover from denervation plus disinsertion and 11.7 weeks to recover form denervation plus decompression. These differences were reported to be statistically significant. These data are summarized in Table 293.

Table 293. Length of time after surgery before returning to work

Study	Number of patients	Which treatment had the shortest recovery time?	Was the difference significant?
Wilhem 1996 [84]	39 denervation 46 denervation and disinsertion 81 denervation and decompression	Denervation	Yes

Conclusions

One retrospective case-controlled study of 61 patients compared fasciectomy, wide fasciectomy plus anconeus transfer, and re-operation of failed fasciectomy to include an anconeus transfer. This study reported that patients treated with wide fasciectomy plus anconeus transfer had better outcomes than did patients treated with either fasciectomy or re-operation of failed fasciectomy to include an anconeus transfer. However, the design of this study was not optimal, and precludes one from making a firm evidence-based conclusion.

One non-parallel historically controlled trial of 166 patients reported that simple denervation lead to statistically significantly better global outcome and greater pain relief than did denervation plus decompression. Simple denervation was also reported to lead to better global outcome, and greater pain relief, than did denervation plus disinsertion, but the difference was not statistically significant. However, design difficulties with this study preclude one from using its results to make a firm evidence-based conclusion.

What are the relative benefits and harms of transcutaneous electrical nerve stimulation therapy for persons with epicondylitis?

Transcutaneous electrical nerve stimulation therapy (TENS) refers to applying an electrical current across the skin. TENS has been reported to relieve pain and stimulate wound healing. 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 compared TENS to sham TENS treatment.

Internal validity

One double-blinded randomized crosover trial was identified that employed transcutaneous electrical nerve stimulation therapy (TENS) for treating epicondylitis. Details of this study are shown in Table 294. The study treated one patient group with a Rebox device, which delivers a low-current voltage to the patient. The control group received sham treatment with a disabled Rebox device. After ten treatments, the groups spent a week receiving no treatment, then they received the opposite treatment.

Analysis and reported data are for only those who completed the entire trial (not intent-to-treat). Ignoring attrition when analyzing the data can create a bias in the results. However, attrition in this trial was not substantial (8.6%).

Table 294. Internal validity

Study	Number of patients	Number of centers	Funded by a for-profit agency?	Study design	Prospective?	Blinding	%Attrition	Intent to treat analysis	Compliance
Johannsen 1993 [612]	35	1	NR	RCT	Yes	Double	8.6	No	NA

Generalizability

The characteristics of the patients are shown in Table 295. The mean age of the patients was 43, which is similar to that reported in studies of the epidemiology of epicondylitis (see the Introduction). However, the patients were predominantly male (82.9% male). Studies of the epidemiology of epicondylitis (see the Introduction) have indicated that patients with epicondylitis are equally likely to be of either sex. Thus, this may be an atypical group of patients. No information as to the occupations or employment status of the patients was reported. The study excluded patients with various comorbidities. This limits the generalizability of the study, as comorbidities are not generally exclusion criteria for treatment with TENS.

Table 295. Generalizability: patient characteristics

Study	Number of patients	Mean age and range	% female	Duration of condition mean and range	% Patients with diabetes	% Patients with arthritis	% Patients with previous relevant injuries	% Patients with other relevant nerve impingement conditions	% Patients with peripheral neuropathy	% Patients pregnant	% Patients on kidney dialysis	Did the study exclude patients with severe disease?	Did the study exclude patients with mild disease?
Johannsen 1993 [612]	35	43 (36-58)	17.1	6 (3-12)	NR	0	0	0	0	NR	NR	No	No

What are the relative benefits and harms of pulsed electromagnetic field therapy for persons with epicondylitis?

Pulsed electromagnetic fields (PEMF) have been said to speed healing, alleviate pain, and reduce inflammation. The scope of our answer to this question is determined by the scope of the published literature. The relevant literature consists of one trial that compared PEMF therapy to sham PEMF therapy.

Internal validity

One double-blinded randomized controlled trial of 30 patients that evaluated pulsed electromagnetic fields (PEMF) as a therapy for epicondylitis was identified. The study design is summarized in Table 296. The gender compositions of the two groups appears to be different, but chi-squared tests calculated by ECRI indicate the difference is of borderline statistical significance (p = 0.06).

Table 296. Internal validity

Study	Number of patients	Number of centers	Funded by a for-profit agency?	Study design	Prospective?	Blinding	%Attrition	Intent to treat analysis	Compliance
Devereaux 1985 [598]	30	1	NR	RCT	Yes	Double	0	Yes	NA

Generalizability

Only patients diagnosed with epicondylitis who had a positive thermographic pattern with a hot area near the lateral epicondyle were included in the trial. Data on what percentage of epicondylitis patients in general who have such a thermographic pattern are not available. Thus, it is unclear whether these patients are typical epicondylitis patients. Other characteristics of these patients are shown in Table 297. The mean age (43.3 years) and percent female (43.3%) are similar to those found in studies of the epidemiology of epicondylitis (see the Introduction). No information as to the occupations or employment status of the patients was reported. The study did exclude patients with some comorbidities, which further limits the generalizability of the trial as comorbidities are not exclusion criteria for treatment with PEMF.

Table 297. Generalizability: patient characteristics

Study	Number of patients	Mean age and range	% female	Duration of condition mean and range	% Patients with diabetes	% Patients with arthritis	% Patients with previous relevant injuries	% Patients with other relevant nerve impingement conditions	% Patients with peripheral neuropathy	% Patients pregnant	% Patients on kidney dialysis	Did the study exclude patients with severe disease?	Did the study exclude patients with mild disease?
Devereaux 1985 [598]	30	43.8	43.3	10.0	NR	0	NR	0	0	0	NR	No	No

Results

The patients were evaluated every two weeks for the ability to lift weight, pain upon wrist dorisflexion, effect on work, pain during common activities of daily living (ADL), tenderness over the elbow, and grip strength. Data were only reported for grip strength, not for any of the patient-oriented outcomes. Grip strength was statistically significantly more effective at 6 weeks evaluation in the group given PEMF as compared to the group given sham treatment. However, examination of the data indicates that this difference is primarily the result of a mean decrease in grip strength at 6 weeks in the sham-treated group. For all of the other outcomes, at all time points, there were no reported statistically significant differences between the treatment groups. However, this study was small (n = 30), so it is possible that it lacked sufficient power to detect a statistically significant difference between the treatment groups. Because data reporting was incomplete, power calculations cannot be performed for this study.

Table 298. Success of treating epicondylitis with PEMF

Study	Number of patients	Which treatment was more effective?	Was the difference statistically significant?	Was the effect size statistically significant?	Did the study have sufficient power to detect the observed difference?
Devereaux 1985 [598]	15 PEMF 15 Sham	PEMF	No Wilcoxon rank sum test	Cannot calculate from the reported data	Cannot calculate from the reported data

PEMF = pulsed electrical magnetic field

Conclusions

A single double-blinded randomized controlled trial of 30 patients reported that there were no statistically significant differences in the signs and symptoms of epicondylitis between patients treated with PEMF and patients receiving sham treatment. When interpreting the results of this trial, it must be kept in mind that the small size of the trial may have prevented the results from reaching statistical significance.

What are the relative benefits and harms of extracorporal shock-wave therapy for persons with epicondylitis?

Extracorporal shock wave therapy (ESWT) refers to passing a shock wave through a localized area of the body. It has been reported to relieve pain.[581] The relevant literature consists of one published study that compared ESWT to a sham ESWT procedure.

Internal validity

Two manuscripts by the same group have been published evaluating ESWT as a treatment for epicondylitis. Both manuscripts refer to the same study; the earlier manuscript includes fewer patients.[582] Therefore, only the later manuscript is discussed in this report.[581] Details of the study design are shown in Table 299. The study was a randomized controlled trial. Neither the patients nor the evaluating physicians were blinded to the type of treatment received. 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] 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]

The trial did not analyze the data by the intent-to-treat principle. Ignoring attrition when analyzing the data can create a bias in the results. For this particular trial, we were unable to compensate for the failure to follow the intent-to-treat principle. The attrition rate from this trial was substantial (13.0%) and thus may have biased the results.

Table 299. Internal validity

Study	Number of patients	Number of centers	Funded by a for-profit agency?	Study design	Prospective?	Blinding	%Attrition	Intent to treat analysis	Compliance
Rompe 1996 [581]	115	1	NR	RCT	Yes	No	13.0	No	NA

NR = not reported
NA = not applicable
RCT = randomized controlled trial

Generalizability

Characteristics of the patient groups enrolled in the trial are shown in Table 300. All of the patients had been diagnosed with lateral epicondylitis. The mean age of the patients was 42.9, and the patient group was 50.4% female. These patient characteristics match those reported in published studies of the epidemiology of epicondylitis (see the Introduction), suggesting that the results of the study are generalizable beyond this particular patient group. The study did not report any

Table 300. Generalizability information: patient characteristics

Study	Number of patients	Mean age and range	% female	Duration of condition mean and range	% Patients with diabetes	% Patients with arthritis	% Patients with previous relevant injuries	% Patients with other relevant nerve impingement conditions	% Patients with peripheral neuropathy	% Patients pregnant	% Patients on kidney dialysis	Did the study exclude patients with severe disease?	Did the study exclude patients with mild disease?
Rompe 1996 [581]	115	42.9 (26-61)	50.4	22.9 (10-120)	NR	0	NR	NR	NR	NR	NR	No	No

Results

The reported patient-oriented results are shown in Table 301 and summarized in Table 302. The patients were asked to rate their improvement in pain and function. There is a statistically significant better outcome for patients treated with ESWT as compared to sham therapy at all followup times. We calculated an effect size for each time point and outcome and this is shown in Table 301.

