Transport Accident Commission & WorkSafe Victoria

Evidence Service

Carpal tunnel release undertaken as an adjunct to surgery for acute injuries to the forearm

Evidence Review

October 2008

Jane Reid, Marie Garrubba, Claire Harris, Veronica Pitt

CONTENTS

ACKNOWLEDGEMENTS

The authors would like to thank several colleagues for their assistance in preparation of this document.

Lisa Sherry from TAC/WSV for clinical information, advice on search terms and selection criteria, and editing of Plain Language Statements.

Lisa Cossens from the Centre for Clinical Effectiveness for document editing.

CARPAL TUNNEL RELEASE UNDERTAKEN AS AN ADJUNCT TO SURGERY FOR ACUTE INJURIES TO THE FOREARM

PLAIN LANGUAGE SUMMARY

The median nerve runs down the arm and through a tunnel in the bones of the wrist where it becomes the main nerve to the thumb side of the hand. An injury to the forearm, the treatment of the injury or the pressure caused by later swelling can cause median nerve problems.

Carpal tunnel release (CTR) is a procedure to relieve pressure on the nerve as it passes through the tunnel. Opinions differ as to whether CTR should be done during operations for injuries to the forearm.

This review evaluated whether CTR during forearm surgery for acute injuries improved patient outcomes.

Some research studies are specifically designed to test whether a treatment is effective or not and the results are trustworthy. These studies are called high level evidence. Other studies are not designed to test the treatment, but just observe what happened to patients who received it or those who did not. These studies can provide some information, but it is not as certain as the information from high level evidence. These studies are referred to as low level evidence, sometimes called observational studies.

Eight relevant studies were found. Two studies compared patients who had CTR with patients who did not. The other six studies only included patients who had CTR. These six studies are low level evidence and in addition, they all had problems with the way they were run. This means that no definite conclusions can be made about whether doing a CTR at the same time as surgery for forearm injuries is a good idea or not.

All studies included patients with fractures to the forearm and in most studies the fracture was at the wrist end of the forearm bone. CTR was not found to benefit these patients, and one study found that patients who had CTR had a higher risk of developing median nerve problems.

In summary, there is weak evidence that patients are not helped by CTR done at the time of surgery for forearm injury, and may even be at risk of harm.

CARPAL TUNNEL RELEASE UNDETAKEN AS AN ADJUNCT TO SURGERY FOR ACUTE INJURIES TO THE FOREARM

EVIDENCE SUMMARY

Definition

Carpal tunnel release (CTR) is a procedure involving division of the transverse carpal ligament. It is sometimes performed as an adjunct to surgery for acute injuries to the forearm.

General comment

The information available is based on low level evidence from observational studies only.

Does carpal tunnel release, with or without neurolysis at the time of forearm surgery for acute injuries, where there is acute carpal tunnel syndrome present or not, improve outcomes?

The weak evidence available suggests that prophylactic median nerve decompression in patients with volar buttress plating for distal radius fractures does not improve outcomes and may be of harm.

There is insufficient evidence to know, with any confidence, the effect of adjunct CTR undertaken during any other operations for injuries to the forearm.

In which conditions is there evidence of improved outcomes?

There are no conditions where there is evidence of improved outcomes.

Carpal tunnel release undertaken as an adjunct to surgery for acute injuries to the forearm
Evidence Review
October 2008

Jane Reid, Marie Garrubba, Claire Harris, Veronica Pitt

BACKGROUND

Median nerve problems can occur after injuries to the forearm or treatment of the injury. The nerve may be affected during the injury with no compression; or may become compromised by pressure caused by post-injury swelling. Beliefs differ as to whether carpal tunnel release (CTR), a procedure involving division of the transverse carpal ligament, should be undertaken during the operation for the injury.

In order to develop and update policies for CTR, the Transport Accident Commission and WorkSafe Victoria (TAC/WSV) Health Services Group requested a systematic review of the evidence of effectiveness of CTR undertaken as an adjunct to surgery for acute injuries to the forearm.

QUESTIONS

Does carpal tunnel release with or without neurolysis at the time of forearm surgery for acute injuries, where there is acute carpal tunnel syndrome present or not, improve outcomes?

In which conditions is there evidence of improved outcomes?

METHODS

Standard systematic review methodology was used to identify and appraise identified research. Details can be found in Appendices 1-3.

RESULTS

Our search of electronic databases yielded 1961 citations. After reviewing the title, abstract or full text, two cohort studies[1, 2] and four case series[3-6] were identified which met the selection criteria.

Reference lists of relevant publications were searched and two additional case series[7, 8] were identified. Relevant publications were used in a citation search in the Web of Science database, but this did not identify any additional studies.

The internet search did not yield any relevant EBGs or SRs.

In addition to the exclusion criteria in Table A1, in Appendix 1, studies were also excluded when the results for patients undergoing CTR were combined with patients who did not have CTR.

The evidence identified, with the condition and the operation undertaken, is summarised in Table 1.

Table 1. Sources of evidence for carpal tunnel release as adjunct to surgery for acute injuries of the forearm

Cohort studies*	Condition	Operation
Odumala et al, 2001[1]	Distal radius fractures	Volar buttress plating (also referred to as volar T plate in the article)
Paley & McMurtry, 1987[2]	Distal radius fractures	Removal of displaced volar fragment
Case series*		
Bora et al, 1984[8]	Malunions of the distal radius	Distal radial osteotomy with the insertion of a biplanar iliac bone graft
Brostrom et al, 1990[5]	Forearm fracture with acute compartment syndrome	Fracture stabilisation and fasciotomy of forearm and carpal compartments
Henry & Stutz, 2007[3]	Distal radius fractures	Distal radius fracture fixation
Posner & Ambrose, 1991[6]	Malunited Colles' fracture	Biplanar closing wedge osteotomy of the radius with resection of the ulna head
Simpson & Jupiter, 1995[7]	Distal radius fracture with elevated intracompartmental pressure in the forearm	Decompression of the superficial and deep flexor compartments with decompression of the carpal tunnel
Zoubos et al, 1997[4]	Distal radius fractures	Fractures were reduced and fixated with small buttress plates and screws

* In alphabetical order by first author's surname

Quality of evidence

All identified research was appraised and found to be of low quality with an associated high risk of bias. The study by Brostrom et al[5] was found to be of better quality but still considered to have a moderate to high risk of bias. The studies had a variety of methodological problems including lack of information regarding potential conflicts of interest, explicit inclusion and exclusion criteria, how the sample was selected, how the data was obtained, how the outcomes were measured and if they were objective, and small sample size. Additional problems with the cohort studies included systematic differences in the management of the intervention and control groups (in addition to the intervention under investigation) and lack of comprehensive information about baseline characteristics. Full details of the appraisals are in Appendix 4.

Level of evidence

As detailed above, the studies included were all observational studies (two cohort studies and six case series); therefore there is only low level evidence available to address this question. The results need to be interpreted with caution due to the potential bias inherent in these study designs.

Scope

A summary of the conditions, interventions and outcomes is provided below; full details appear in Appendix 5.

Patient groups

Four studies (two cohort and two case series) included patients with distal radius fractures;[1-4] two case series included patients with malunited distal radius fractures;[6, 8] and two case series included patients with compartment syndrome due to forearm[7] or distal radius fracture.[5]

Median nerve compromise

The study conducted by Odumala et al[1] was the only study in which all patients did not have median nerve compression symptoms. Five studies undertook CTR on patients with median nerve compression symptoms.[2-5, 7] Two studies included mixed populations (i.e. some patients had median nerve symptoms and some did not).[6, 8]

It is important to note that two studies each included a group of patients with no median nerve compression symptoms who did not undergo CTR.[3, 4] These studies also included a group of patients who had median nerve compression who did undergo CTR. The CTR groups were fundamentally different to the non-CTR group making it inappropriate to compare them. We have therefore only included the results from the CTR groups in this review.

Age of patients
All patients included in the studies were older than 14 years.

Intervention
In five studies the operation was for the acute injury,[1-5] one study reported findings of operations required within hours of the initial procedure[7] and two studies reported on revision operations required some time after the injury.[6, 8]

Neurolysis was not conducted with CTR in any of the included studies.

Outcomes measured
A range of outcomes were reported. Only one study assessed carpal tunnel syndrome.[3] Authors reported median nerve compromise in a number of ways; these included median nerve function,[4, 5] median nerve dysfunction,[1] median nerve recovery,[2] median nerve sensation,[7] median nerve compression symptoms[8] and numbness and/or paresthesias.[6] Six studies reported on pain,[2, 3, 5-8] five studies reported on function,[3, 5-8] three studies reported on return to work,[5, 7, 8] and three studies reported on complications.[3, 4, 8]

Findings
Results are reported by outcome. Cohort studies are reported before case series.

Median nerve compromise
As stated above, median nerve compromise was reported in all studies, but was reported in a number of ways. In the following section the actual terms used in the studies will be reported.

The cohort study by Odumala et al[1] found that "*prophylactic median nerve decompressed patients*" (n=24) had more than twice the risk (relative odds 2.7, 95% CI 0.94, 4.76, p=0.08) of developing median nerve dysfunction than the non decompressed patients (n=45). This was not statistically significant, probably due to the small sample size, but is potentially clinically significant. All cases resolved spontaneously except three patients who required subsequent carpal tunnel decompression. One of these patients was in the prophylactic carpal tunnel decompression group (incomplete division of the flexor retinaculum found at operation) and two patients were not. This study evaluated median nerve dysfunction by the Phalen test, hypoanaesthesia, motor disturbance and nerve conduction studies.

The cohort study by Paley & McMurtry[2] found that of the four patients who had CTR, full recovery of the median nerve occurred in three patients. The fourth patient was reported to have decreased sensation at six months. It was not reported what happened after six months. The one patient who did not have CTR was reported to have some improvement in median nerve sensation, but had sensory deficit at nine months. It was not reported what happened after nine months. The study evaluated median nerve recovery but it was not documented how this was measured.

Three case series reported that the condition of the median nerve returned to normal after the surgery. Bora et al[8] (n=11) found that median nerve compression symptoms in all their patients were resolved after surgery. Posner & Ambrose[6] (n=14) reported that "*Numbness and/or paresthesias were relieved in those patients who had symptoms and signs of compression before operation".* The study by Zoubos et al[4] (n=4) reported that normal median nerve function occurred postoperatively. All these studies failed to document how these outcomes were measured.

Henry & Stutz[3] (n=169) reported that no patients demonstrated postoperative symptoms of carpal tunnel syndrome. However, it was reported that two patients had monofilament scores which failed to return to normal (2.83g); both had final scores of 3.61g. This may suggest these patients still had some median nerve compromise.

Two case series reported that the majority of the patients had normal median nerve function after surgery. Brostrom et al[5] (n=16) reported that normal motor and sensory median nerve function was regained in 15 patients, but one patient still had impaired two-point discrimination capacity in median nerve-innervated fingers. Simpson & Jupiter[7] (n=5) reported that only one patient complained of numbness affecting the index, middle and ring fingers after prolonged use of the arm or in extremes of cold, but no objective sensory deficit was demonstrable. All other patients did not demonstrate any neurological abnormality. It was not documented what tools were used to measure this in these two studies.