Table 301. Results of treating epicondylitis with ESWT

Study	Outcome	Treatment group	N	Time of followup months	Reported outcome				Statistical test	Hedges' d (95% CI)[a]
					Excellent	Good	Acceptable	Poor		
Rompe 1996 [581]	Patient-rated improvement in pain and function								Chi-squared test[a] P<0.000001 at all time points	
		ESWT	50	1	11	16	18	5		2.76 (2.22 to 3.31)
		Sham	50	1	0	10	16	24		
		ESWT	50	1.5	10	16	18	6		3.05 (2.48 to 3.62)
		Sham	50	1.5	0	6	10	34		
		ESWT	50	6	6	11	13	21		1.20 (0.78 to 1.62)
		Sham	50	6	0	3	12	35		
	Pain at night, patient-rated	ESWT	50	0	34.6 (15.8)				Fisher's exact test p >0.05 at time 0, p <0.001 at all other times	-0.21 (-0.61 to 0.18)
		Sham	50	0	31.2 (16)					
		ESWT	50	1	13.2 (9.9)					1.49 (1.04 to 1.93)
		Sham	50	1	34.6 (17.6)					
		ESWT	50	1.5	7.7 (8.8)					1.91 (1.44 to 2.38)
		Sham	50	1.5	35.1 (18.1)					
		ESWT	50	6	7.3 (8.7)					1.48 (1.04 to 1.93)
		Sham	50	6	27.3 (16.8)					

[a] calculated by ECRI

Table 302. Effect of ESWT on epicondylitis

Study	Number of patients	Which treatment resulted in the greatest improvement?	Was the difference statistically significant?	Was the effect size statistically significant?
Rompe 1996 [581]	50 ESWT 50 Sham	ESWT, at 1, 1.5, and 6 months	Yes	Yes

ESWT = extracorporal shock wave therapy

Conclusions

One randomized controlled trial of 100 patients reported that patients treated with ESWT had statistically significantly greater improvements in pain and arm function than did patients given sham treatment. However, it is difficult to reach firm evidence-based conclusions from the results of this trial because the lack of blinding and lack of intent-to-treat analysis of this trial may have affected its results.

Table 303. Summary of trials of mixed therapies for epicondylitis

Study	Treatments compared
Drechsler 1997 [593]	Manipulations plus home exercise
	Ultrasound plus physiotherapy plus home exercise
Holdsworth 1993 [620]	Ultrasound
	Ultrasound plus brace
	phonophoresis
	Phonophoresis plus brace
Vasseljen 1992 [591]	Laser
	Ultrasound plus deep friction massage
Stratford 1989 [621]	Ultrasound
	Ultrasound plus deep friction massage
	Phonophoresis
	Phonophoresis plus deep friction massage
Burton 1988 [594]	Manipulation
	Manipulation plus brace
	Manipulation plus cream
	Manipulation plus cream plus brace

Table 304. Internal validity

Study	Number of patients	Number of centers	Funded by a for-profit agency?	Study design	Prospective?	Blinding	%Attrition	Intent to treat analysis	Compliance
Drechsler 1997 [593]	18	1	NR	RCT	Yes	No	0	Yes	NR
Holdsworth 1993 [620]	42	1	NR	RCT	Yes	Patients	14.3	No	NA
Vasseljen 1992 [591]	30	1	NR	RCT	Yes	No	0	Yes	NA
Stratford 1989 [621]	40	1	No	RCT	Yes	Double	0	Yes	NA
Burton 1988 [594]	33	1	Yes	RCT	Yes	No	0	Yes	NR

RCT = randomized controlled trial
NR = not reported
NA = not applicable

Generalizability

Details of the patient characteristics are shown in Table 305. Epidemiology studies of epicondylitis (see the Introduction) have found that the typical patient is in the mid-forties and of either sex. All of the patient groups of these studies fit this profile.

The presence of various comorbidities associated with epicondylitis is incompletely reported in these studies. Some studies excluded patients with various comorbidities, indicated in Table 305 with a zero under that comorbidity. This

Table 305. Generalizability: patient characteristics

Study	Number of patients	Mean age and range	% female	Duration of condition mean and range	% Patients with diabetes	% Patients with arthritis	% Patients with previous relevant injuries	% Patients with other relevant nerve impingement conditions	% Patients with peripheral neuropathy	% Patients pregnant	% Patients on kidney dialysis	Did the study exclude patients with severe disease?	Did the study exclude patients with mild disease?
Drechsler 1997 [593]	18	45.9 (30-57)	55.6	NR	0	0	NR	0	0	NR	0	No	No
Holdsworth 1993 [620]	42	45.3 (22-62)	35.7	NR	NR	0	0	0	0	NR	NR	No	No
Vasseljen 1992 [591]	30	45.5 (25-70)	56.7	2.1 (1-12)	NR	0	NR	NR	NR	NR	NR	No	No
Stratford 1989 [621]	40	43.3	50.0	4.3	NR	NR	NR	0	NR	NR	NR	No	No
Burton 1988 [594]	33	45.1	48.5	1.2	NR	NR	NR	NR	NR	NR	NR	No	No

NR = not reported

Table 306. Treating epicondylitis with ultrasound plus physiotherapy compared to manipulations

Study	Number of patients	Patient-reported difficulties in performing ADL	Statistical significance of difference between groups
Drechsler 1997 [593]	10 US, physiotherapy 8 Manipulations	Mean (SD) At 1.5 months US + physio: 1.9 (0.233) Manipulations: 1.875 (0.295) At 3 months US + physio: 2.1 (0.0314) Manipulations: 1.5 (0.189)	ANOVA At 1.5 months, NS At 3 months, $p < 0.05$

US = ultrasound
Physio = physiotherapy

Table 307. Treating epicondylitis with ultrasound plus physiotherapy compared to manipulations

Study	Number of patients	Which treatment was most successful?	Was the difference statistically significant?	Effect size d (95% CI)[a]
Drechsler 1997 [593]	10 US, physiotherapy 8 Manipulations	Manipulation	At 1.5 months, No At 3 months, Yes	At 1.5 months, 0.11 (-0.77 to 0.99) At 3 months, 4.24 (2.66 to 5.82)

[a] calculated by ECRI
US = ultrasound

Ultrasound with or without bracing

Holdsworth 1993 compared groups treated with ultrasound combined with elbow bracing therapy to groups treated with ultrasound only. The data reported by Holdsworth 1993 are shown in Table 308 and summarized in Table 309. Holdsworth 1993 reported that the addition of bracing to either ultrasound or phonophoresis had no statistically significant effect on patient-rated success of the treatment. However, this trial could have detected only an 83% or larger difference between groups. Therefore, its small size may have caused it to miss clinically important effects.

Table 308. Results of treating epicondylitis with ultrasound plus bracing

Study	Number of patients	Patient-rated success of treatment on VAS	Statistical significance of difference between groups
Holdsworth 1993 [620]	7 Phonophoresis 10 Phonophoresis plus bracing 9 ultrasound 8 Ultrasound plus bracing	1.5 months mean (SE) Phonophoresis: 49.6 (12.4) Phonophoresis + bracing: 55.9 (16.1) Ultrasound: 63 (12.2) Ultrasound + bracing: 62.6 (11.3)	ANOVA NS

Table 309. Treating epicondylitis with ultrasound plus bracing

Study	Number of patients	Which treatment was more successful?	Was the difference statistically significant ?	Minimal difference between groups the study had the power to detect	Effect size d (95% CI)[a]
Holdsworth 1993 [620]	7 Phonophoresis 10 Phonophoresis plus bracing 9 Ultrasound 8 Ultrasound plus bracing	Phonophoresis	No	83.5%	Phonophoresis: 0.33 (-0.55 to 1.21) 0.15 (-0.73 to 1.03) 0.01 (-0.87 to 0.89)

[a] calculated by ECRI using ultrasound as the comparison group

Ultrasound plus massage compared to laser

Vasseljen 1992 compared laser therapy to a mixture of ultrasound and deep friction massage. Each patient received eight treatments. Pain (physician-rated) was measured after all the treatments had been administered, and four weeks later. The group treated with ultrasound plus massage had significantly less pain ($p < 0.01$; ANOVA) after treatment than did the group treated with laser therapy.

Ultrasound plus massage compared to ultrasound

Stratford 1989 compared ultrasound plus deep friction massage to ultrasound alone. Each patient received nine treatments over the course of five weeks. The results are shown in Table 310 and summarized in Table 311. The study did not find a statistically significant difference between any of the treatment combinations. However, the study could have only detected a 42% or larger difference between the groups. Therefore, it was too small to detect a small to moderate clinically important effect.

Table 310. Results of treating epicondylitis with ultrasound plus massage as compared to ultrasound

Study	Type of Treatment	Number of patients with successful treatment	Statistical significance of difference between groups
Stratford 1989 [621]	10 Phonophoresis 10 Phonophoresis plus massage 9 Ultrasound 11 Ultrasound plus massage	3 phonophoresis 2 phonophoresis plus massage 1 ultrasound 4 ultrasound plus massage	Chi-squared test[a] Phonophoresis with or without massage P = 0.61 Ultrasound with or withour massage P = 0.19

[a] calculated by ECRI

Table 311. Success of treating epicondylitis with ultrasound plus massage as compared to ultrasound

Study	Number of patients	Which treatment was most successful?	Was the difference statistically significant ?	Minimal difference between groups the study had the power to detect	Effect size d (95% CI)[a]
Stratford 1989 [621]	10 Phonophoresis 10 Phonophoresis plus massage 9 Ultrasound 11 Ultrasound plus massage	Ultrasound plus massage	No	42%	Phonophoresis: 0.71 (-0.65 to 2.07) Phonophoresis plus massage: 0.43 (-1.0 to 1.85) Ultrasound plus massage: 0.95 (-0.39 to 2.28)

[a] calculated by ECRI with ultrasound as the comparison group

Manipulation plus bracing

Burton 1988 compared manipulations to improve mobility of the elbow to manipulations plus bracing, manipulations plus a topical anti-inflammatory cream, and a combination of all three therapies. Burton 1988 measured patient-rated hand-arm function. The data are shown in Table 312 and summarized in Table 313. No statistically significant differences between groups were found. However, this study lacks the statistical power to detect less than a 67% difference between the therapies, and thus could not have detected small to moderate clinically important effects.