Pain

Pain was evaluated by six studies (one cohort study and five case series). As well as the general term pain, the more specific terms of reflex sympathetic dystrophy and neuropathic pain were used. In the following section the terms used in the studies will be quoted. It should be noted that none of the studies documented how pain was measured.

The cohort study by Paley & McMurtry[2] (n=5) reported that one patient in the CTR group had residual reflex sympathetic dystrophy at six months. It was not reported what happened after six months. It was not documented if any of the other patients, in the CTR group or control group, experienced any reflex sympathetic dystrophy.

One case series by Henry & Stutz[3] reported that there were no cases of neuropathic pain syndrome.

The other four case series reported that not all patients were relieved of pain. Bora et al[8] (n=11) reported that "*Fifty percent of the patients continued to experience mild weather ache which, however, improved with time".* Posner & Ambrose[6] (n=14) reported that "*Pain was significantly reduced in every patient, although one patient reported continued discomfort but only when participating in racquet sports*". Brostrom et al[5] (n=16) reported that "*Five patients had no complaints; three patients reported pain in the arm at rest and eight had slight pain during exercise*". Simpson & Jupiter[7] (n=5) reported that one patient had pain requiring medication on a regular basis; one patient had pain after heavy duties and required medication infrequently; two patients experienced minimal wrist pain which did not require medication.

Function, return to work and complications

Function, return to work and complications were only reported in the case series. Therefore we have no comparison group to determine the impact of CTR.

The importance of having a comparison group is particularly crucial for these outcomes, as all operations were composite procedures consisting of the primary operation plus the CTR. Because these operations were composite procedures, and there was no comparison group, it is impossible to separate the effect of the primary operation from the effect of CTR for these outcomes.

Therefore the information reported in the case series provides no useful evidence regarding the impact of CTR on function, return to work and complications. For that reason the results provided in the case series will not be reported here. Full details can be found in Appendix 5.

DISCUSSION

The majority of included studies had a high risk of bias and were all low level evidence. Therefore we can only have limited confidence in the findings and need to interpret the results with caution.

Only one study[1] was designed to specifically evaluate the effectiveness of adjunct CTR in patients undergoing surgery for acute injuries to the forearm and had both an intervention group and control group. This study only evaluated the outcome of median nerve dysfunction.

The intervention being investigated for this review is a composite procedure comprised of CTR plus another surgical operation. It is therefore impossible to know the effect of CTR alone. A comparison group is needed to quantify this. For function, return to work and complications, the only evidence is from case series which provide no useful information for these outcomes.

There are different opinions in the literature regarding whether CTR should be undertaken during an operation for injuries to the forearm. The studies included in this review either included: 1) patients with no symptoms of median nerve compromise, 2) patients with symptoms of median nerve compromise, or 3) mix of patients with and without median nerve compression.

Patients with no preoperative median nerve compromise

The cohort study by Odumala et al[1] was the only study to evaluate the effectiveness of CTR for patients with no median nerve compromise. They found that patients who had prophylactic median nerve decompression were more likely to develop median nerve dysfunction than patients who did not. The authors concluded that "*prophylactic median nerve decompression does not alter the course of median nerve dysfunction and may increase post-operative morbidity".*

This study had various methodological flaws so the validity of the findings are uncertain. However, it is the highest level of evidence identified in this review.

Patients with preoperative median nerve compromise

Of the five studies identified which only conducted CTR on patients with preoperative median nerve compromise, only two studies[3, 4] found that no patients had median nerve compromise at follow-up; in addition one study[3] found that these patients were also pain free. Three studies[2, 5, 7] reported that small numbers of patients continued to experience median nerve problems and pain despite having CTR.

These studies were of poor quality and provide only low level evidence. In addition, they were not designed to address our question; their aim was to report on a group of patients who had various operations of the forearm.

Reasons given by the authors for conducting CTR varied.

Paley & McMurtry[2] believe that "c*arpal tunnel release and removal or reduction of the displaced volar fragment should be carried out as early as possible to avoid the complications of reflex sympathetic dystrophy".* This statement does not seem valid given that the only occurrence of reflex sympathetic dystrophy at follow-up occurred in a patient who had CTR. The one patient who did not have CTR was not reported to have any complaints of reflex sympathetic dystrophy.

Brostrom et al[5] and Simpson & Jupiter[7] undertook CTR to minimise damage to the nerve which can occur with the build up of pressure due to the compartment syndrome.

Henry & Stutz[3] and Zoubos et al[4] both believe only patients at risk need to have CTR. Zoubos et al[4] state that *"the median nerve, when not damaged or compressed, should not be explored or decompressed during surgery".*

Mixed groups with and without preoperative median nerve compromise

The two studies with mixed groups of patients[6, 8] found that none of their patients had residual median nerve problems however some patients did continue to have residual pain. It would have been useful to know if there were any differences between the group who had median nerve symptoms preoperatively and the group who did not. Unfortunately this information was not provided.

Bora et al[8] conducted CTR to permit "*better control of the distal fragment and makes it easier to correct the position of the distal fragment when the maneuver for correction is implemented*". Posner & Ambrose[6] stated that "*Decompression of the median nerve was necessary in 10 patients who had symptoms and/or signs of a carpal tunnel syndrome. In the 4 patients who had no evidence of median nerve compression before operation, a surgical release of the carpal tunnel was still done to preclude the possibility of a neuropathy developing as a consequence of postoperative swelling. We agree with Bora that division of the transverse carpal ligaments adds little to the operative time, does not increase postoperative morbidity, and, of most importance, significantly reduces the likelihood that such surgery will be required in future".* There would appear to be a lack of evidence to justify the statement that CTR "*does not increase postoperative morbidity, and, of most importance, significantly reduces the likelihood that such surgery will be required in future*".

Limitations of this review

Limitations of the review are that only studies in English were included and hand-searching was not undertaken. The implication of this is that some relevant studies may have been missed. In addition, although the application of selection criteria and appraisal of studies was conducted independently by two reviewers, there was only one person who extracted the data. This may have lead potentially to transcription errors.

Recommendations for future research

Randomised controlled trials (RCTs) are the best study design for evaluating effectiveness of intervention. We recommend a well conducted RCT be undertaken to answer the questions posed in this review.

CONCLUSION

Does carpal tunnel release (CTR) with or without at the time of forearm surgery for acute injuries, where there is acute carpal tunnel syndrome present or not, improve outcomes?

There is some low level evidence to suggest that prophylactic median nerve decompression in patients with volar buttress plating for distal radius fractures does not improve outcomes and may be of harm. However this finding needs to be interpreted with caution due to the methodological problems and the potential for bias inherent in the studies included in the review.

There is insufficient evidence to know, with any confidence, the effect of adjunct CTR undertaken during any other operations for injuries to the forearm.

In which conditions is there evidence of improved outcomes?

There are no conditions were there is evidence of improved outcomes.

DISCLAIMER

CONFLICT OF INTEREST

The TAC/WSV Evidence Service is provided by the Centre for Clinical Effectiveness (CCE) and the Australasian Cochrane Centre (ACC). Neither CCE nor ACC accepts funding from pharmaceutical or biotechnology companies or other commercial entities with potential vested interest in the outcomes of systematic reviews. Both groups abide by the Cochrane Collaboration Policy on Commercial Sponsorship.[9]

The TAC/WSV Health Services Group has engaged CCE and ACC for their objectivity and independence and recognises that any materials developed must be free of influence from parties with vested interests. The Evidence Service has full editorial control.

REFERENCES

1. Odumala O, Ayekoloye C, Packer G. Prophylactic carpal tunnel decompression during buttress plating of the distal radius--is it justified? *Injury.* Sep 2001;32(7):577-579.
2. Paley D, McMurtry RY. Median nerve compression by volarly displaced fragments of the distal radius. *Clinical Orthopaedics & Related Research.* Feb 1987(215):139-147.
3. Henry M, Stutz C. A prospective plan to minimise median nerve related complications associated with operatively treated distal radius fractures. *Hand Surgery.* 2007;12(3):199-204.
4. Zoubos AB, Babis GC, Korres DS, Pantazopoulos T. Surgical treatment of 35 volar Barton fractures. No need for routine decompression of the median nerve. *Acta Orthopaedica Scandinavica, Supplement.* 1997;68(275):65-68.
5. Brostrom LA, Stark A, Svartengren G. Acute compartment syndrome in forearm fractures. *Acta Orthopaedica Scandinavica.* Feb 1990;61(1):50-53.
6. Posner MA, Ambrose L. Malunited Colles' fractures: correction with a biplanar closing wedge osteotomy. *Journal of Hand Surgery - American Volume.* Nov 1991;16(6):1017-1026.
7. Simpson NS, Jupiter JB. Delayed onset of forearm compartment syndrome: a complication of distal radius fracture in young adults. *Journal of Orthopaedic Trauma.* 1995;9(5):411-418.
8. Bora FW, Osterman AL, Zielinski CJ. Osteotomy of the distal radius with a biplanar iliac bone graft for malunion. *Bulletin of the Hospital for Joint Diseases Orthopaedic Institute.* 1984;44(2):122-131.
9. The Cochrane Collaboration. Commercial sponsorship and The Cochrane Collaboration. April 2006; http://www.cochrane.org/docs/commercialsponsorship.htm. Accessed August 2008.

APPENDIX 1: METHODS

TAC/WSV staff assisted in the development of search terms and inclusion and exclusion criteria.

Inclusion and exclusion criteria

Inclusion and exclusion criteria were established *a priori* and were applied independently by two reviewers. Differences were resolved by discussion or with a third reviewer.

Table A1.1 Selection criteria

Patient/ population	**Inclusion:** All ages and genders; Any acute injury requiring surgery to the forearm, or forearm surgery following on from acute injuries, where the primary intent of the operation was not carpal tunnel syndrome
	Exclusion: Cancer; non-traumatic or chronic carpal tunnel syndrome due to medications, obesity, pregnancy; hospital or other iatrogenic injuries*
Intervention/ indicator	**Inclusion:** Carpal tunnel release with or without neurolysis of nerves passing through the carpal tunnel when the procedure is conducted as adjunct therapy and not the primary intention of the surgery
	Exclusion: Surgery to the forearm with the sole purpose of undertaking carpal tunnel release for alleviation of carpal tunnel syndrome
Comparison/ control	**Inclusion:** Forearm surgery without carpal tunnel release
	Exclusion: N/A
Outcomes	**Inclusion:** Post surgery carpal tunnel syndrome, median nerve dysfunction, median nerve compression syndrome, pain, function, adverse events, return to work
	Exclusion: Nil
Setting	**Inclusion**: Day surgery or inpatient surgery
	Exclusion: Nil
Study Design	**Inclusion:** Evidence-based guidelines (identified by a systematic approach to identify, select and critically appraise relevant research and/or explicit links between recommendations and the evidence); systematic reviews (explicit systematic search strategy that is reproducible); controlled trials, comparative studies, cohort studies, case control studies or case series
	Exclusion: Expert opinion, non-systematic reviews, editorials, letters, case reports
Publication details	**Inclusion:** Studies in English and conducted on humans
	Exclusion: Studies in languages other than English and/or conducted on animals
Time period	**Inclusion:** Evidence-based guidelines and systematic reviews will be limited to the previous 10 years. No time limit will be used for the identification of primary studies
	Exclusion: Evidence-based guidelines and systematic reviews conducted greater than 10 years ago

* During the application of selection criteria, and after discussion with TAC/WSV, it was determined that 'hospital or other iatrogenic injuries' should also be excluded to reflect the patient group of interest more accurately.

Search strategy

Standard systematic review (SR) strategies, as outline below, were used to identify existing reviews and trials. Additional strategies were included to identify evidence based guidelines (EBG).

Guidelines are generally published as electronic 'stand alone' documents on the internet rather than papers in peer reviewed journals. The search to identify guidelines is therefore quite different to searches usually undertaken for SRs of primary research in the health literature. Methods to identify guidelines include identification of relevant websites followed by searches within them, direct searches of the internet and searches within the electronic health databases.

Unlike SRs of the primary research literature which usually involve a single clinical question, a guideline is a compilation of SRs arising from numerous clinical questions. These reviews may be grouped within the guideline into sections or chapters based on patient characteristics, health care settings, domains of clinical care or other categories related to the particular condition or patient population. Due to this complexity and comprehensiveness, the information contained in a particular section or chapter may be found in more than one type of guideline. For example, information on use of carpal tunnel release may be found in a guideline about forearm surgery or alternatively there may be a guideline about carpal tunnel surgery or median nerve decompression that includes a section on injury to the forearm requiring carpal tunnel release.

Internet searches to identify relevant websites

The reviewers were aware of websites of guideline clearinghouses, guideline developers, centres of evidence-based practice, Australian government health services and websites of specific relevance (e.g. accident compensation groups) known to contain evidence-based resources. The 19 generic websites previously identified by the review team (7 professional organisations, 9 guideline services, 2 Australian government websites and 1 centre of evidence-based practice) were searched for relevant guidelines. Details of websites searched can be found in Appendix 2.

Website searches to identify relevant guidelines

Websites were searched using any lists of guidelines, publications or other resources identified on the site and scanned for relevant documents for carpal tunnel release and median nerve decompression. In some cases, where an internal search engine was available, websites were searched using the following search strings.

- ('carpal tunnel' OR 'median nerve')
- (wound OR injury OR trauma OR fracture OR surgery) AND (arm OR radius OR ulna)

Internet searches to identify relevant guidelines and systematic reviews

An internet search strategy was conducted using the Google 'Advanced Search' function. The search strings were limited to documents in English and were used to identify guidelines for carpal tunnel surgery or median nerve decompression and injuries to the forearm requiring surgery

- ('carpal tunnel' OR 'median nerve') AND (evidence OR guideline OR systematic)
- (wound OR injury OR trauma OR fracture OR surgery) AND (arm OR radius OR ulna) AND (evidence OR guideline OR systematic)

The searches are outlined in detail in Appendix 3.

Electronic databases

Table A1.2 Databases accessed

Evidence Source	Period	Date of Search
Medline (Ovid)	1950 to present	1st September 2008
All EBM (Ovid) *	**	1st September 2008
CINAHL (Ovid)	1982 to 2008 August Week 4	1st September 2008
EMBASE	1980 to 2008 Week 35	1st September 2008

*including The Cochrane Database of Systematic Reviews, ACP Journal Club, DARE, CENTRAL, HTA and NHSEED.
** The Cochrane Database of Systematic Reviews (2nd Quarter 2008); ACP Journal Club (1991 to July 2008); DARE, CENTRAL, HTA and NHSEED (3rd Quarter 2008).

Database search

The following search was conducted in Medline and adapted for use in other databases.

No terms have been included for comparison or outcomes to enable a broader search.

Table A1.3 Search undertaken in Medline

1	exp "Wounds and Injuries"/ or (fracture$ or injur$ or trauma$ or wound$ or accident$).mp.	11	carp$ and(tunn$ or canal).ti,ab,tw.
2	(radius or radial or ulnar or forearm or wrist or hand or arm or limb or upper extremity).mp.	12	Median Neuropathy/
3	1 and 2	13	Median Nerve/ or median.mp.
4	surg$.mp.	14	(neuropath$ or entrapment or compression or dysfunction$).ti,ab,tw.
5	operat$.mp.	15	13 and 14
6	release$.ti,ab,tw.	16	or/9-12
7	decompress$.ti,ab,tw.	17	15 or 16
8	or/4-7	18	3 and 8 and 17
9	Carpal Tunnel Syndrome/	19	limit 18 to (English language and humans)
10	((Carp$ or Tunn$ or Canal) and (syndrome or pressur$ or compress$)).ti,ab,tw.		

Citation searches

Reference lists of potentially relevant publications were searched to identify any further primary or secondary studies. Any relevant primary studies identified in our search were used in a citation search in the Web of Science database to identify any further studies that met our inclusion criteria.

Appraisal

All quality appraisals were conducted independently by two reviewers. Differences were resolved by discussion or with a third reviewer.

Quality

Evidence-based guidelines and systematic reviews

We had planned that the most recent and comprehensive EBG or SR would be appraised according to standard appraisal criteria. If this EBG or SR was found not be of high quality, we would appraise the next most recent and comprehensive study until a high quality source of evidence was identified. However no EBGs or SRs were identified, so this process was not required.

Other study designs

We had also planned, if EBGs or SRs were identified, to limit the appraisal of other study designs to controlled trials identified in our search, but not included in the EBG or SR. However, as stated above, no EBGs or SRs were identified.

All included studies were critically appraised according to standard criteria addressing the potential limitations or bias associated with each study design.

Scope

Information on characteristics of the included studies were extracted and summarised. This included a description of the study design, the study population, details of the intervention, any comparisons included in the study, and a list of the outcomes reported. The characteristics of separate studies were reviewed to consider the scope covered and identify any gaps in the available evidence. Details are included in Appendix 5.

Data collection

Outcome data on the incidence of post-surgery carpal tunnel syndrome, pain, function, timing of return to work, and any adverse events was extracted from the included studies.

Consistency of findings

The findings reported by separate studies were compared and assessed for consistency. In cases where findings appear to be inconsistent with other studies, these were further explored to determine whether differences in study design, scope, or quality can explain disparate findings between studies.

APPENDIX 2: WEBSITE SEARCHES TO IDENTIFY RELEVANT GUIDELINES

Table A2.1 Searches within previously identified websites

Guideline Services		
National Health and Medical Research Council (NHMRC)	www.nhmrc.gov.au	Web page reviewed by: guidelines; health - scrolled entire list
National Institute for Health and Clinical Excellence UK (NICE)	www.nice.org.uk	Web page reviewed by: our guidance; health topic; injury, accident & wounds Web page reviewed by: our guidance; health topic; musculoskeletal Web page reviewed by: our guidance; health topic; surgical procedures
New Zealand Guideline Group (NZGG)	www.nzgg.org.nz	Web page reviewed by: publications - scrolled entire list Web page reviewed by: evidence for practice - scrolled entire list
Scottish Intercollegiate Guidelines Network (SIGN)	www.sign.ac.uk	Web page reviewed by: guidelines - scrolled entire list
Joanna Briggs Institute	www.joannabriggs.edu.au	Web page reviewed by: Systematic Reviews & Best Practice Information – scrolled lists (member access only)
Guidelines International Network	www.g-i-n.net	Web page reviewed by: health topics selection (public) – scrolled entire list
Guidelines Advisory Committee	www.gacguidelines.ca	Web page reviewed by: List all topics and summaries – scrolled entire list
National Guideline Clearinghouse US (NGC) (1) **searched on 01/09/2008 – 23 Results total** (2) **searched on 04/09/2008 – 154 Results total**	www.guidelines.gov	 Searched by: ('carpal tunnel' OR 'median nerve') Searched by: (wound OR injury OR trauma OR fracture OR surgery) AND (arm OR radius OR ulna)
TRIP Database (1) **searched on 01/09/2008 – 348 Results total** (10 – North America, 3 – Europe, 0 – Other) (2) **searched on 01/09/2008 – 1574 Results total** (57 – North America, 63 – Europe, 16 – Other)	www.tripdatabase.com	 Searched by: ('carpal tunnel' OR 'median nerve') limited by guidelines Searched by: (wound OR injury OR trauma OR fracture OR surgery) AND (arm OR radius OR ulna) limited by guidelines
Australian Government Websites		
Australian Government Department of Health and Ageing	www.health.gov.au	Web page reviewed by: Health Professionals – Treatments & Techniques – Guidelines – None relevant
NSW Health	www.health.nsw.gov.au	Web page reviewed by: Publications & Resources – Policy Directives and Guidelines – None relevant
Centres of Evidence Based Practice Websites		
WA Centre for Evidence Based Nursing and Midwifery	http://wacebnm.curtin.edu.au	Web page reviewed by: Resources – 'Reports, Guidelines and Article' – None relevant

TAC/WSV relevant sites		
Transport Accident Commission	www.tac.vic.gov.au/	No EB Guidelines – "guidance available" Documents on website include policies can be found under provider resources = medical services
Motor Accidents Authority NSW	http://www.maa.nsw.gov.au/	Web page reviewed by: Publications & Reports – MAA Guidelines – Guides for Professionals - Scrolled list
Accident Compensation Corporation	http://www.acc.co.nz/index.htm	Web page reviewed by: For Providers – Guidelines & Best Practice – Published Clinical Guidelines
Pain Treatment Topics	http://pain-topics.org/guidelines_reports/index.php	Web page reviewed by: Current Pain Treatment Guidelines – Scrolled list
WorkSafe	http://www.worksafe.gov.au	Web page reviewed by: Health and Safety Topics – scrolled guidance list
Work Cover NSW	http://www.workcover.nsw.gov.au	Web page reviewed by: Publications – None relevant
Work Cover WA	http://www.workcover.wa.gov.au	Web page reviewed by: Publications – Publications for health providers

APPENDIX 3: INTERNET SEARCHES TO IDENTIFY RELEVANT GUIDELINES AND SYSTEMATIC REVIEWS

Identification of relevant guidelines for carpal tunnel surgery or median nerve decompression using Google	
Find web pages that have **all these words**	('carpal tunnel' OR 'median nerve') AND (evidence OR guideline OR systematic)
Find web pages that have this **exact wording or phrase**	
Find web pages that have **one or more of these words**	
Don't show pages that have **any of these unwanted words**	
Language	English
Results 04/09/2008 completed search	172,000
Google Edits at	472

Identification of relevant guidelines for injury to the forearm using Google	
Find web pages that have **all these words**	(wound OR injury OR trauma OR fracture OR surgery) AND (arm OR radius OR ulna) AND (evidence OR guideline OR systematic)
Find web pages that have this **exact wording or phrase**	
Find web pages that have **one or more of these words**	
Don't show pages that have **any of these unwanted words**	
Language	English
Results 04/09/2008 completed search	15,000,000
Google Edits at	387

APPENDIX 4: APPRAISAL OF STUDY QUALITY

Study: Bora FW, Osterman AL, Zielinski CJ. Osteotomy of the distal radius with a biplanar iliac bone graft for malunion. *Bulletin of the Hospital for Joint Diseases Orthopaedic Institute.* 1984;44(2):122-131.