Table 312. Results of treatment of epicondylitis with combinations of manipulation, bracing, and topical anti-inflammatories

Study	Number of patients	Mean (SD) of patient-rated function VAS			Effect size d (95% CI)[a]
Burton 1988 [594]	8 Bracing plus manipulation 8 Bracing plus cream plus manipulation 9 Cream plus manipulation 8 Manipulation	Initial measure	Bracing plus manipulation	3.2 (0.4)	0.0 (-0.88 to 0.88)
			Bracing plus cream plus manipulation	3.6 (1.0)	0.35 (-0.54 to 1.23)
			Cream plus manipulation	3 (0.7)	-0.19 (-1.07 to 0.68)
			Manipulation	3.2 (1.2)	
		1 week	Bracing plus manipulation	2.8 (0.8)	0.00 (-0.88 to 0.88)
			Bracing plus cream plus manipulation	2.8 (1.4)	0.00 (-0.88 to 0.88)
			Cream plus manipulation	2.5 (0.7)	-0.29 (-1.17 to 0.59)
			Manipulation	2.8 (1.2)	
		2 weeks	Bracing plus manipulation	2.5 (1.1)	0.00 (-0.88 to 0.88)
			Bracing plus cream plus manipulation	2.5 (1.7)	0.00 (-0.88 to 0.88)
			Cream plus manipulation	1.7 (0.6)	-0.63 (-1.53 to 0.26)
			Manipulation	2.5 (1.6)	
		4 weeks	Bracing plus manipulation	1.6 (1.0)	0.08 (-0.79 to 0.96)
			Bracing plus cream plus manipulation	1.5 (1.6)	0.00 (-0.88 to 0.88)
			Cream plus manipulation	1 (0.8)	-0.44 (-1.33 to 0.44)
			Manipulation	1.5 (1.3)	

[a] calculated by ECRI with manipulation as the comparision group

Table 313. Treatment of epicondylitis with combinations of manipulation, bracing, and topical anti-inflammatories

Study	N patients	Which treatment resulted in greater function?	Was the difference statistically significant?	Minimal difference the study had the power to detect	Where any of the effect sizes statistically significant?
Burton 1988[594]	8 Bracing plus manipulation 8 Bracing plus cream plus manipulation 9 Cream plus manipulation 8 Manipulation	Bracing plus cream plus manipulation	No for all followup times ANOVA test p >0.05	67%	No

Morbidities and complications

None of the included studies reported any complications or morbidities.

Conclusions

Five randomized controlled trials evaluated various combinations of therapies for the treatment of epicondylitis. Because no two trials evaluated the same combinations, no meta-analysis could be performed. One trial of 18 patients found that patients treated with manipulation plus a home exercise program had fewer difficulties in performing activities of daily living than did patients treated with a combination of ultrasound, physiotherapy, and home exercise. The other four trials did not find statistically significant differences between-treatment groups. However, these studies were small, which may have prevented them from detecting clinically important differences between the treatment groups. One of these studies reported a trend towards phonophoresis being rated as more successful than ultrasound, phonophoresis plus bracing, or ultrasound plus bracing. One of these studies reported a trend towards ultrasound plus deep friction massage being rated as more successful than ultrasound, phonophoresis, or phonophoresis plus deep friction massage. One of these studies reported no statistically significant functional differences after treatment with various combinations of bracing, manipulation, and topical anti-inflammatory cream. One of these studies reported a trend towards less pain experienced by patients treated with ultrasound plus deep friction massage than those treated with laser therapy.

No firm evidence-based conclusions as to the effectiveness of these combinations of therapies can be reached from the results presented by these trials. Four of the studies included too few patients to be able to have detected small but clinically meaningful effects of the therapies. Although the fifth study did find a statistically significant difference between groups for one outcome, it was a small study (n = 18)

Table 314. Summary of the trials comparing different therapies for epicondylitis

Study	Treatments compared Group 1	Group 2
Hay 1999 [609]	Injection of methylprednisolone and lidocaine	Naproxen, 500 mg 2X/day Placebo pills
Pienimaki 1996 [599]	Physical therapy	Ultrasound
Verhaar 1995 [607]	Injection of triamcinolone and lidocaine	Deep friction massage and manipulations, 12 times over 4 weeks
Haker 1993 [611]	Injection of bupivacaine and triamcinolone	Epicondylitis clasp, worn daily for 3 months Elbow immobilized in splint, worn daily for 3 months
Halle 1986 [606]	Injection of hydrocortisone and lidocaine TENS	Ultrasound Phonophoresis of hydrocortisone
Saartok 1986 [610]	Injection of betamethasone	Naproxen, 250 mg/day for 2 weeks
Brattberg 1983 [608]	Injection of steroids, unspecified type, unspecified number of injections	Acupuncture at five points in the region of the elbow. One to two treatments per week for four weeks

TENS = transcutaneous electrical nerve stimulation therapy
NSAID = non steroidal anti-inflammatory drug

Table 315. Internal validity

Study	Number of patients	Number of centers	Funded by a for-profit agency?	Study design	Prospective?	Blinding	%Attrition	Intent to treat analysis	Compliance
Hay 1999 [609]	182	Multiple	NR	RCT	Yes	Rater	0.55	Yes	NR
Pienimaki 1996 [599]	42	1	NR	RCT	Yes	Rater	7.1	No	NA
Verhaar 1995 [607]	106	1	No	RCT	Yes	No	2.8	No	NA
Haker 1993 [611]	76	1	NR	RCT	Yes	Double	6.6	No	NA
Halle 1986 [606]	48	1	NR	RCT	Yes	No	0	Yes	NR
Saartok 1986 [610]	21	1	NR	RCT	Yes	Double	14.2	No	NR
Brattberg 1983 [608]	63	1	NR	CT	Yes	No	4.8	No	NA

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

Generalizability

Details of the patient characteristics are shown in Table 316. The patients in all of the trials appear to be fairly typical of epicondylitis patients in general (see the epidemiology subsection in the Introduction). However, the Saartok trial appears to be predominantly male (19.0% female), and the Haker trial is also predominantly male (25.0% female); studies of the epidemiology of epicondylitis suggest that the general population is approximately 50% female. Thus, these two trials may be drawn from special subpopulations and their results may not be generalizable.

Table 316. Generalizability: patient characteristics

Study	Number of patients	Mean age and range	% female	Duration of condition mean and range	% Patients with diabetes	% Patients with arthritis	% Patients with previous relevant injuries	% Patients with other relevant nerve impingement conditions	% Patients with peripheral neuropathy	% Patients pregnant	% Patients on kidney dialysis	Did the study exclude patients with severe disease?	Did the study exclude patients with mild disease?
Hay 1999 [609]	182	NR	42.8	NR	NR	0	NR	NR	NR	0	NR	No	No
Pienimaki 1996 [599]	42	42 (31-53)	59.5	NR	NR	0	0	0	0	NR	NR	No	No
Verhaar 1995 [607]	106	43	47	8	NR	0	NR	0	0	NR	NR	No	No
Haker 1993 [611]	76	47.8	25	5 (1-36)	NR	0	NR	0	0	NR	NR	No	No
Halle 1986 [606]	48	(20-59)	54.1	NR	NR	NR	NR	0	0	NR	NR	No	No
Saartok 1986 [610]	21	45	19.0	NR	NR	NR	NR	NR	NR	NR	NR	No	No
Brattberg 1983 [608]	63	(30-60)	36.5	NR	NR	NR	NR	NR	NR	NR	NR	No	No

NR = not reported

Table 317. Generalizability: occupations

Study	Number of patients	% Patients employed	% Patients on Workers' compensatio	% Patients retired	% Patients homemakers	Reported occupations
Hay 1999 [609]	182	62.6	NR	NR	NR	NR
Pienimaki 1996 [599]	42	30.9	NR	NR	NR	NR
Verhaar 1995 [607]	106	NR	NR	NR	NR	NR
Haker 1993 [611]	76	NR	NR	NR	NR	NR
Halle 1986 [606]	48	NR	NR	6.3	29.1	33.3% blue collar workers 31.3% white collar workers
Saartok 1986 [610]	21	NR	NR	NR	NR	NR
Brattberg 1983 [608]	63	NR	NR	NR	NR	NR

NR = not reported

Results

NSAIDs compared to corticosteroid injections

Two randomized controlled trials of a total of 203 patients compared oral NSAIDs (naproxen) to corticosteroid injections (methylprednisolone and betamethasone). Both studies measured pain and function. In addition, they rated the overall success of the treatments. One of the studies reported no statistically significant difference in outcomes between the study groups, while the other study reported that the patients treated with corticosteroid injections had statistically statistically significantly better outcomes than did patients treated with oral NSAIDs or with placebo. The patient-oriented outcomes reported by these two studies are shown in Table 318 and summarized in Table 319. The study that reported no significant difference in outcomes (Saartok 1986) only had a total of 21 patients, and thus may have been too small for the difference in outcomes between its patient groups to reach statistical significance. We calculated that this study could have detected a 36% or greater difference between its groups. The fact that the Hay trial found a larger difference than this suggests that the results of these two trials are truly different, and not simply the result of a lack of statistical power on the part of the Saartok trial. As discussed previously, it is possible that the Hay trial was confounded by co-interventions.

Table 318. Results of treating epicondylitis with NSAIDs as compared to steroid injections

Study	Number of patients	Global assessment-patient rated categories	Statistical significance of difference between groups
Hay 1999 [609]	52 corticosteroid injection 53 NSAIDS 56 placebo	Corticosteroid injections: 22 complete recovery, 26 improvement, 3 no change, 1 worse, 0 much worse NSAIDs: 3 complete recovery, 27 improvement, 16 no change, 7 worse, 0 much worse Placebo: 2 complete recovery, 26 improvement, 23 no change, 4 worse, 1 much worse	Mann-Whitney U test p <0.05 injections compared to NSAID and injections compared to placebo
Saartok 1986 [610]	11Corticosteroid injection 10 NSAIDs	Corticosteroid injections: 1 much improved, 5 improved, 2 no change, 4 worse, 0 much worse NSAIDs: 0 much improved, 6 improved, 3 no change, 1 worse, 0 much worse	Mann-Whitney U test NS

Table 319. Success of treating epicondylitis with NSAIDs as compared to steroid injections

Study	Number of patients	Time of followup	Which treatment was more successful?	Was the difference statistically significant?	Minimal difference the study had the power to detect	Effect size d (95% CI)[a]
Hay 1999 [609]	52 steroid injection 53 oral NSAIDs 56 placebo	One month	Injection of corticosteroids	Yes	NA	Steroids vs. placebo: 0.57 (0.18 to 0.95) NSAIDs vs. placebo: -0.08 (-0.46 to 0.30) Steroids vs. NSAIDs: 1.31 (0.88 to 1.73)
Saartok 1986 [610]	11 steroid injection 10 oral NSAIDs	2 weeks	No difference	No	36%	0.54 (-0.33 to 1.42)

[a] calculated by ECRI
NSAID = non steroidal anti-inflammatory drug

Acupuncture compared to corticosteroid injections

One controlled trial of 63 patients compared acupuncture treatment to injections of corticosteroids. This trial reported only patient-rated pain. Patients were followed for different times after the treatment, with a mean followup time of 5.8 months, and a range of 2 to 9 months. Statistical tests performed by the authors indicated that acupunture treatment was statistically significantly more successful at relieving pain than was corticosteroid treatment. The data are summarized in Table 320. The calculated effect size agrees with the statistical tests performed by the authors. However, when interpreting the results of this trial it must be kept in mind that all of the patients had been found to be unresponsive to treatment with corticosteroid injections before being enrolled in the trial.