Description of study: case series – level IV evidence

Patient/population • Complaint • Median nerve • Age • Other	• Patients with malunions of the distal radius (more than one inch of shortening) with complaints of weak grip and limited forearm rotation and wrist motion. • About 50 percent had median nerve symptoms. • Patients were aged between 14 and 62 years. • The injury in each case was more than one year old.
N	11
Setting	Not specified
Intervention/indicator	Distal radial osteotomy with the insertion of a biplanar iliac bone graft and median nerve decompression.
Comparison/control	No comparison/control group
Outcomes	Median nerve compression symptoms, pain, function (motion and grip strength), return to work, complications, restoration and maintenance of radial length, restoration of the volar tilt and cosmesis.
Inclusion Criteria	No inclusion criteria were specified; however, it appears that patients with malunions of the distal radius were included.
Exclusion Criteria	Not specified

Study Validity

Were there any conflicts of interest in the writing or funding of this study?	Not reported	
Does the study have a clearly focused question?	Partial	*"The purpose of this paper is to describe the treatment of malunion of the distal radius by osteotomy of the distal radius with insertion of a biplanar iliac bone graft, and to discuss the results wand indications for this procedure."*
Is a case series the appropriate method to answer this question?	No	Case series is not an appropriate method for testing effectiveness. A randomised controlled trial is the most appropriate way to answer this question.
Was the study prospective?	Not reported	
Does the study have specified inclusion/exclusion criteria?	No	
If there were specified inclusion/ exclusion criteria, were these appropriate?	N/A	

Were the cases representative of a defined population?	Not reported	It was not documented how the patients were selected.
Does the study provide an explicit description of study subjects?	Yes	Information regarding age, gender, type of injury, primary treatment and preoperative symptoms (e.g. grip strength, pain, numbness in the median nerve distribution and forearm rotation) was provided.
Was there sufficient duration of follow-up?	Yes	Follow- up was for at least 2 years (mean 3.4 years).
Was the size of the study appropriate?	Partial	This is a small study with only 11 patients. No rationale for study size was provided.
Were all outcomes measured in a standard, valid and reliable way?	Not reported	It was not reported how the outcomes were measured.
Were outcomes assessed objectively and independently?	Not reported	It was not reported how the outcomes were assessed.
Is the paper free of selective outcome reporting?	Not reported	It was not reported what the planned outcomes were and therefore we are able to state if the article is free of selective reporting.
Were the outcomes measured appropriate?	Partial	The outcomes measured are appropriate. How they were measured was not documented.
If statistical analysis was undertaken, was this appropriate?	N/A	It was not reported what, if any, statistical tests were used.
What percentage of cases refused to participate in the study?	Not reported	
What percentage of cases were lost-to-follow-up?	0%	*"Follow-up data are available on all patients"*
What percentage of cases were not included in the analysis?	N/A	
Other		
What is the overall risk of bias?	High	

Results

Median nerve compression symptoms

"M*edian nerve compression symptoms in all our patients were resolved after surgery."* It was not documented how this was measured.

Pain

"Fifty percent of the patients continued to experience mild weather ache which, however, improved with time." It was not documented how this was measured.

Function

Active motion was "*measured in percentage of normal".* It was not documented if "*normal*" referred to normal values in the general population or compared to uninjured hand.

	Preoperative (%)	Postoperative (%)
Pronation	10	65
Supination	15	45
Wrist volar flexion	25	60

Wrist dorsiflexion decreased from 80% of normal preoperatively to 50% postoperatively. Again, it was not documented if 'normal' referred to normal values in the general population or compared to uninjured hand.

Grip strength was compared to the uninjured hand. "*It improved significantly in all patients after surgery from a preoperative mean of 45% of the normal hand to 80% postoperatively."* The article does not document if "*significantly*" refers to statistical testing and if so what test was undertaken.

Return to work

There were 7 patients working at the time of injury. They returned to their jobs an average of 14 weeks post surgery.

Complications

"*One loss of position in the Smith's fracture when the pins were removed prematurely at four weeks*." One patient had an avulsion fracture of part of the wing of the ileum through the donor site. No infections of non unions occurred and no secondary operations were required.

Restoration and maintenance of radial length reported in article, restoration of the volar tilt and cosmesis were reported in the article, but have not been reported here.

Author's Conclusions

None related to CTR

Our comments/summary

The major limitation with this study is that it is a case series and has no control/comparison group; case series are unable to provide evidence of effectiveness. Limitations of the study also include lack of information regarding potential conflicts of interest, explicit inclusion and exclusion criteria, how the data was obtained, how the sample was chosen, how outcomes were measured, or analysed and small sample size.

Study: Brostrom LA, Stark A, Svartengren G. Acute compartment syndrome in forearm fractures. Acta Orthopaedica Scandinavica. Feb 1990;61(1):50-53.

Description of study: case series – level IV evidence

Patient/population • Complaint • Median nerve • Age	 • Patients with forearm fracture with acute compartment syndrome. • Median nerve function was impaired in all the patients. • Patients were aged between 18 and 65 years.
N	16
Setting	Karolinska Hospital, Stockholm, Sweden.
Intervention/indicator	Fracture stabilisation and fasciotomy of forearm and carpal compartments (to open the carpal tunnel and the canal of Guyon)
Comparison/control	No comparison/control group
Outcomes	Nerve function, pain, function (including stiffness, weakness, range of motion and grip strength), return to work and radiographic analysis (fracture healing, displacement and development of arthrosis).
Inclusion Criteria	No inclusion criteria were specified; however, it appears that patients with forearm fracture with acute compartment syndrome were included.
Exclusion Criteria	Not specified

Study Validity

Were there any conflicts of interest in the writing or funding of this study?	Not reported	
Does the study have a clearly focused question?	Partial	*"The aim of our study was to analyze the late results of decompression fasciotomy in a series of patients with forearm fracture and acute compartment syndrome."*
Is a case series the appropriate method to answer this question?	No	Case series is not an appropriate method for testing effectiveness. A randomised controlled trial is the most appropriate way to answer this question.
Was the study prospective?	Not reported	
Does the study have specified inclusion/exclusion criteria?	No	
If there were specified inclusion/ exclusion criteria, were these appropriate?	N/A	
Were the cases representative of a defined population?	Partial	The article documented that between 1978 and 1983, 16 patients were treated for forearm fracture and acute compartment syndrome. Although there does not seem to be explicit criteria for inclusion, it appears all patients for a period of time were included.

Does the study provide an explicit description of study subjects?	Yes	Information regarding age, gender, type of injury and median nerve function was provided.
Was there sufficient duration of follow-up?	Yes	Patients were examined clinically and radiographically two to five years after their operation.
Was the size of the study appropriate?	Partial	This is a small study with only 16 patients. No rationale for study size was provided.
Were all outcomes measured in a standard, valid and reliable way?	Partial	"*Subjective assessment regarding pain (severe/moderate/slight/none), stiffness (yes/no) and weakness (yes /no) was preformed. Range of motion was measured with a gonimeter and grip strength with a Martin vigorimeter. A decrease was expressed in percentage of values in the healthy arm. Nerve function was analysed and two-point discrimination capacity measured."* It was not documented if the questionnaire used had been standardised or validated.
Were outcomes assessed objectively and independently?	Partial	Pain, stiffness, weakness have been documented as being subjective. Using a g*onimeter and Martin vigorimeter* provide objective measurement. It was not reported if the tests were conducted independently.
Is the paper free of selective outcome reporting?	Not reported	It was not reported what the planned outcomes were and therefore we are able to state if the article is free of selective reporting.
Were the outcomes measured appropriate?	Yes	
If statistical analysis was undertaken, was this appropriate?	N/A	No statistical testing was undertaken.
What percentage of cases refused to participate in the study?	Not reported	
What percentage of cases were lost-to-follow-up?	Not reported	
What percentage of cases were not included in the analysis?	N/A	
Other		
What is the overall risk of bias?	Moderate / High	

Results

Median nerve function

Normal motor and sensory median nerve function was regained in 15 patients. One patient still had impaired two-point discrimination capacity (>15mm) in median nerve-innervated fingers.

Pain

"F*ive patients had no complaints; 3 patients reported pain in the arm at rest and 8 had slight pain during exercise. Stiffness of the arm was experienced by 7 patients, and 3 had problems of arm weakness."*

Function

Wrist motion – compared to the values in the unaffected hand, there was a mean decrease of:

- 42% (range 1–64%) for volar flexion
- 38% (range 20-75%) for dorsal extension
- 30% (0–47%) for both pronation and supination.

A finger flexion defect of at least 1 cm was observed in five patients. The range of wrist motion did not differ between high and low-energy injuries.

Grip strength – compared to the values in the unaffected hand, there was a mean decrease of 54% (range 10–94%).

Return to work

Eight patients returned to their pervious occupations within a year of the injury. Six were still listed as sick after two years. The other two patients were of retirement age. It was not reported what the employment status before the injury was for the six who did not return to work, although it appears likely that they were working.

Radiographic analysis (fracture healing, displacement and development of arthrosis) was reported in the article, but as these outcomes were not part of our question, have not been reported here.

Author's Conclusions

"The prompt treatment of compartment syndrome in our cases probably explains the near complete restoration of nerve function."

Our comments/summary

The major limitation with this study is that it is a case series and has no control group; case series are unable to provide evidence of effectiveness.
Limitations of the study also include lack of information regarding inclusion/exclusion criteria, how the sample was chosen and therefore if they are representative of this group of patients and small sample size.

Study: Henry M, Stutz C. A prospective plan to minimise median nerve related complications associated with operatively treated distal radius fractures. Hand Surgery. 2007;12(3):199-204.

Description of study: case series – level IV evidence

Patient/population • Complaint • Median nerve • Age	 • Patients had operatively treated distal radius fractures. • Clinical symptoms of median nerve compression were present. • Age was not specified for the carpal tunnel release patients; however, all patients included in the study patients were aged between 17 and 89 years.
N	169
Setting	Not specified
Intervention/indicator	Group 1. Distal radius fracture fixation plus Agee single portal endoscopic carpal tunnel release method (n=93) Group 2. Distal radius fracture fixation plus Flexor carpi radialis sheath release of the transverse carpal ligament from its radial margin (n=76)
Comparison/control	No comparison/control group. The study included a group who were considered at low risk of carpal tunnel syndrome post operatively (monofilament scores of 3.61g or less) and therefore did not have carpal tunnel release (n=205). Because of this fundamental difference, this group can not be considered comparable to the carpal tunnel release groups.
Outcomes	Carpal tunnel syndrome, pain and complications.
Inclusion Criteria	No inclusion criteria were specified explicitly; however it appears that patients were included with: • clinical symptoms of median nerve compression (the injured side tested at least one filament grade less than the uninjured side, or at least 4.31 g and was accompanied by subjective complaints of numbness in the median nerve distribution); and • operatively treated distal radius fractures were included.
Exclusion Criteria	No exclusion criteria were specified; however it appears that patients were excluded with: • stable distal radius fractures treated non-surgically; and • low risk of carpal tunnel syndrome post operatively (monofilament scores of 3.61g or less).

Study Validity

Were there any conflicts of interest in the writing or funding of this study?	Not reported	
Does the study have a clearly focused question?	Yes	The study involved a plan to identify patients at risk of developing median nerve related complications and undertake carpal tunnel release on these patients at the time of radius fracture fixation. The aim of the study was to assess the incidence of post-operative carpal tunnel syndrome and neuropathic pain in patients managed within this protocol.
Is a case series the appropriate method to answer this question?	No	Case series is not an appropriate method for testing effectiveness. A randomised controlled trial is the most appropriate way to answer this question.
Was the study prospective?	Yes	
Does the study have specified inclusion/exclusion criteria?	No	

If there were specified inclusion/ exclusion criteria, were these appropriate?	N/A	
Were the cases representative of a defined population?	Yes	The article stated that all patients with surgically treated distal radius fractures were included.
Does the study provide an explicit description of study subjects?	Yes	Information regarding age, gender, type of injury, cause of injury and median nerve compression was provided.
Was there sufficient duration of follow-up?	Partial	Mean follow-up was for 3.6 months post-operative (range 10 weeks to 35 months). Three months is the minimum follow-up time necessary.
Was the size of the study appropriate?	Yes	There were 169 patients who had carpal tunnel release. This number appears to be appropriate, but no rationale for study size has been provided.
Were all outcomes measured in a standard, valid and reliable way?	Partial	Other than monofilament scores, it was not documented how carpal tunnel syndrome was assessed. It was not documented how neuropathic pain, wrist flexion or wrist extension was assessed. Grip strength was measured at position #2 on the Jamar dynamometer.
Were outcomes assessed objectively and independently?	Partial	Monofilament testing is an objective measure. It was not documented how neuropathic pain, wrist flexion or wrist extension was assessed. It was not reported if the tests were conducted independently.
Is the paper free of selective outcome reporting?	Not reported	It has not been reported if the outcomes to be measured were decided *a priori* or how they were decided.
Were the outcomes measured appropriate?	Yes	
If statistical analysis was undertaken, was this appropriate?	N/A	No statistical analysis was reported.
What percentage of cases refused to participate in the study?	Not reported	
What percentage of cases were lost-to-follow-up?	Not reported	*"There were 383 consecutively operated cases in this period, nine of which failed to maintain at least eight weeks follow-up and were excluded."* It was not documented which group (carpal tunnel release or no carpal tunnel release) these patients were in.
What percentage of cases were not included in the analysis?	N/A	As above
Other		
What is the overall risk of bias?	High	

Results

Carpal tunnel syndrome

The article reported that no patients, in any group, demonstrated symptoms of carpal tunnel syndrome.

However, two patients (one in the Agee single portal endoscopic carpal tunnel release group (Group 1) and one in the Flexor carpi radialis sheath release of the transverse carpal ligament from its radial margin group (Group 2)) had monofilament scores which failed to return to normal (2.83g). Both had final scores of 3.61g.

Neuropathic pain

There were no cases of neuropathic pain syndrome identified in any patients.

Function

- Mean wrist flexion in Group 1 was 57.9° and in Group 2 this was 53.8°. The score for the non carpal tunnel release group was 61.4°.
- Mean wrist extension in Group 1 was 63.9° and in Group 2 this was 55.4°. The score for the non carpal tunnel release group was 61.7°.

No information was provided about range or standard deviation of scores. In addition, no information was provided regarding clinical significance of these figures.

- Grip strength was measured at position #2 on the Jamar dynamometer. Mean (% contralateral hand) for Group 1 was 25.4kg (75.9%) and for Group 2 was 20.2kg (62.6%). The score for the non carpal tunnel release group was 25.0kg (70%).

Complications

No complications, related to the carpal tunnel release, were identified.

Author's Conclusions

None related to CTR

Our comments/summary

The major limitation with this study is that it is a case series and has no comparative group; case series are unable to provide evidence of effectiveness.
Limitations of the study also include lack of information regarding potential conflicts of interest, inclusion/exclusion criteria, how the data was obtained, how outcome data was obtained and not documenting clinical significance of results.

Study: Odumala O, Ayekoloye C, Packer G. Prophylactic carpal tunnel decompression during buttress plating of the distal radius--is it justified? Injury. Sep 2001;32(7):577-579.

Description of study: cohort study – level III evidence.	
Patient/population • Complaint • Median nerve • Age	 • Patients with distal radial fractures • None of the patients had a pre-operative diagnosis of carpal tunnel syndrome. • Patients were aged between 24 and 81 years.
N	24 intervention, 45 control
Setting	Southend Hospital, Essex, UK
Intervention (exposure)	Volar buttress plating (also referred to as volar T plate in the article) and prophylactic carpal tunnel decompression
Comparison/control	Volar buttress plating without prophylactic carpal tunnel decompression
Outcomes	Median nerve dysfunction
Inclusion criteria	No inclusion criteria were specified; however, it appears that patients with volar buttress plating for distal radial fractures were included.
Exclusion criteria	No exclusion criteria were specified; however, it appears that a pre-operative diagnosis of carpal tunnel syndrome and open multiple open fractures were exclusion criteria.

Study Validity		
Were there any conflicts of interest in the writing or funding of this study?	Not reported	
Does the study have a clearly focused question?	Yes	*"It is the practice of some orthopaedic surgeons to perform prophylactic decompression of the carpal tunnel during volar buttress plating of the distal radius. Our objective in this study was to evaluate the effectiveness of prophylactic carpal tunnel decompression in preventing the complication of median nerve dysfunction in this group."*
Is a cohort study the appropriate method to answer this question?	Partial	A randomised controlled trial is the ideal study design to answer this question.
Was the study prospective?	No	The study was a retrospective study.
Does the study have specified inclusion/exclusion criteria?	No	
If there were specified inclusion/ exclusion criteria, were these appropriate?	Partial	*"Sixty-nine consecutive patients who had volar T plate for fractures of the distal radius were analysed over a 4-year period (1995–1998)."* Although there does not seem to be explicit criteria for inclusion, it appears all patients treated for a period of time were included.

Other than the exposure under investigation, were the groups selected from similar populations?	Partial	It was not documented how the patients were selected. The article does report on baseline characteristics and states: *"Patient variables of age, sex, fracture pattern (30 Barton's and 39 Smith's fractures), and hand involved were similar in both groups".* It would have been useful to have been provided with information regarding degree of severity of injury; this information was not provided.
Aside from the exposure, were the groups treated the same?	Not reported	*"Seven consultants were involved in the study of which three of them routinely performed prophylactic carpal tunnel decompression as part of the procedure for buttress plating in distal radial fractures. The operative approach was the Henry's distal forearm approach in patients who did not have carpal tunnel decompression and an extended incision to the ulnar side of the thenar eminence for patients who had carpal tunnel decompression."* This would suggest that the two groups were treated by different surgeons and had different incisions. This may introduce a systemic bias, but it is difficult to know how this would affect the results.
Was exposure measured in a standard, valid and reliable way?	Partial	In this study exposure/intervention was prophylactic carpal tunnel decompression and it should be easy to know if it was undertaken. However, it was not documented how this was confirmed. In addition, it was reported that one patient, who was in the carpal tunnel decompression group, was found to have incomplete division of the flexor retinaculum when a second carpal tunnel decompression was undertaken.
Were outcome assessors blind to the exposure?	Not reported	
Were all outcomes measured in a standard, valid and reliable way?	Partial	Patients' clinical notes were assessed for symptoms of median nerve dysfunction. The tests/measures that were used as indicators of median nerve appear to have been Phalen test, hypoanaesthesia, motor disturbance and nerve conduction studies. How standardised or reliably these were documented in the medical record is unclear. It was not reported how median nerve dysfunction was diagnosed. It would appear that not all these tests/measures had to be positive for median nerve dysfunction to be diagnosed (e.g. "*Phalen test: 13 out of 17 patients"*). However the number required to be positive has not been reported.
Were outcomes assessed objectively and independently?	Partial	The authors state that the clinical notes were assessed for symptoms of median nerve dysfunction. It appears the tests/measures that were used as indicators of median nerve dysfunction were Phalen test, hypoanaesthesia, motor disturbance and nerve conduction studies, which are all objective tests. It was not reported if the tests were conducted independently.
Is the paper free of selective outcome reporting?	Not reported	This study was conducted retrospectively. It has not been reported if the outcomes to be measured were decided *a priori* or how they were decided.
Were the outcomes measured appropriate?	Partial	
Was there sufficient duration of follow-up?	Yes	It would appear that median nerve dysfunction was assessed between 2 weeks and at least 6 months after the operation.
Was the study sufficiently powered to detect any differences between the groups?	Not reported	Sample size calculations were not provided.

If statistical analysis was undertaken, was this appropriate?	Yes	*"Data analysis was descriptive and by simple comparison of proportions. Data were analysed with the univariate logistic regression. Categorical data were analysed with the X ^{2}-test and continuous data with the Student's t-test. A P-value of _0.05 was considered significant."* This statistical tests used appear to be appropriate; It has not been reported if this was planned *a priori*
Were the groups similar at baseline with regards to key prognostic variables?	Partial	*"Patient variables of age, sex, fracture pattern (30 Barton's and 39 Smith's fractures), and hand involved were similar in both groups."* It would have been useful to have been provided with information regarding degree of severity; this information was not provided.
What percentage of the individuals recruited into each arm of the study were lost to follow-up?	Not reported	
What percentage of the individuals were not included in the analysis?	Not reported	It appears all patients were included in the analysis, although this has not been explicitly documented.
Other		
What is the overall risk of bias?	High	

Results

Median nerve dysfunction

Prophylactic decompressed patients had more than twice the risk (relative odds=2.7 (95% CI 0.94, 4.76, p=0.08)) of developing median nerve dysfunction. This is not statistically significant, but is potentially clinically significant. All cases resolved spontaneously except for three cases that required carpal tunnel decompression. One patient had prophylactic carpal tunnel decompression (incomplete division of the flexor retinaculum found at operation) and two patients did not.

Age, sex, fracture pattern (Barton's and Smith's) and side of the hand involved did not have any significant effect on the development of median nerve dysfunction.

There was also no significant difference in the incidence of median nerve dysfunction based on the degree of severity using the AO classification (p=0.4).

Author's Conclusions

"We conclude that prophylactic median nerve decompression does not alter the course of median nerve dysfunction and may increase post-operative morbidity."