Table 320. Success of treating epicondylitis with acupuncture as compared to steroid injections

Study	Number of patients	Pain-patient rated categories	Statistical significance of difference between groups	Effect size d (95% CI)[a]
Brattberg 1983 [608]	34 acupuncture 26 corticosteroid injection	Acupuncture: 8 no pain, 9 slight pain, 4 better, 3 improved, 10 unchanged, 0 worse Injections: 2 no pain, 6 slight pain, 0 better, 8 improved, 6 unchanged, 4 worse	Chi-squared test P<0.05 Statistically significant	-0.59 (-1.09 to -0.08)

[a] calculated by ECRI

Physiotherapy compared to corticosteroid injections

One randomized controlled trial of 106 patients compared a combination of exercises and deep friction massage designed to improve mobility of the elbow to injections of corticosteroids. The reported results for the other patient-oriented outcomes are shown in Table 321 and summarized in Table 322. Manipulation and massage were found to be statistically significantly less effective than are injections of corticosteroids at treating pain and are rated as less effective by patients. Statistically significantly more patients treated with corticosteroid injections returned to work, but the effect size calculated for this outcome did not reach statistical significance.

Table 321. Results of treating epicondylitis with physiotherapy as compared to steroid injections

Study	Number of patients	Outcome measured	Outcome measurement At 1.5 months	Statistical significance of difference between groups
Verhaar 1995 [607]	52 corticosteroid injection 51 Manipulations and massage	Global assessment - patient rated categories	corticosteroid injection: 18 excellent, 18 good, 10 moderate, 6 poor Manipulations and massage: 1 excellent, 12 good, 15 moderate, 23 poor	Chi-squared test P<0.001
		Pain - patient rated categories	Injection: 22 absent, 20 slight, 9 moderate,1 severe Manipulations and massage: 3 absent, 19 slight, 22 moderate, 7 poor	Chi-squared test p <0.001
		Return to work	Injection: 9 resumed work, 15 still working, 9 unable to work, 19 did not work and still do not Manipulations and massage: 4 resumed work, 14 still working, 13 unable to work, 20 did not work and still do not	Chi-squared test p <0.05

Table 322. Success of treating epicondylitis with manipulations compared to injections of steroids

Study	Number of patients	Time of followup	Which treatment was more successful?	Was the difference statistically significant?	Effect size d (95% CI)[a]
Verhaar 1995 [607]	52 steroid injection 51 manipulation	1.5 months	Injections of corticosteroids	Yes (Chi-squared test)	Global assessment: 1.15 (0.74 to 1.56) Pain:1.02 (0.61 to 1.43) Return to work: 0.10 (-0.29 to 0.48)

[a] calculated by ECRI

Bracing or immobilization compared to corticosteroid injections

One randomized controlled trial of 76 patients compared forearm elbow bracing, immobilization of the elbow, and corticosteroid injections. The authors report that after two weeks, the group treated with the corticosteroid injections had a statistically significantly better result for the outcome patient-rated pain than did the other two treatment groups. At longer followup times, however, the authors report there was no statistically significant difference between the treatment groups. The

data from the longer followup times were not reported. The calculated effect size agrees with the statistical tests performed by the authors. The data are summarized in Table 323.

Table 323. Results of bracing, injections, and splinting compared

Study	Number of patients	Patient-rated improvement in pain	Statistical signficance of the difference between groups	Effect size d (95% CI)[a]
Haker 1993 [611]	17 bracing 19 corticosteroid injection 19 immobilization / splinting	At 0.5 months, bracing 1 excellent, 1 good, 4 improved, 3 somewhat improved, 8 no change injections 3 excellent, 10 good, 2 improved, 3 somewhat improved, 1 no change splinting 0 excellent, 1 good, 6 improved, 6 somewhat improved, 6 no change	Chi-squared test Injections vs. bracing p = 0.000055 Injections vs. splinting p = 0.000427 Splinting vs. bracing p = 0.000001 Injections are most effective	Bracing: 1.04 (0.36 to 1.71) Splinting: 1.19 (0.51 to 1.86)

[a] calculated by ECRI using corticosteroid injections as the comparison group

TENS, ultrasound, phonophoresis, and injections of corticosteroids compared

One randomized controlled trial of 48 patients compared four different treatments for epicondylitis: TENS, ultrasound, phonophoresis of hydrocortisone, and injections of corticosteroids. This study measured patient-reported pain in several ways, and combined the results into a summary percentage. The authors report that there was no statistically significant difference in outcomes between any of the treatment groups. The calculated effect sizes agree with the results of the authors' statistical tests. However, the study was small and this may be the reason why the difference in outcomes between the groups did not reach statistical significance. The data reported by this study are shown in Table 324 and summarized in Table 325.

Table 324. Results of comparing injections, TENS, phonophoresis, and ultrasound

Study	Number of patients	Global outcome	Statistical significance of difference between groups
Halle1986 [606]	12 Corticosteroid injection 12 phonphoresis 12 TENS 12 ultrasound	Corticosteroid injection: 63% improved, 25% unchanged, 12% worse phonophoresis: 65% improved, 12% unchanged, 23% worse TENS: 56% improved, 23% unchanged, 21% worse ultrasound: 69% improved, 12% unchanged, 19% worse	Kruskal-Wallas ANOVA test NS

Table 325. The study by Halle 1986 lacks statistical power

Study	Number of patients	Followup time	Which treatment was most effective?	Was the difference statistically significant?	Minimal difference between groups the study had the power to detect	Effect size d (95% CI)[a]
Halle 1986 [606]	12 injections 12 phonophoresis 12 ultrasound 12TENS	0.13 month	Corticosteroid injections	No	31%	Phonophoresis: -0.67 (-1.49 to 0.15) TENS: -0.02 (-0.82 to 0.78) Ultrasound: -0.53 (-1.35 to 0.28)

[a] calculated by ECRI using injections as the control group

Physiotherapy compared to ultrasound

One randomized controlled trial of 42 patients compared ultrasound treatment to a regimen of stretching, strengthening, and conditioning exercises. This study reported only one patient-oriented outcome, return to work. The reported results for this outcome are shown in Table 326 and summarized in Table 327. The study may be too small (n = 39) for its results on patients returning to work to have reached statistical significance.

Table 326. Results of physiotherapy compared to ultrasound

Study	Number of patients	Number of patients not working	Statistical significance of difference between groups
Pienimaki 1996 [599]	19 ultrasound 20 Physiotherapy	6 ultrasound 2 physiotherapy	Chi-squared test p = 0.355

Table 327. Physiotherapy compared to ultrasound

Study	Number of patients	Followup time	Which treatment resulted in more patients returning to work?	Was the difference statistically significant?	Minimal difference between groups the study had the power to detect	Effect size d (95% CI)[a]
Pienimaki 1996 [599]	19 ultrasound 20 physiotherapy	2 months	Physiotherapy	No	31%	0.77 (-0.20 to 1.74)

[a] calculated by ECRI

Conclusions

One randomized controlled trial of 106 patients reported that patients treated with injections of corticosteroids had better outcomes than did patients treated with manipulations and deep friction massage. One randomized controlled trial of 76 patients reported that patients treated with injections of corticosteroids had better outcomes than did patients treated with braces or immobilization.

Two randomized controlled trials of a total of 203 patients compared oral NSAIDs to injections of corticosteroids. One study did not find a statistically significant difference between the groups. The other study reported that patients treated with injections of corticosteroids had better outcomes than did the patients treated with oral NSAIDs. This study may have been confounded by co-interventions administered to the patients in addition to their allocated treatment.

One randomized controlled trial of 63 patients reported that patients treated with acupuncture had better outcomes than patients treated with corticosteroid injections. However, this study included only patients previously found to be unresponsive to injections of corticosteroids.

Two randomized controlled trials, one comparing TENS, ultrasound, phonophoresis, and injections of steroids, the other comparing physical therapy to ultrasound, reported no statistically significant differences between-treatment

groups. However, both trials may have been too small to be able to have detected clinically meaningful differences between-treatment groups.

Thirty-eight randomized controlled trials, four randomized crossover trials, and eight controlled trials of a total of 3147 patients evaluated eighteen different types of treatments for epicondylitis and reported 73 different outcomes. The studies tend to be small, and there are too few studies addressing each treatment to allow any definitive evidence-based conclusions to be made. Two tentative conclusions can be reached: Laser therapy does not appear to be an effective treatment for epicondylitis, and patients with epicondylitis who were treated with acupuncture had better global outcomes and greater pain relief than patients given sham acupuncture.

Question #4. Is there a correlation between specific clinical findings and specific treatment outcomes among patients with epicondylitis?

In addressing this question, we consider whether published literature suggests that there are clinical findings that predict positive or negative outcomes after treatment for epicondylitis. 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

As discussed in the Methods section, we retrieved articles identified by our literature searches according to certain *a priori* criteria. However, not all of the retrieved studies met our more specific inclusion criteria for this question. These latter studies, and the reason we did not consider them for this question are shown in Table 328.

Table 328. Excluded studies

Author	Reason for exclusion
Seegenschmiedt et al. 1998 [628]	Incomplete description of multivariate analysis (did not describe all variables and unclear description of some variables)
Gabel and Morrey 1995 [555]	Stratified study that did not examine any correlations that were also examined by at least two other studies
Verhaar et al. 1993 [559]	Stratified study that did not examine any correlations that were also examined by at least two other studies

Evidence base

After these exclusions, there remained three studies with a total of 160 patients.

Study quality

The criteria used to evaluate study quality were identical to those described in Question 4 for carpal tunnel syndrome. Table 329 shows relevant quality characteristics of studies that met the inclusion criteria for this question. All studies performed some type of multiple regression analysis. Two were prospective and one was retrospective.

Table 329. Study quality

Author/year	Prospective?	Methods used to identify predictor variables
Kurvers et al. 1995 [556]	No	Multiple regression
Stratford et al. 1989 [621]	Yes	Multiple regression
Gerberich et al. 1985 [629]	Yes	Multiple logistic regression

Results

Table 330 shows the relationship of specific clinical findings to treatment outcomes in those studies that used regression to identify predictor variables. There are three such studies with a total of 160 patients. Also presented in this table are non-clinical variables (e.g. age, gender) to show all of the variables used in each multiple regression (the variables relevant to the present question are bolded in Table 330).