Our comments/summary

This study has a high risk of bias. Areas of concern include lack of information regarding potential conflicts of interest, explicit inclusion and exclusion criteria, the two groups not being treated the same (apart from the intervention), lack of information regarding baseline characteristics, how the data was obtained, if outcome assessors were blind to intervention, not all outcomes were objective and small sample size.

Study: Paley D, McMurtry RY. Median nerve compression by volarly displaced fragments of the distal radius. Clinical Orthopaedics & Related Research. Feb 1987(215):139-147.

Description of study: cohort study – level III evidence.

Patient/population • Complaint • Median nerve • Age	 • Patients with fracture of the distal radius with volar displaced fragment. • These patients had median nerve symptoms. • Patients were aged between 16 and 66 years.
N	4 intervention, 1 control
Setting	Not specified
Intervention (exposure)	Removal of displaced volar fragment and carpal tunnel release
Comparison/control	Removal of displaced volar fragment
Outcomes	Median nerve recovery
Inclusion Criteria	No inclusion criteria were specified; however, it appears that patients with volarly displaced fragments of the distal radius were included.
Exclusion Criteria	Not specified

Study Validity

Were there any conflicts of interest in the writing or funding of this study?	Not reported	
Does the study have a clearly focused question?	Not reported	It is unclear from the article what the aim of the study was. The aim of the article is to report on five patients who had treatment for median nerve compression by volar displaced fragments of the distal radius.
Is a cohort study the appropriate method to answer this question?	Partial	A randomised controlled trial is the ideal study design to answer this question. The article does not claim to be a cohort study, but there is an intervention group and a control group.
Was the study prospective?	Not reported	Although the article does not explicitly state if the study was prospective or retrospective, from the way it has been written it would appear to have been conducted retrospectively.
Does the study have specified inclusion/exclusion criteria?	No	
If there were specified inclusion/ exclusion criteria, were these appropriate?	N/A	
Other than the exposure under investigation, were the groups selected from similar populations?	Not reported	Minimal information was provided about the patients.
Aside from the exposure, were the groups treated the same?	Not reported	We have limited information about how the groups were treated.

Was exposure measured in a standard, valid and reliable way?	Partial	In this study exposure is carpal tunnel release and it should be easy know if this has been undertaken. However, it was not documented how this was confirmed.
Were outcome assessors blind to the exposure?	Not reported	
Were all outcomes measured in a standard, valid and reliable way?	Not reported	
Were outcomes assessed objectively and independently?	Not reported	How the outcome (median nerve recovery) was assessed was not documented.
Is the paper free of selective outcome reporting?	Not reported	This study appears to have been conducted retrospectively. It has not been reported if the outcomes to be measured were decided *a priori* or how they were decided.
Were the outcomes measured appropriate?	Partial	Median nerve recovery would be an appropriate outcome for our question. How it was measured was not documented.
Was there sufficient duration of follow-up?	Not reported	It has not been documented how long follow-up was for.
Was the study sufficiently powered to detect any differences between the groups?	Not reported	Sample size calculations were not undertaken. However, no statistical analyses were undertaken.
If statistical analysis was undertaken, was this appropriate?	N/A	No statistical analyses were undertaken.
Were the groups similar at baseline with regards to key prognostic variables?	No	Limited information has been provided. In addition the groups were of small size (one person in the control group). It would be difficult to ensure similarity with such small numbers.
What percentage of the individuals recruited into each arm of the study were lost to follow-up?	Not reported	
What percentage of the individuals were not included in the analysis?	N/A	As above
Other		
What is the overall risk of bias?	High	

Results

Median nerve recovery

Carpal tunnel release group – of the four patients who had carpal tunnel release, full recovery of the median nerve occurred in three. In these three patients, full recovery occurred at one month for one patient, 3 months for one patient and time not reported for one patient. The fourth patient was reported to have decreased sensation and residual reflex sympathetic dystrophy at six months. It was not reported what happened after six months.

Control group – the one patient in this group was reported to have some improvement in median nerve sensation, but had sensory deficit at nine months. It was not reported what happened after nine months.

It was not documented how the outcomes were measured.

Author's Conclusions

"Carpal tunnel release and removal or reduction of the displaced volar fragment should be carried out as early as possible to avoid the complications of reflex sympathetic dystrophy. Removal of the bony fragment alone, without carpal tunnel decompression, may be insufficient."

Our comments/summary

This study does not claim to be a cohort study; however, as it has an intervention group and a control group, we have included it, and appraised it as a cohort study. The study, as a cohort study, is a badly conducted study with a high risk of bias. Problems include not having a clearly focused question, not having specified inclusion and exclusion criteria, different treatment in the two groups (other than intervention), not reporting how the outcomes were assessed and small numbers in the groups.

The article also reported on another 4 patients with distal radial fractures who had displaced volar fragments. We have not included this group as they did not meet our inclusion criteria; only one patient had an operation and this was for carpal tunnel release.

Study: Posner MA, Ambrose L. Malunited Colles' fractures: correction with a biplanar closing wedge osteotomy. Journal of Hand Surgery - American Volume. Nov 1991;16(6):1017-1026.

Description of study: case series – level IV evidence

Patient/population • Complaint • Median nerve • Age	 • Patients with symptomatic malunited Colles' fracture. • Ten patients had CTS at the time of surgery; four did not have CTS at the time of surgery. • Patients were aged between 14 and 66 years.
N	14
Setting	Not specified
Intervention/indicator	Biplanar closing wedge osteotomy of the radius with resection of the ulna head and decompression of the carpal tunnel. Each procedure was carried out through a separate incision.
Comparison/control	No comparison/control group
Outcomes	Pain, function (including grip strength and mobility), numbness and/or paresthesias, patient's pleasure with appearance, articular configuration of the distal radius and radial inclination of the articular surface of the bone in the frontal plane.
Inclusion Criteria	No inclusion criteria were specified; however, it appears that patients with malunited Colles' fractures were included.
Exclusion Criteria	Not specified

Study Validity

Were there any conflicts of interest in the writing or funding of this study?	No	*"No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article."*
Does the study have a clearly focused question?	Yes	*"The objectives of our study were to evaluate the effects of each of these features in a group of patients who had severe disabilities as a result of malunited Colles' fractures and to review the results of their treatment with a biplanar closing wedge osteotomy of the radius with resection of the ulna head and decompression of the carpal tunnel."* "*These features*" include the length of the radius, the inclination of its articular surface in the frontal plane, the angle of the articular surface in the sagittal plane.
Is a case series the appropriate method to answer this question?	No	Case series is not an appropriate method for testing effectiveness. A randomised controlled trial is the most appropriate way to answer this question.
Was the study prospective?	Not reported	
Does the study have specified inclusion/exclusion criteria?	No	
If there were specified inclusion/ exclusion criteria, were these appropriate??	N/A	

Were the cases representative of a defined population?	Not reported	It was not documented how the patients were selected. It would have been useful to know if patients were selected consequently or in an unbiased manner.
Does the study provide an explicit description of study subjects?	Partial	Information regarding age, gender, function and presence of CTS was provided. Other information which it would have been useful to know includes pain score, and numbness and/or paresthesias measurement.
Was there sufficient duration of follow-up?	Yes	*"The follow-up ranges from 19 to 118 months with an average of 62 months."*
Was the size of the study appropriate?	Partial	This is a small study with only 14 patients. No rationale for study size was provided.
Were all outcomes measured in a standard, valid and reliable way?	Not reported	It was not reported how the outcomes relevant to our question were measured.
Were outcomes assessed objectively and independently?	Not reported	It was not reported how the outcomes relevant to our question were assessed.
Is the paper free of selective outcome reporting?	Not reported	It was not reported what the planned outcomes were and therefore we are able to state if the article is free of selective reporting.
Were the outcomes measured appropriate?	Partial	It would have been useful to know adverse events.
If statistical analysis was undertaken, was this appropriate?	N/A	It was not reported what, if any, statistical tests were used.
What percentage of cases refused to participate in the study?	Not reported	
What percentage of cases were lost-to-follow-up?	Not reported	
What percentage of cases were not included in the analysis?	N/A	
Other		
What is the overall risk of bias?	High	

Results

Numbness and/or paresthesias

"Numbness and/or paresthesias were relieved in those patients who had symptoms and signs of compression before operation." How these were measured, what these scores were, if statistical tests undertaken and if so what the results were was not reported.

Pain

"Pain was significantly reduced in every patient, although one patient reported continued discomfort but only when participating in racquet sports." How pain was measured, what the pain scores were, if statistical tests undertaken and if so what the results were was not reported

Function (including grip strength and mobility)

"All patients reported an improvement in their condition, particularly grip strength." How "*improvement in condition*" or grip strength was measured, what these scores were, if statistical tests undertaken and if so what the results were was not reported.

"Postoperative mobility was improved in every patient, although four patients showed a slight decrease in extension, averaging 16 degrees. However, flexion as well as forearm pronation and supination all improved in these patients. The most significant improvements in postoperative mobility were in the two motions that were most limited preoperatively; flexion increased on average of 28 degrees (85%) and pronation an average of 31 degrees (66%). Extension and supination were also improved an average of 12.1 degrees (22%) and 30 degrees (58%), respectively. The total flexion-extension arc of wrist motions improved an average of 60% and the total pronation-supination arc of forearm rotation an average of 105%." How these were measured, if statistical tests undertaken and if so what the results were was not reported.

Patient's pleasure with appearance, articular configuration of the distal radius and radial inclination of the articular surface of the bone in the frontal plane were also reported in the study, but not included in this review as these outcomes were not part of our inclusion criteria.

Author's Conclusions

(Relating to carpal tunnel release)

"*Decompression of the median nerve was necessary in 10 patients who had symptoms and/or signs of a carpal tunnel syndrome. In the 4 patients who had no evidence of median nerve compression before operation, a surgical release of the carpal tunnel was still done to preclude the possibility of a neuropathy developing as a consequence of postoperative swelling. We agree with Bora that division of the transverse carpal ligaments adds little to the operative time, does not increase postoperative morbidity, and, of most importance, significantly reduces the likelihood that such surgery will be required in future."*

Our comments/summary

The major limitation with this study is that it is a case series and has no control/comparison group; case series are unable to provide evidence of effectiveness. Limitations of the study also include not having specified inclusion/exclusion criteria; lack of information regarding how the sample was chosen and therefore if they are representative of this group of patients; lack of information regarding how outcomes were measured, or analysed; and small sample size.

There is no evidence from this study to support the last part of the conclusion (i.e. there is no evidence to know that division of the transverse carpal ligament "*does not increase postoperative morbidity, and, of most importance, significantly reduces the likelihood that such surgery will be required in future*".)

Study: Simpson NS, Jupiter JB. Delayed onset of forearm compartment syndrome: a complication of distal radius fracture in young adults. Journal of Orthopaedic Trauma. 1995;9(5):411-418.

Description of study: case series – level IV evidence

Patient/population • Complaint • Median nerve • Age	 • Patients with a fracture of the distal radius and elevated intracompartmental pressure in the forearm which developed subsequently to the initial fracture stabilisation. • Not documented if median nerve was compressed, but symptoms of increasing volar compartment pressures (i.e. increasing pain and paresthesia) were present • Patients were aged between 23 and 45 years.
N	5 (8 arms)
Setting	Massachusetts General Hospital Orthopaedic Trauma Service, US
Intervention/indicator	Decompression of the superficial and deep flexor compartments with decompression of the carpal tunnel.
Comparison/control	No comparison/control group.
Outcomes	Nerve sensation, pain, function, return to work, bone union, radial length, radial angle, palmar tilt and volar tilt.
Inclusion criteria	*"Isolated fracture of the distal radius, with no demonstrable ipsilateral upper extremity injury, and clinical evidence of elevated intracompartmental pressure in the forearm requiring fasciotomy."*
Exclusion criteria	Not specified

Study Validity

Were there any conflicts of interest in the writing or funding of this study?	Not reported	
Does the study have a clearly focused question?	Partial	The article reports on the clinical features and management of patients with fractures of the distal radius in whom the injury led to an increase in forearm compartment pressure which developed subsequent to the initial fracture stabilisation.
Is a case series the appropriate method to answer this question?	No	Case series is not an appropriate method for testing effectiveness. A randomised controlled trial is the most appropriate way to answer this question.
Was the study prospective?	Not reported	Although the article does not explicitly state if the study was prospective or retrospective, from the way it has been written it would appear to have been conducted retrospectively.
Does the study have specified inclusion/exclusion criteria?	Partial	See above in inclusion criteria
If there were specified inclusion/ exclusion criteria, were these appropriate?	Yes	The inclusion criteria would appear appropriate to address the aim of the article.
Were the cases representative of a defined population?	Not reported	It was not documented how the patients were selected. It would have been useful to know if patients were selected consequently or in an unbiased manner.

Does the study provide an explicit description of study subjects?	Yes	Information regarding age, gender, type of injury, cause of injury, arm involved, associated injuries and compartment pressure was provided.
Was there sufficient duration of follow-up?	Not reported	It has not been documented how long follow-up was for.
Was the size of the study appropriate?	No	There were only 5 patients (8 wrists) included in the study. Ideally there would have been a larger sample.
Were all outcomes measured in a standard, valid and reliable way?	Not reported	It was not reported how outcomes were measured.
Were outcomes assessed objectively and independently?	Not reported	It was not reported how outcomes were assessed.
Is the paper free of selective outcome reporting?	Not reported	It has not been reported if the outcomes to be measured were decided *a priori* or how they were decided.
Were the outcomes measured appropriate?	Partial	The outcomes measured are appropriate for our question. How they were measured was not documented.
If statistical analysis was undertaken, was this appropriate?	N/A	No statistical analysis was reported.
What percentage of cases refused to participate in the study?	Not reported	
What percentage of cases were lost-to-follow-up?	Not reported	
What percentage of cases were not included in the analysis?	N/A	As above
Other		
What is the overall risk of bias?	High	

Results

Median nerve sensation

One patient complained of numbness affecting the index, middle and ring fingers after prolonged use of the arm or in extremes of cold, but no objective sensory deficit was demonstrable. Apart from this, no extremity exhibited any neurological abnormality or features of sympathetic dystrophy. It was not reported this was measured.

Wrist pain

One patient had pain requiring medication on a regular basis. One patient had pain after heavy duties and required medication infrequently. Two patients experienced minimal wrist pain which did not require medication. It was not reported this was measured.

Function

Flexion-extension – The arc of flexion-extension in 3 wrists exceeded 100°, was 70° in 3 wrists, 60° in one wrist and absent in one wrist (this wrist was fused). There was unrestricted active digital flexion and extension at the metacarpophalangeal and interphalangeal joints. It was not reported this was measured or the clinical significance of these values.

Grip strength – Grip strength was diminished in comparison with normal values in every wrist. In 3 wrists strength exceeded 75% of expected values, was 50–75% in 3 wrists and was <50% in one patient (2 wrists). It was not reported how "*normal*" was defined.

Wrist function scores – according to a modified rating scale used in the study, the mean subjective and objective wrist function scores were 76 points (range 40–92) and 75 (range 65–85) respectively. The study authors state that this equates to subjectively 3 wrists were rated as excellent, one as good, one as fair and 2 as poor; and objectively 4 were rated as good and 3 as fair. It was not reported how any of these measurements were obtained or the clinical significance of the values.

Contractures – no contractures were apparent in any of the 7 mobile wrists.

Return to work

Three of the five patients had returned to their former jobs; one patient had returned to employment less strenuous work than before the injury; and one patient was unable to return to work.

Bone union, radial length, radial angle, palmar tilt, volar tilt were reported in the article, but as these outcomes were not part of our question, have not been reported here.

Author's Conclusions

"If potentially serious complications are to be prevented, careful observation of these patients, often for periods of 48 h, is important. Selective recording of forearm intracompartmental pressures may be advised in at-risk patients."

Our comments/summary

The major limitation with this study is that it is a case series and has no comparative group; case series are unable to provide evidence of effectiveness.

Limitations of the study also include lack of information regarding potential conflicts of interest, how the patients were selected, how the data was obtained, how outcome data was obtained, the duration of follow-up, not documenting clinical significance of results and small sample size.

Study: Zoubos AB, Babis GC, Korres DS, Pantazopoulos T. Surgical treatment of 35 volar Barton fractures. No need for routine decompression of the median nerve. Acta Orthopaedica Scandinavica, Supplement. 1997;68(275):65-68.

Description of study: case series – level IV evidence

Patient/population • Complaint • Median nerve • Age	 • Patients with anterior intraarticular marginal fractures of the distal radius with volar carpal dislocations (volar Barton fractures). • Mild preoperative symptoms of median nerve compression. • Age was not specified for the median nerve depression patients; however, all patients included in the study patients were aged between 17 and 68 years.
N	4
Setting	Orthopaedic Department of Athens University
Intervention/indicator	Fractures were reduced and fixated with small buttress plates and screws; and median nerve was decompressed.
Comparison/control	No comparison/control group. The study included a group of patients whose median nerve was considered to be unaffected by the injury; these patients did not have median nerve decompression (n=31). Because of this fundamental difference, this group can not be considered comparable to the median nerve decompression group.
Outcomes	Median nerve function and complications
Inclusion Criteria	No inclusion criteria were specified explicitly; however it appears that patients were included with: • volar Barton fractures; and • mild preoperative symptoms of median nerve compression
Exclusion Criteria	No exclusion criteria were specified explicitly; however it appears that patients were excluded if their median nerve was considered to be unaffected by the injury.

Study Validity

Were there any conflicts of interest in the writing or funding of this study?	Not reported	
Does the study have a clearly focused question?	Partial	The stated aim of the article was to present the long term results of surgical treatment of volar Barton fractures.
Is a case series the appropriate method to answer this question?	No	Case series is not an appropriate method for testing effectiveness. A randomised controlled trial is the most appropriate way to answer this question.
Was the study prospective?	No	This study was conducted retrospectively.
Does the study have specified inclusion/exclusion criteria?	No	
If there were specified inclusion/exclusion criteria, were these appropriate?	N/A	
Were the cases representative of a defined population?	Not reported	It was not documented how the patients were selected.

Does the study provide an explicit description of study subjects?	Partial	Information regarding age, gender, type of injury, cause of injury and median nerve compression was provided. However, frequencies were not provided for all these variables.
Was there sufficient duration of follow-up?	Yes	Mean follow-up was for 6 years (range 2–10 years).
Was the size of the study appropriate?	No	There were only 4 patients who had median nerve decompression.
Were all outcomes measured in a standard, valid and reliable way?	Not reported	It was not documented how median nerve function was measured.
Were outcomes assessed objectively and independently?	Not reported	It was not documented how median nerve function was assessed.
Is the paper free of selective outcome reporting?	Not reported	It has not been reported if the outcomes to be measured were decided *a priori* or how they were decided.
Were the outcomes measured appropriate?	Partial	Median nerve function and complications would be appropriate outcomes for our question. How they were measured was not documented.
If statistical analysis was undertaken, was this appropriate?	N/A	No statistical analysis was reported.
What percentage of cases refused to participate in the study?	Not reported	
What percentage of cases were lost-to-follow-up?	Not reported	
What percentage of cases were not included in the analysis?	N/A	As above
Other		
What is the overall risk of bias?	High	

Results

Median nerve function

Normal function occurred postoperatively. The group which did not have median nerve decompression were reported to have "*excellent results*". "*Excellent*" was not defined.

Complications

It was reported that no complications occurred.

It was not reported how these outcomes were measured.

Criteria of Pattee and Thompson were used to report clinical and radiographical results. These have not been reported here as the results were not provided separately for each group.

Author's Conclusions

"We conclude that the median nerve, when not damaged or compressed, should not be explored or decompressed during surgery".

Our comments/summary

The major limitation with this study is that it is a case series and has no comparative group; case series are unable to provide evidence of effectiveness.

Limitations of the study also include lack of information regarding potential conflicts of interest, specified inclusion/exclusion criteria, how the sample was selected, how the data was obtained, knowing how outcomes were measured and small sample size.

APPENDIX 5: COMPARISON OF STUDY CHARACTERISTICS

Table A5.1 Comparison of study characteristics for cohort studies

Study	Odumala et al[1]	Paley & McMurtry[2]
Publication date	2001	1987
Prospective	No	Not reported
Risk of bias	High	High
N	24 intervention, 45 control	4 intervention, 1 control
Patient/population	Patients with distal radial fractures	Patients with distal radial fractures
MV compromised	No	Yes
Primary procedure	Yes	Yes
Age of patients	24 to 81 years	16 to 66 years
Intervention	Volar buttress plating (also referred to as volar T plate in the article) and prophylactic CT decompression	Removal of displaced volar fragment and CTR
Comparison	Volar buttress plating	Removal of displaced volar fragment
Outcomes (of relevance)	Median nerve dysfunction	Median nerve recovery
Results: • Median nerve problems	<u>Median nerve dysfunction</u> Prophylactic decompressed patients had more than twice the relative odds=2.7 (95% CI 0.94, 4.76, p=0.08) of developing median nerve dysfunction. This is not statistically significant, but is potentially clinically significant. All cases resolved spontaneously except for three cases that required carpal tunnel decompression. One patient had prophylactic carpal tunnel decompression (incomplete division of the flexor retinaculum found at operation) and two patients did not.	<u>Median nerve recovery</u> The four patients who had CTR, full recovery of the median nerve occurred in three. In these three patients, full recovery occurred at one month for one patient, 3 months for one patient and time not reported for one patient. The fourth patient was reported to have decreased sensation and residual reflex sympathetic dystrophy at six months. It was not reported what happened after six months. The one patient who did not have CTR was reported to have some improvement in median nerve sensation, but had sensory deficit at nine months. It was not reported what happened after nine months. It was not documented how this outcome was measured.
• Pain		<u>Reflex sympathetic dystrophy</u> One patient in the CTR group was reported to have decreased sensation and residual reflex sympathetic dystrophy at six months. It was not reported what happened after six months. It was not documented how this outcome was measured.
• Function		
Complications		
Conclusion	*"We conclude that prophylactic median nerve decompression does not alter the course of median nerve dysfunction and may increase post-operative morbidity."*	*"Carpal tunnel release and removal or reduction of the displaced volar fragment should be carried out as early as possible to avoid the complications of reflex sympathetic dystrophy. Removal of the bony fragment alone, without carpal tunnel decompression, may be insufficient."*