Only one study reported on each combination of outcome and clinical finding. All three studies reported correlations between variables and global assessment of the success of the treatment. None of the studies reported correlation coefficients or p-values.

Stratford et al. included only two clinical findings in their multiple regression analysis: grip strength and site of pain.[621] They found that grip strength did not correlate with treatment outcome, but site of pain did. Patients with pain over the origin of the extensor carpi radialis longus (ECRL) had better outcomes than did patients with pain elsewhere. Patients with pain over the origin of the extensor carpi radialis brevis (ECRB) had poorer outcomes than did patients with pain elsewhere.

Gerberich et al. incorporated only two clinical findings into their analysis: severity of pain before treatment, and degree of functional limitations before treatment.[629] They reported no statistically significant correlation between the degree of functional limitations and success of the treatment, but found a correlation between severity of pain and success of the treatment. Patients with severe pain had poorer outcomes than patients with milder pain.

Table 330. Relationship between specific clinical findings and treatment outcomes among patients with Epicondylitis (multiple regression analysis)

Author/year	N	Treatment	Outcomes	Variables used in multiple regression												
				Age	Gender	Hobbies	Comorbidity (ulnar neuritis)	Duration of symptoms	**Functional limitations**	**Site of pain**	**Severity of pain**	**Grip strength**	**Timing of onset (acute or gradual)**	Compliance with rest	Use of hydrocortisone cream	Number of treatments
Kurvers et al. 1995 [556]	38 (ME)	Surgery	Global outcome (level of symptoms)	NS	NS	NS	Sig	–	–	–	–	–	NS	–	–	–
Stratford et al. 1989 [621]	40 (LE)	Ultrasound	Global outcome (success/failure)	NS	NS	–	–	NS	–	Sig	–	NS	–	NS	–	–
Gerberich et al. 1985 [629]	82 (LE)	Ultrasound	Global outcome (improvement)	NS	NS	–	–	NS	NS	–	Sig	–	–	–	NS	Sig (males) NS (females)

LE – Lateral epicondylitis
ME – Medial epicondylitis
aVariables in boldface indicate clinical findings

Question #5. Is there a correlation between duration of symptoms and specific treatment outcomes among patients with epicondylitis?

In addressing this question, we consider whether published literature suggests that duration of symptoms predicts positive or negative outcomes after treatment for carpal 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 duration of symptoms.

Excluded studies

No studies were excluded due to failure to meet the question-specific criteria.

Evidence base

Seven studies with a total of 319 patients addressed this question.

Study quality

The criteria used to evaluate study quality were identical to those described in Question 4 for carpal tunnel syndrome. Seven studies were identified that reported treatment outcomes stratified or analyzed by duration of symptoms. These studies are listed in Table 331. Four studies (two prospective and two retrospective) performed multiple regression to identify predictor variables. The remaining three studies (one prospective and two retrospective) used stratification or alternative statistical comparisons.

Table 331. Study quality

Author/year	Prospective?	Methods used to identify predictor variables
Bankes and Jessop1998 [553]	No	Not described
Seegenschmiedt 1998 [628]	No	Multiple regression
Kurvers 1995 [556]	No	Multiple regression
Newey and Pattterson1994 [558]	No	Stratification
Verhaar 1993 [559]	Yes	chi-square test for linear trends
Stratford 1989 [621]	Yes	Multiple regression
Gerberich 1985 [629]	Yes	Multiple logistic regression

Table 332. Relationship between duration of symptoms and treatment outcomes among patients with Epicondylitis (multiple regression analysis)

Author/year	N	Treatment	Outcomes	Mean duration of symptoms (range)	Statistical significance (duration associated with better outcome)	Other variables examined
Seegenschmiedt and Keilholz 1998 [628]	104 (LE and ME)	Radiotherapy	Global outcome (Response to treatment)	15 months (6-86 months)	Sig (shorter duration - <12 months)	Immobilization in plaster (sig), other variables not reported
Kurvers et al. 1995 [556]	38 (ME)	Surgery	Global outcome (level of symptoms)	12 months (6-30 months)	NS	Age, gender, timing of symptom onset, comorbid conditions, hobbies
Stratford et al. 1989 [621]	40 (LE)	Ultrasound	Global outcome (success/failure)	NR	NS	Age, gender, compliance, grip strength, site of pain
Gerberich et al. 1985 [629]	82 (LE)	Ultrasound	Global outcome (improvement)	9.8 months	NS	Age, gender, severity of pain, degree of functional limitations, use of hydrocortisone cream, number of treatments

LE – Lateral epicondylitis
ME – Medial epicondylitis
NS – Not signficant

Table 333. The relationship between duration of symptoms and treatment outcomes among patients with Epicondylitis (stratification or univariate statistical comparisons)

Author/ year	N	Treatment	Outcomes	Mean duration of symptoms (range)	Statistical significance (duration associated with better outcome)
Bankes and Jessop 1998 [553]	20	Surgery	Global outcome (patient improvement)	32.2 (11-126)	NS
Newey and Pattterson 1994 [558]	27	Surgery	Global outcome (pain relief)	32.5 (8-108)	Sig (shorter duration)
Verhaar 1993 [559]	57	Surgery	Global outcome (patient satisfaction)	NR	NS

LE – Lateral epicondylitis
ME – Medial epicondylitis
NS – Not signficant

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

In addressing this question, we consider whether published literature suggests that there are demographic variables that predict positive or negative outcomes after treatment for carpal 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 demographic characteristics.

Excluded studies

As discussed in the Methods section, we retrieved articles identified by our literature searches according to certain *a priori* criteria. However, not all of the retrieved studies met our more specific inclusion criteria for this question. These latter studies, and the reason we did not consider them for this question are shown in Table 334.

Table 334. Excluded studies

Author	Reason for exclusion
Seegenschmiedt et al. 1998 [628]	Study did not report whether demographic variables were included in the multiple regression analysis
O'Neil 1980 [567]	Stratified study that conducted a demographic variable/outcome comparison not performed by any other study

Evidence base

After these exclusions, there remained six studies with 277 patients.

Study quality

The criteria used to evaluate study quality were identical to those described for Question 4 for carpal tunnel syndrome. Table 335 shows the studies that met the inclusion criteria for this question. Three studies (two prospective and one retrospective) performed multiple regression to identify predictor variables. The remaining three studies (one prospective and two retrospective) performed stratification or alternative statistical comparisons.

Table 335. Study quality

Author/year	Prospective?	Methods used to identify predictor variables
Gabel and Morrey1995 [555]	No	Statistical analysis (method not described)
Kurvers 1995 [556]	No	Multiple regression
Newey and Pattterson1994 [558]	No	Stratification
Verhaar 1993 [559]	Yes	chi-square test for linear trends
Stratford 1989 [621]	Yes	Multiple regression
Gerberich 1985 [629]	Yes	Multiple logistic regression

Results

Three studies that addressed this question performed multiple regression to identify predictor variables (Table 336). Two of the studies treated patients with ultrasound and one used surgical treatment. None of the three studies found a statistically significant correlation between age and outcome, or gender and outcome. One study reported that there was no statistically significant correlation between patients with hobbies involving knitting or needlework and outcomes. The only study that examined co-morbidities reported that patients with coexistent ulnar neuritis had a poorer outcome after surgery than did patients without ulnar neuritis.

Three other studies performed stratification or statistical comparisons that did not control for the effects of other predictor variables (Table 337). All studies evaluated surgical treatments. Age was the only relevant variable reported by all of these studies, and none found a statistically significant correlation between age and treatment outcome.

Table 336. Relationship between patient characteristics and treatment outcomes among patients with Epicondylitis (multiple regression analysis)

Author/ year	N	Treatment	Outcomes	Variables used in multiple regression												
				Age[a]	**Gender**	**Hobbies**	**Comorbidity (ulnar neuritis)**	Duration of symptoms	Functional limitations	Site of pain	Severity of pain	Grip strength	Timing of onset (acute or gradual)	Compliance with rest	Use of hydrocortisone cream	Number of treatments
Kurvers et al. 1995 [556]	38 (ME)	Surgery	Global outcome (response to treatment)	NS	NS	NS	Sig	–	–	–	–	–	NS	–	–	–
Stratford et al. 1989 [621]	40 (LE)	Ultrasound	Global outcome (success/failure)	NS	NS	–	–	NS	–	Sig	–	NS	–	NS	–	–
Gerberich et al. 1985 [629]	82 (LE)	Ultrasound	Global outcome (improvement)	NS	NS	–	–	NS	NS	–	Sig	–	–	–	NS	Sig (males) NS (females)

LE – Lateral epicondylitis
ME – Medial epicondylitis
NS – Not significant
[a]Variable in boldface indicate patient characteristics

Table 337. The relationship between duration of symptoms and treatment outcomes among patients with Epicondylitis (stratification or univariate statistical comparisons)

Author/year	N	Treatment	Outcome	Age
Gabel and Morrey1995 [555]	26 (LE)	Surgery	Global outcome (Excellent to poor)	NS
Newey and Patterson1994 [558]	28 (LE)	Surgery	Global outcome (Pain relief)	NS
Verhaar 1993 [559]	63 (LE)	Surgery	Global outcome (Level of satisfaction)	NS

LE – Lateral epicondylitis
NS – Not significant

Conclusions

Six studies reported data that addressed this question. Three of them used multiple regression to identify predictor variables. All three studies found no statistically significant correlation between gender or age and response to treatment. One study found no such correlation between certain hobbies and response to treatment. The only study that examined co-morbidities reported that patients with co-existant ulnar neuropathy had significantly poorer outcomes than patients without ulnar neuropathy. However, it is difficult to reach evidence-based conclusions from the results of a single study.

Table 338. Trials of functional assessment instruments that met the inclusion criteria

Study	Instruments evaluated[a]	N subjects	Outcome measurements
Overend 1999 [315]	PRFEQ	50	Validity Test-retest reliability
Stratford 1993 [630]	F-VAS	40	Validity Response to treatment
Stratford 1987 [631]	F-VAS	32	Validity Response to treatment Test-retest reliability

a The full names of the instruments and descriptions of the instruments are given in Table 339.

Table 339. Instruments evaluated to measure functional limitations associated with epicondylitis

Instrument	Abbreviation	First described by	Scoring system	Subjects covered	Extent of use[a]
Patient-rated forearm evaluation questionnaire	PREFQ	Overend 1999 [632]	Functional categories	Common activities of daily living	Not widely used
Functional visual analog scale	F-VAS	Stratford 1987 [631]	VAS	Not described	Not widely used

a a search of Medline for the assessment instrument found that there were fewer than 3 studies reporting the use of each of the instruments

Study quality

Internal validity

Studies evaluating instruments need not include a separate control group, because each patient acts as his/her own control. All of the studies included in this section are single-arm prospective cohort studies. Factors relating to the quality of the studies are shown in Table 340. None of the studies administered and scored the instruments with evaluators who were blinded to the identity, history, and other test scores of the patients. Studies that did not use blinded evaluators may be subject to bias.

Table 340. Details of study design

Study	Number of patients	Number of centers	Funded by a for-profit agency?	Study design	Prospective	Blinding	% Attrition	Intent to treat analysis	% Compliance
Overend 1999 [632]	50	1	No	Cohort	Yes	No	6	No	NA
Stratford 1993 [630]	40	1	NR	Cohort	Yes	No	0	Yes	NA
Stratford 1987 [631]	32	1	No	Cohort	Yes	No	0	Yes	NA

NA = not applicable

Generalizability

An important factor in evaluating assessment instruments is the patient group. In order to accurately evaluate the instrument, it is important that the test group be similar to the patients that the instrument will be used to evaluate in clinical practice. Details of the patient groups are shown in Table 341. The mean ages and gender composition of the patient groups are similar to that reported in epidemiology studies of epicondylitis (see the Introduction). None of the studies reported on the presence of co-morbid conditions that may have contributed to functional limitations. None of the studies reported any information as to the occupations or employment status of the patients.

Table 341.Study generalizability: patient characteristics

Study	Number of patients	Mean age and range	% female	Duration of conditon mean and range months	% 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?
Overend 1999 [632]	50	45	48.9	NR	NR	NR	NR	NR	NR	NR	NR	No	No
Stratford 1993 [630]	40	43	50	4.2	NR	NR	NR	0	NR	NR	NR	No	No
Stratford 1987 [631]	32	44.9 (32-61)	NR	3.7 (0-12)	NR	NR	NR	NR	NR	NR	NR	No	No

NR = not reported

Results

Test-retest reliability

Both instruments (F-VAS and PRFEQ) are reported to give consistent results when administered to the same subjects on different days (Table 342).

Table 342. Results of test-retest reliability tests

Study	Number of patients	Tests evaluated	Time between test administrations	Type of statistical comparison being made	Was the instrument reliable?
Overend 1999 [632]	50	PRFEQ	NR	Correlation coefficient r = 0.89	Yes
Stratford 1987 [631]	32	F-VAS	4 days	Correlation coefficient r = 0.85	Yes

NR = not reported

Internal reliability

None of the included studies reported data relevant to this aspect of instrument evaluation.

Content validity

None of the included studies reported data that addressed this aspect of validity.

Response to treatment

Stratford reported that scores on the F-VAS increase as patients are successfully treated for epicondylitis (Table 343).

Table 343. Results of response to treatment tests

Study	Number of patients	Test evaluated	Treatment	Time of testing months	Effect size Hedges' d (95% CI)[a]	Was the instrument responsive to treatment?
Stratford 1993 [630]	40	F-VAS	Not reported	1	0.97 (0.22 to 1.72)	Yes
Stratford 1987 [631]	32	F-VAS	Ultrasound	1.5	1.60 (1.04 to 2.16)	Yes

a calculated by ECRI

Table 344. Results of validity tests

Study	Number of patients	Test evaluated	Type of statistical comparison being made	Validated against	Was the instrument valid by this measurement ?
Overend 1999 [632]	50	PRFEQ	Intraclass correlation coefficient r = -0.36	Hand grip strength	Yes, but r is low
Stratford 1993 [630]	40	F-VAS	Interclass correlation coefficient r = 0.53	Hand grip strength	Yes
Stratford 1987 [631]	32	F-VAS	Interclass correlation coefficient r = 0.66	Hand grip strength	Yes

Predictive validity

None of the included studies reported data relevant to this aspect of instrument evaluation.

Conclusion

Three studies evaluated two different instruments as ways to measure functional limitations of patients with epicondylitis. The results of the studies are summarized in Table 345. Neither assessment instrument was shown to be a useful instrument for evaluating functional limitations in persons with epicondylitis. However, it is difficult to reach firm evidence-based conclusions about the instruments evaluated in this report due to the limited evidence base.

Table 345. Utility of assessment instruments for evaluating functional limitations associated with epicondylitis

Instrument	Is the instrument			Strength of Evidence
	Valid?	Responsive to treatment?	Reliable?	
Patient-rated forearm evaluation questionnaire	No	NR	Yes	One study of 50 patients
Functional visual analog scale	Yes	Yes	Yes	Two studies of 72 patients by the same group

NR = not reported

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

This question addresses the functional limitations of individuals before receiving conservative or surgical treatment for epicondylitis. Our objective is to catalogue these limitations, and not to address the effectiveness of these treatments. We address the effectiveness of conservative and surgical treatments in Question 3.
The available literature governs our approach to the present question. Hence, we consider functional status rather than functional limitations, because no published studies specifically addressed the latter. In addition, the only available data operationally defines functional status in terms of scores on certain written tests. Therefore, we also address functional status in these terms. The validity and reliability of these written tests is discussed in Question 9. Study inclusion criteria are described under Methods.

Excluded studies

As discussed in the Methods section, we retrieved articles identified by our literature searches according to certain *a priori* criteria. However, not all of the retrieved studies met our more specific inclusion criteria for this question. These latter studies, and the reason we did not consider them for this question are shown in Table 346.

Table 346. Excluded studies

Author	Reason for exclusion
Pienimaki and Vanharanta 1998 [544]	Study reported that patients received prior treatment

Evidence base

Two studies (with a total of 82 patients) remained that addressed this question after the above exclusion.

Internal validity

Aspects of study quality that are most relevant to the present question are shown in Table 347. Because we are cataloging functional status rather than using it to determine treatment effectiveness, randomization and the use of control groups are not of paramount importance here. Therefore, Table 347 does not depict these aspects of study design. However, the following variables are important: attrition rates, whether the trial was prospective, and whether the raters of functional status (in this case the patients) were blinded to the treatment the patient received. Attrition was low (6%) or non-existent in the two included studies. Both were unblinded prospective case series. Because it is difficult to blind patients to the treatment received, we are considering unblinded studies to be of acceptable quality for this question.

Table 347. Study quality

Author	Number of patients	Number of centers	Funded by a for-profit agency?	Prospective	Blinding	% Attrition	Intent to treat analysis	% Compliance
Overend 1999 [632]	50	1	No	Yes	No	6	No	NA
Stratford 1987 [631]	32	1	No	Yes	No	0	Yes	NA

NA – Not applicable

Generalizability

Selected patient characteristics are presented in Table 348. Both studies reported mean age of patients and percent female, one study reported duration of symptoms, and no studies reported comorbidities or severity of disease. Mean age and percent female patients were consistent with the numbers reported by epidemiologic studies (see Introduction section, epicondylitis, subheading epidemiology).

No study reported information concerning patient employment or occupation (Table 349). Therefore, one cannot determine the generalizability of these studies in terms of occupational variables.

Table 348. Patient characteristics

Author	Number of patients	Mean age (range)	% female	Duration of condition (range)	% Patients with diabetes	% Patients with arthritis	% Patients with prevous relevant injuries	% Patients with other relevant nerve	% Patients with peripheral neuropathy	% Patients pregnant	% Patients on kidney dialysis	Did the study exclude patients with severe	Did the study exclude patients with mild
Overend 1999 [632]	50	45	48.9	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Stratford 1987 [631]	32	44.9 (32-61)	50	Mean: 111 days (3-364)	NR	NR	NR	NR	NR	NR	NR	NR	NR

NR – Not reported

Table 349. Patient occupation

Author	Year	ID#	Number of patients	% Patients employed	% Patients on Workers Compensation	% Patients retired	% Patients homemakers	Reported Occupations
Overend	1999	[632]	50	NR	NR	NR	NR	NR
Stratford	1987	[631]	32	NR	NR	NR	NR	NR

NR – Not reported

Results

Table 350 shows the results of the two studies that addressed this question. Overend (1999) excluded patients with prior surgery or elbow injection (within the last 30 days), but there is still uncertainty about whether some patients received prior treatment.[632] Stratford (1987) did not report whether patients had received prior treatment. Both studies used different functional status scales, so their results are not directly comparable. They found similar mean or median values in their pre-treatment study groups (between 30-40% of the maximum score).

Table 350. Studies with pre-treatment functional limitation data for patients with lateral epicondylitis

Study	N	Study Design	Stratified subgroups	n	Scale	Overall mean pre-treatment functional status score (SD)	% of maximum score
Overend (1999) [632]	50	Stratified case series	Male Female	24 23	PRFEQ (0-10 scale)	2.8 (1.9) 4.1 (2.1) p = 0.033[a]	28 41
			Subacute LE Chronic LE	35 12		3.6 (2.0) 3.1 (2.2) p = 0.475[a]	36 31
			Work-related LE Non-work-related LE	21 26		4.2 (2.3) 2.8 (1.7) p = 0.022[a]	42 28
			Total group	47		3.4 (2.1)	34
Stratford (1987) [631]	32	Prospective case series	NA	NA	PFF (0-8)	Median: 3	37.5

[a]Calculated by ECRI
PFF – Pain-Free Function Index
PRFEQ – Patient Rated Forearm Evaluation Scale

Conclusions

This question is addressed by only two studies comprised of a total of 82 patients. Although these studies suggest that the functional difficulties experienced by patients with epicondylitis are increased by 30% to 40%, the low number of studies and patients makes it difficult to arrive at an evidence-based answer to this question.

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

This question considers the functional limitations of an individual after they have received conservative or surgical treatment for epicondylitis. In addressing it, our objective is to catalogue these limitations, and not to address the effectiveness of these treatments. We address the effectiveness of conservative and surgical treatments in Question 3.

Excluded studies

As discussed in the Methods section, we retrieved articles identified by our literature searches according to certain *a priori* criteria. However, one of the retrieved studies did not meet our more specific inclusion criteria for this question. This study, and the reason we did not consider it for this question is shown in
Table 351.