Table A5.2 Comparison of study characteristics for case series studies

Study	Bora et al[8]	Brostrom et al[5]	Henry & Stutz[3]	Posner & Ambrose[6]	Simpson & Jupiter[7]	Zoubos et al[4]
Publication date	1984	1990	2007	1991	1995	1997
Prospective	Not reported	Not reported	Yes	Not reported	Not reported	No
Risk of bias	High	Moderate / High	High	High	High	High
N	11	16	169	14	5 (8 arms)	4
Patient/population	Patients with malunions of the distal radius (more than one inch of shortening) with complaints of weak grip and limited forearm rotation and wrist motion.	Patients with forearm fracture with acute compartment syndrome	Patients with distal radial fractures	Patients with symptomatic malunited Colles' fracture.	Patients with a fracture of the distal radius and elevated intracompartmental pressure in the forearm which developed subsequently to the initial fracture stabilisation.	Patients with distal radial fractures
MV compromised	50% yes, 50% no.	Yes	Yes	10 yes, 4 no	Not documented if median nerve was compressed, but symptoms of increasing volar compartment pressures (i.e. increasing pain and paresthesia) were present	Yes
Primary procedure	No	Yes	Yes	No	No	Yes
Age of patients	14 to 62 years	18 to 65 years	17 to 89 years	14 to 66 years	23 to 45 years	17 to 68 years
Intervention	Distal radial osteotomy with the insertion of a biplanar iliac bone graft and median nerve decompression.	Fracture stabilisation and fasciotomy of forearm and carpal compartments	Distal radius fracture fixation and CTR (by Agee single portal endoscopy, Group 1, n=93 and flexor carpi radialis sheath release of the transverse carpal, Group 2, n=76).	Biplanar closing wedge osteotomy of the radius with resection of the ulna head and decompression of the carpal tunnel. Each procedure was carried out through a separate incision.	Decompression of the superficial and deep flexor compartments with decompression of the carpal tunnel.	Fractures were reduced and fixated with small buttress plates and screws; and median nerve was decompressed.
Comparison	No comparison/control group	No comparison/control group	No comparison/control group. The study included a group who were considered at low risk of carpal tunnel syndrome post operatively (Group 3, n=205). Because of this fundamental difference, this group can not be considered comparable to the carpal tunnel release groups.	No comparison/control group	No comparison/control group	No comparison/control group. The study included a group of patients whose median nerve was considered to be unaffected by the injury; these patients did not have median nerve decompression (n=31). Because of this fundamental difference, this group can not be considered comparable to the median nerve decompression group.
Outcomes (of relevance)	Pain, median nerve compression symptoms, function, return to work, complications, restoration and maintenance of radial length, restoration of the volar tilt and cosmesis.	Nerve function, pain, function (including stiffness, weakness, range of motion and grip strength) and return to work.	Carpal tunnel syndrome, pain and complications	Pain, function (including grip strength and mobility), numbness and/or paresthesias, patient's pleasure with appearance, articular	Nerve sensation, pain, function and return to work.	Median nerve function and complications

Study	Bora et al[8]	Brostrom et al[5]	Henry & Stutz[3]	Posner & Ambrose[6]	Simpson & Jupiter[7]	Zoubos et al[4]
				configuration of the distal radius and radial inclination of the articular surface of the bone in the frontal plane.		
Results: • Median nerve problems	Median nerve compression symptoms "M*edian nerve compression symptoms in all our patients were resolved after surgery."* It was not documented how this was measured.	Median nerve function Normal motor and sensory median nerve function was regained in 15 patients. One patient still had impaired two-point discrimination capacity (>15mm) in median nerve-innervated fingers.	Carpal tunnel syndrome The article reported that no patients demonstrated symptoms of CTS. However, two patients had monofilament scores which failed to return to normal (2.83g). Both had final scores of 3.61g.	Numbness and/or paresthesias *"Numbness and/or paresthesias were relieved in those patients who had symptoms and signs of compression before operation."* How these were measured, what these scores were, if statistical tests undertaken and if so what the results were was not reported.	Median nerve sensation One patient complained of numbness affecting the index, middle and ring fingers after prolonged use of the arm or in extremes of cold, but no objective sensory deficit was demonstrable. Apart from this, no extremity exhibited any neurological abnormality or features of sympathetic dystrophy. It was not reported this was measured.	Median nerve function Normal median nerve function occurred postoperatively. The group which did not have median nerve decompression were reported to have "*excellent results*". "*Excellent*" was not defined. It was not reported how this outcome were measured.
• Pain	Pain "*Fifty percent of the patients continued to experience mild weather ache which, however, improved with time."* It was not documented how this was measured.	Pain "F*ive patients had no complaints; 3 patients reported pain in the arm at rest and 8 had slight pain during exercise. Stiffness of the arm was experienced by 7 patients, and 3 had problems of arm weakness*	Neuropathic pain There were no cases of neuropathic pain syndrome identified in any patients. It was not documented how this outcome was measured.	Pain *"Pain was significantly reduced in every patient, although one patient reported continued discomfort but only when participating in racquet sports."* How pain was measured, what the pain scores were, if statistical tests undertaken and if so what the results were was not reported.	Wrist pain One patient had pain requiring medication on a regular basis. One patient had pain after heavy duties and required medication infrequently. Two patients experienced minimal wrist pain which did not require medication. It was not reported this was measured.	
• Function	Function Active motion was "*measured in percentage of normal"*. It was not documented if "*normal*" referred to normal values in the general population or compared to uninjured hand. Preop (%) / Postop (%) Pronation 10 / 65 Supination 15 / 45 Wrist volar flexion 25 / 60 Wrist dorsiflexion decreased from 80% of normal preoperatively to 50% postoperatively. Again, it was not documented if 'normal' referred to normal values in the general population or compared to uninjured hand.	Function Wrist motion – compared to the values in the unaffected hand, there was a mean decrease of: • 42% (range 1–64%) for volar flexion • 38% (range 20-75%) for dorsal extension • 30% (0–47%) for both pronation and supination. A finger flexion defect of at least 1 cm was observed in five patients. The range of wrist motion did not differ between high and low-energy injuries. Grip strength – compared	Function • Mean wrist flexion in Group 1 was 57.9° and in Group 2 this was 53.8°. The score for the non carpal tunnel release group was 61.4°. • Mean wrist extension in Group 1 was 63.9° and in Group 2 this was 55.4°. The score for the non carpal tunnel release group was 61.7°. No information was provided about range or standard deviation of scores or clinical	Function (including grip strength and mobility) *"All patients reported an improvement in their condition, particularly grip strength."* How "*improvement in condition*" or grip strength was measured, what these scores were, if statistical tests undertaken and if so what the results were was not reported. *"Postoperative mobility was improved in every patient, although four patients showed a slight decrease in extension, averaging 16 degrees. However, flexion as well as forearm pronation and supination all improved in these patients. The*	Function Flexion-extension – The arc of flexion-extension in 3 wrists exceeded 100°, was 70° in 3 wrists, 60° in one wrist and absent in one wrist (this wrist was fused). There was unrestricted active digital flexion and extension at the metacarpophalangeal and interphalangeal joints. It was not reported this was measured or the clinical significance of these values. Grip strength – Grip strength was diminished in comparison with normal values in every wrist. In 3 wrists strength exceeded 75% of expected	

Study	Bora et al[8]	Brostrom et al[5]	Henry & Stutz[3]	Posner & Ambrose[6]	Simpson & Jupiter[7]	Zoubos et al[4]
	Grip strength was compared to the uninjured hand. "*It improved significantly in all patients after surgery from a preoperative mean of 45% of the normal hand to 80% postoperatively."* The article does not document if "*significantly*" refers to statistical testing and if so what test was undertaken.	to the values in the unaffected hand, there was a mean decrease of 54% (range 10–94%).	significance of these figures. Grip strength - mean for Group 1 was 25.4kg (75.9%) and for Group 2 was 20.2kg (62.6%). The score for the non carpal tunnel release group was 25.0kg (70%).	*most significant improvements in postoperative mobility were in the two motions that were most limited preoperatively; flexion increased on average of 28 degrees (85%) and pronation an average of 31 degrees (66%). Extension and supination were also improved an average of 12.1 degrees (22%) and 30 degrees (58%), respectively. The total flexion-extension arc of wrist motions improved an average of 60% and the total pronation-supination arc of forearm rotation an average of 105%."* How these were measured, if statistical tests undertaken and if so what the results were was not reported.	values, was 50–75% in 3 wrists and was <50% in one patient (2 wrists). It was not reported how "*normal*" was defined. Wrist function scores – according to a modified rating scale used in the study, the mean subjective and objective wrist function scores were 76 points (range 40–92) and 75 (range 65–85) respectively. The study authors state that this equates to subjectively 3 wrists were rated as excellent, one as good, one as fair and 2 as poor; and objectively 4 were rated as good and 3 as fair. It was not reported how any of these measurements were obtained or the clinical significance of the values. Contractures – no contractures were apparent in any of the 7 mobile wrists.	
• Return to work	<u>Return to work</u> There were 7 patients working at the time of injury. They returned to their jobs an average of 14 weeks post surgery.	<u>Return to work</u> Eight patients returned to their pervious occupations within a year of the injury. Six were still listed as sick after two years. The other two patients were of retirement age. It was not reported what the employment status before the injury was for the six who did not return to work, although it appears likely that they were working.			<u>Return to work</u> Three of the five patients had returned to their former jobs; one patient had returned to employment less strenuous work than before the injury; and one patient was unable to return to work	
• Complications	<u>Complications</u> " *One loss of position in the Smith's fracture when the pins were removed prematurely at four weeks*." One patient had an avulsion fracture of part of the wing of the ileum through the donor site.		<u>Complications</u> No complications, related to the CTR, were identified.			<u>Complications</u> It was reported that no complications occurred.

Conclusion	None related to CTR	*"The prompt treatment of compartment syndrome in our cases probably explains the near complete restoration of nerve function."*	None related to CTR	"*Decompression of the median nerve was necessary in 10 patients who had symptoms and/or signs of a carpal tunnel syndrome. In the 4 patients who had no evidence of median nerve compression before operation, a surgical release of the carpal tunnel was still done to preclude the possibility of a neuropathy developing as a consequence of postoperative swelling. We agree with Bora that division of the transverse carpal ligaments adds little to the operative time, does not increase postoperative morbidity, and, of most importance, significantly reduces the likelihood that such surgery will be required in future."*	*"If potentially serious complications are to be prevented, careful observation of these patients, often for periods of 48 h, is important. Selective recording of forearm intracompartmental pressures may be advised in at-risk patients."*	*"We conclude that the median nerve, when not damaged or compressed, should not be explored or decompressed during surgery".*