Table 351. Excluded studies

Author	Reason for exclusion
Stratford et al., 1987[631]	Study reports median value for successes and failures but does not report the number or percentage of successes and failures.

Evidence base

After this exclusion, there were no studies that met the general or question-specific inclusion criteria.

Conclusion

There were no studies that met the inclusion criteria for this question. Therefore, it cannot be answered in an evidence-based fashion.

Excluded studies

As discussed in the Methods section, we retrieved articles identified by our literature searches according to certain *a priori* criteria. However, one of the retrieved studies did not meet our more specific inclusion criteria for this question. This study, and the reason we did not consider it for this question are shown in
Table 352.

Table 352. Excluded studies

Author and year	Reason for exclusion
Kay 2000[86]	Demographic information not reported separately for surgical and non-surgical patients

Evidence base

Three studies with a total of 160 patients contained information relevant to this question for patients with de Quervain's disease. Table 353 shows selected patient characteristics and reported surgical indications. Information not reported by these studies included race, extent of disease, pregnancy, menopause, oral contraceptive use, alcohol use, smoking status, whether patients were overweight, workers' compensation status, and whether the patient retained a lawyer.

Table 353. Specific indications for surgery for de Quervain's disease

Author/year	N	Mean age (range)	% female	Study design	Signs and symptoms	Occupations (n)	Specific indications for surgery
Ta et al. (1999) [88]	43	48 (24-73)	79.1	Retrospective stratified case series	Pain over radial aspect of wrist aggravated by excessive use of thumb, a positive Finkelstein test	Packer (10), domestic (9), secretary (7), machine operator (6), computer engineer (3), teacher (2), hospital orderly (2), salesperson (2), carpenter (1), and business executive (1)	Specific indications not reported
Witt et al. (1991) [633]	95	44 (16-75)	77	Prospective stratified case series	Pain radiating from radial styloid process to thumb and forearm, increased pain on passive movement of thumb and wrist, swelling and tenderness over first dorsal compartment, and positive result on Finkelstein testing	Housekeeping (26), Secretarial and clerical work (17), light manual labor (16), managerial or professional work (16), strenuous manual labor (4), music (2), education (2)	Failure of non-operative treatment
Yuasa et al. (1998) [634]	22	47 (21-67)	95.5	Retrospective case series	Radial wrist pain, tenderness over first extensor compartment, and positive Finkelstein's test results	NR	Failure of non-operative treatment

NR – Not reported

Conclusions

Two of the three studies that addressed this question reported that surgery was performed only on patients who did not benefit from conservative (non-operative) treatment.[633,634] However, with so few studies and so many unreported patient characteristics, one cannot assume that the present data are representative of the larger patient population with de Quervain's disease.

Question #3: What are the relative benefits and harms of various surgical and nonsurgical interventions for persons with de Quervain's disease?

For this question, we included any controlled trials (even retrospective) as long as at least two groups (treated or otherwise) were comparable. Study inclusion criteria for this question are listed under Methods (section).

Excluded studies

As discussed in the Methods section, we retrieved articles identified by our literature searches according to certain *a priori* criteria. However, not all of the retrieved studies met our more specific inclusion criteria for this question. These latter studies, and the reason we did not consider them for this question are shown in Table 354.

Table 354. Excluded studies

Author	Reason for exclusion
Kay 2000 [86]	Uncontrolled study
Ta et al. 1999 [88]	Uncontrolled study
Yuasa et al. 1998 [634]	Uncontrolled study
Witt et al. 1991 [633]	Uncontrolled study

Evidence base

After these exclusions, one trial describing 87 patients remained.

Internal validity

The criteria used to evaluate study quality were identical to those described for Question 3 under carpal tunnel syndrome. Table 355 shows the internal validity of the only study that met the inclusion criteria. Because this study was non-randomized, retrospective and unblinded, it is particularly susceptible to bias. The extent of such bias, if any, and its impact on interpretation of the results, can not be determined.

Table 355. Study quality

Author	Number of patients	Number of centers	Funded by a for-profit agency?	Study design	Prospective	Blinding	% Attrition	Intent to treat analysis	% Compliance
Weiss 1994 [635]	87	1	No	Non-randomized controlled trial	No	No	0	Yes	NR

NR – Not reported

Generalizability

Selected patient characteristics are presented in Table 356. Because there were so few studies (even counting excluded studies) evaluating treatment of de Quervain's disease, the generalizability of the study by Weiss et al. to the larger patient population cannot be determined. However, the study appears to be consistent with the epidemiological information reported in review articles of de Quervain's disease (see Introduction, de Quervain's disease, subheading epidemiology).

Weiss et al. presented little specific information related to occupation (Table 357), but as already noted, there are too few studies to determine the generalizability of this study to the larger patient population.

Table 356. Patient characteristics

Author	Number of patients	Mean age (range)	% female	Duration of condition mean and range (months)	% Patients with diabetes	% Patients with arthritis	% Patients with prevous relevant injuries	% Patients with other relevant nerve impingement conditions	% Patients with peripheral neuropathy	% Patients pregnant	% Patients on kidney dialysis	Did the study exclude patients with severe disease?	Did the study exclude patients with mild disease?
Weiss 1994 [635]	87	38 (17-72)	85.1	7 (0.25-36)	5.7	1.1	10.3	5.7	0	1.1	0	NR	NR

Table 357. Patient occupation

Author	Number of patients	% Patients employed	% Patients on Workers Compensation	% Patients retired	% Patients homemakers	Reported Occupations
Weiss 1994 [635]	87	NR	39.1	NR	NR	Heavy manual labor, lightlabor, keyboard or typing activities

Results

Weiss et al. found a statistically significant increase in the number of treatment successes after corticosteroid plus lidocaine (CS) injection compared to immobilization splints or splints plus injection (Table 358 and Table 359). Treatment successes were defined as patients with no or minimal symptoms who did not subsequently require surgery.

Table 358. Results of global assessment

Study	Number of wrists[a]	Global assessment patient-reported categories	Statistical significance of difference between groups
Weiss 1994 [635]	42 CS injection 37 immobilization splint 14 CS injection plus immobilization splint	29 successes, 13 failures 11 successes, 26 failures 8 successes, 6 failures	Fisher's exact test P <0.001

aResults were reported based on number of wrists, rather than patients, that received treatment.
CS – Corticosteroid plus lidocaine

Table 359. Success of nonsurgical treatments for de Quervain's disease

Study	Number of wrists[a]	Length of followup (months)	Which treatment was more successful?	Was the difference statistically significant?	Effect size Hedges' d (95% CI)
Weiss 1994 [635]	42 CS injection 37 immobilization splint 14 CS injection plus immobilization splint	Mean (range)[b] 13 (6-14)	CS injection	Yes	Injection vs splint: 0.91 (0.38 to1.44) Injection plus splint vs splint: 0.62 (-0.08 to 1.32)

aResults were reported based on number of wrists, rather than patients, that received treatment
bLength of followup only reported for patients who did not undergo eventual surgery (treatment successes)
CS – Corticosteroid plus lidocaine

Conclusions

Although one study found that corticosteroid plus lidocaine injection produced more treatment successes than immobilization splints among de Quervain's patients, there were design problems with this study. Because of these problems and the fact that only one study addressed this question, it is difficult to reach firm evidence-based conclusions

Question #4: Is there a relationship between specific clinical findings and specific treatment outcomes among patients with de Quervain's disease?

In addressing this question, we consider whether published literature suggests that there are clinical findings that predict positive or negative outcomes after treatment for de Quervain's disease. 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

We did not exclude any study that addressed this question.

Evidence base

Evidence that addresses this question is derived from one study of 43 patients.

Study quality

The criteria used to evaluate study quality were identical to those described for Question 4 under carpal tunnel syndrome. One retrospective study (Ta et al., 1999) addressed this question for patients with de Quervain's disease (Table 360).[88] Of 43 patients who received surgery, 31 had a septated first dorsal compartment. The authors attempted to identify predictor variables by performing a multiple logistic regression with descending stepwise variable selection.

Table 360. Study quality

Author	Prospective?	Methods used to identify predictor variables
Ta et al. (1999) [88]	No	Multiple logistic regression

Results

The results of the only study that addressed this question are shown in Table 361. Odds ratios for non-septated and septated patients were not significantly different for a global outcome (patient satisfaction) or complications.

Table 361. Relationship between clinical findings and treatment outcomes

Author	Treatment	Variables examined	Comparison groups	Outcomes	Results
Ta et al. (1999) [88]	Surgery (n = 43)	Age, gender, steroid treatment, septation, duration of symptoms, occupational status	Septation No (12) Yes (31)	Global outcome (patient satisfaction -yes/no) Complications (yes/no)	Odds Ratio (95% CI) 1.0 (referent) 0.53 (0.07-3.68) p = 0.61 1.0 (referent) 1.25 (0.79-9.66) p = 1.00

Conclusions

This question was addressed by only one relatively small retrospective study. This precludes a firm evidence-based answer to this question.

Question #5: Is there a relationship between duration of symptoms and specific treatment outcomes among patients with de Quervain's disease?

In addressing this question, we consider whether published literature suggests that duration of symptoms predicts positive or negative outcomes after treatment for de Quervain's disease. The studies we considered all attempted to identify predictors by using regression techniques or by comparing outcomes in different groups of patients with different duration of symptoms.

Excluded studies

As discussed in the Methods section, we retrieved articles identified by our literature searches according to certain *a priori* criteria. However, one study did not meet our more specific inclusion criteria for this question. This study, and the reason we did not consider it for this question are shown in Table 362.

Table 362. Excluded Studies

Author	Reason for exclusion
Witt et al. (1991) [633]	Stratified study with no duration of symptoms stratifications/outcome comparisons reported by other studies

Evidence base

After the above exclusion, there remained one study with 43 patients.

Study quality

The criteria used to evaluate study quality were identical to those described for Question 4 under carpal tunnel syndrome. Only one study addressed this question for patients with de Quervain's disease (Table 363). Ta et al. (1999) conducted a retrospective study that attempted to identify predictor variables with a multiple logistic regression in descending stepwise order.

Table 363. Study quality

Author/year	Prospective?	Methods used to identify predictor variables
Ta et al. (1999) [88]	No	Multiple logistic regression

Results

Table 364 shows the results of the study by Ta et al. Patients with a longer duration of symptoms were more likely to experience satisfaction after surgery.[88]

Table 364. Relationship between duration of symptoms and treatment outcomes among patients with de Quervain's disease

Author/ year	Treatment(s)	Variables examined	Comparison groups	Outcomes	Results
Ta et al. (1999) [88]	Surgery (n = 43)	Age, gender, steroid treatment, septation, duration of symptoms, occupational status	Duration of symptoms 1-3 months (n = 2) 4-6 months (n = 8) 7-9 months (n = 14) 10-12 months (n = 2) 13-15 months (n = 16) >15 months (n = 1)	Global outcome (patient satisfaction - yes/no)	Odds Ratio (95% CI) 1.0 (referent) 1.21 (0.75-2.36) 1.16 (0.91-2.03) 1.42 (1.12-2.78) 1.74 (1.08-2.24) 1.62 (1.04-3.12) p = 0.034
				Complications (yes/no)	1.0 (referent) 0.82 (0.54-1.71) 1.15 (0.72-1.86) 1.79 (0.46-2.53) 1.21 (0.63-1.85) 1.72 (0.89-2.65) p = 0.24

Conclusions

This question was addressed by only one relatively small retrospective study. This precludes a firm evidence-based answer to this question.

Question #6: Is there a relationship between factors such as patients' age, gender, socioeconomic status and/or racial or ethnic grouping and specific treatment outcomes among patients with de Quervains's disease?

In addressing this question, we consider whether published literature suggests that there are demographic variables that predict positive or negative outcomes after treatment for carpal 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 demographic characteristics.

Excluded studies

As discussed in the Methods section, we retrieved articles identified by our literature searches according to certain *a priori* criteria. However, one of the retrieved studies did not meet our more specific inclusion criteria for this question. This study, and the reason we did not consider it for this question are shown in Table 365.

Table 365. Excluded studies

Author	Reason for exclusion
Witt et al. (1991) [633]	Stratified study with no demographic variable stratifications/outcome comparisons reported by other studies

Evidence base

After the above exclusion, there remained one study with 43 patients.

Study quality

The criteria used to evaluate study quality were identical to those described for Question 4. One study addressed this question for patients with de Quervain's disease (Table 366). Ta et al. (1999) conducted a retrospective study that attempted to identify predictor variables with a multiple logistic regression in descending stepwise order.

Table 366. Study quality

Author/year	Prospective?	Methods used to minimize differences between stratified groups	Is the stratification confounded?
Ta et al. (1999) [88]	No	Multiple logistic regression	No

Results

Table 367 shows the results of the study by Ta et al. They found that there was no statistically significant relationship between occupational status, age, or gender and patient satisfaction or complications.[88]

Table 367. Relationship between patient demographics and treatment outcomes

Author	Treatment(s)	Variables examined	Comparison groups	Outcomes	Results
Ta et al. (1999) [88]	Surgery (n = 43)	Age, gender, steroid treatment, septation, duration of symptoms, occupational status	Occupational status Unemployed (n = 12) Employed (n = 31)	Global outcome (patient satisfaction -yes/no) Complications (yes/no)	Odds Ratio (95% CI) 1.0 (referent) 3.60 (0.36-5.26) p = 0.36 1.0 (referent) 0.32 (0.12-3.78) p = 0.62
			Age (years) 21-30 (n = 3) 31-40 (n = 9) 41-50 (n = 14) 51-60 (n = 9) >60 (n = 8)	Global outcome (patient satisfaction-yes/no) Complications (yes/no)	Odds Ratio (95% CI) 0.92 (0.57-1.36) 0.80 (0.43-1.21) 1.06 (0.82-1.16) 1.02 (0.64-1.47) (referent) p = 0.16 1.06 (0.76-1.53) 0.72 (0.52-1.27) 0.94 (0.85-1.33) 0.88 (0.72-1.10) p = 0.41
			Gender Female (n = 34) Male (n = 9)	Global outcome (patient satisfaction-yes/no) Complications (yes/no)	Odds Ratio (95% CI) (referent) 0.40 (0.11-1.42) p = 0.54 (referent) 4.15 (0.54-35.10) p = 0.16

Conclusions

This question was addressed by only one relatively small retrospective study. This precludes a firm evidence-based answer to this question.

Table 368. Excluded studies reporting patients with more than one work-related musculoskeletal disorder of the upper extremity in the same limb.

Study	Reason for exclusion
Bursell 1999 [641]	No functional activity outcomes
Chung 1999 [642]	No functional activity outcomes
Richardson 1999 [638]	No functional activity outcomes
Baba 1998 [643]	No functional activity outcomes
Morgan 1998 [644]	No functional activity outcomes
Chaudhry 1997 [637]	No functional activity outcomes
Guzel 1997 [645]	No functional activity outcomes
Moore 1996 [646]	No functional activity outcomes
Golovchinsky 1995 [258]	No functional activity outcomes
Lanzetta 1995 [647]	No functional activity outcomes
Nemchausky 1995 [648]	No functional activity outcomes
Sie 1992 [649]	No functional activity outcomes
Gonzalez 1991 [650]	No functional activity outcomes
Grundberg and Reagan 1991 [639]	No functional activity measures using validated functional status scales or assessing ability to perform specific functional activities.
Narakas 1990 [640]	No relevant functional activity measures
Wood 1990 [651]	No functional activity outcomes
Kerrigan 1988 [652]	No functional activity outcomes
Osterman 1988 [653]	No functional activity outcomes
Eason 1985 [654]	No functional activity outcomes
Hurst 1985 [655]	No functional activity outcomes
Bryar 1984 [656]	No functional activity outcomes
Massey 1981 [657]	No functional activity outcomes
Nissenbaum 1980 [658]	No functional activity outcomes

Evidence base

After the above exclusions, no studies remained that met the general or question-specific inclusion criteria.

Conclusions

There were no studies that met the inclusion criteria for this question. Therefore, it cannot be answered in an evidence-based fashion.

Table 369. Internal Validity

Author	Number of patients	Number of centers	Funded by a for-profit agency?	Prospective	% Attrition	Intent to treat analysis
Mitchell-Krever and Lacroix 1998 [659]	53	1	NR	Yes	At 2-6 months: 0 At 1.5-2 years: 80	Yes
Salazar and Knapp 1996 [660]	36	1	NR	Yes	0	Yes

NR – Not reported

Generalizability

Patient ages were similar in the two studies, they fall within the typical range reported in epidemiologic studies (see Introduction section for the individual disorders), and roughly half of the patients in each study were female (Table 370). Other patient characteristics were incompletely reported.

Table 370. Generalizability

Author	Number of patients	Mean age (range)	% female	Duration of condition mean and range (months)	% Patients with diabetes	% Patients with arthritis	% Patients with prevous relevant injuries	% Patients with other relevant nerve impingement conditions	% Patients with peripheral neuropathy	% Patients pregnant	% Patients on kidney dialysis	Did the study exclude patients with severe disease?	Did the study exclude patients with mild disease?
Mitchell-Krever and Lacroix 1998 [659]	53	Range: 20-59	41.5	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Salazar and Knapp 1996 [660]	36	Range: 20-55	66.7	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

NR – Not reported

Results

Both studies used measures of individual functional activities to determine level of function in non-dominant hands. The results are shown in Table 371. In the study by Mitchell-Krever and Lacroix, higher scores indicate better function. Three of the tests in this study (finger dexterity, Purdue pegboard test, and the O'Connor tweezer dexterity test) were particularly informative because the reported scores represent percentile ranking compared to the same sex dominant hand. Because Salazar and Knapp measured the time it took to perform specific tasks, lower scores indicate better functional ability in their study. Both studies showed statistically significant improvement over time in the functional ability of non-dominant hands.

Mitchell-Krever and Lacroix found that almost every task improved after their training program as assessed during a two to six month followup period. Gross motor skills, fine motor skills, combined fine and gross motor skills, writing skills, and grip strength all showed statistically significant improvement. Typing and keypadding speed also increased, but accuracy for both skills was unchanged perhaps because accuracy was already high (>95%). Age was not related to post-

Table 371. Results of outcomes measured in publications that reported information on changing hand dominance.

Author	Length of followup	Outcome	Pretest Mean	Pretest SD	Post-test Mean	Post-test SD
Mitchell-Krever and Lacroix, 1998[659]	Mean: 5 months (range 2-6 months)	Peg transfer [a]	53.68	10.97	87.43	11.10
		Peg turn [a]	49.53	12.21	89.06	10.63
		Rivets and washers [a]	41.85	11.76	77.30	13.66
		Finger dexterity [a]	26.11	24.43	61.97	29.74
		Purdue pegboard test [a]	13.77	17.53	42.93	26.10
		O'Connor Tweezers Dexterity test [a]	10.40	17.61	38.55	29.71
		Writing – manuscript [a]	7.27	2.68	15.42	4.95
		Writing – cursive [a]	7.44	3.26	14.82	6.05
		Typing speed [a]	8.21	4.79	17.83	8.05
		Typing accuracy	94.92	4.78	95.00	4.75
		Keypadding speed [a]	10.73	5.26	30.71	13.85
		Keypadding accuracy	95.21	9.41	96.17	3.45
		Grip strength [a]	32.57	14.36	36.97	13.68
Salazar and Knapp, 1996[660b]	One week after first test	Bolts task				
		Men	36.9	10.2	33.0	8.3
		Women	46.5	13.4	42.9	12.7
		O'Connor Tweezers Dexterity test [c]				
		Men	33.7	11.4	24.4	6.0
		Women	34.2	13.5	31.2	15.0
		Drilling task [c]				
		Men	36.4	10.9	20.0	6.8
		Women	63.1	27.9	34.4	22.1
		Nail-driving task				
		Men	15.9	5.8	15.2	4.0
		Women	58.3	35.8	48.4	28.0

a Significant improvement between pre- and post-test scores, *t*-test with P<0.001 as reported in Mitchell-Krever and Lacroix, 1998[659]

b Only data for non-preferred hand is presented

c Significant improvement between pre- and post-test scores, F-test with P<0.05 as reported in Salazar and Knapp, 1996[660]

Conclusions

The evidence presented in these two studies suggests that learning and training in the use of the non-dominant hand is possible and statistically significant improvement can be accomplished in 2 to 6 months of training. For some activities, statistically significant improvement can be accomplished within one week. However, these studies lack long-term followup data to determine how well the interventions work towards providing the patient with employment opportunities and if the improvement of the non-dominant hand is sufficient to allow resumption of normal activities.