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**Surgical site infection after hand surgery outside the operating
theatre: a systematic review**

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Surgical site infection after hand surgery outside the operating theatre: a systematic review

ABSTRACT

We carried out a systematic review to determine the incidence of infection for hand surgery done in settings other than the operating theatre. Databases were searched and a PRISMA chart created by three independent reviewers. From 1200 studies identified, 46 full text articles were reviewed and six were included (two level 3 studies and four level 4). In three studies there were no infections after surgery in an office, procedure room or emergency department. Two studies with a combined number of 1,962 procedures reviewed carpal tunnel decompressions and reported identical infection rates of 0.4%. Although the current evidence is of poor quality it suggests that some types of hand surgery may be done outside the operating theatre without increasing the risk of infection.

Level of Evidence: 4

INTRODUCTION

Most hand surgery procedures can be carried out under local or regional anaesthesia as day cases, and the indications for this are continually expanding in order to streamline patient care, improve efficiency and save money. There is an assumption that infection control requires that all invasive surgical procedures should take place in an operating theatre (OT) with full sterility, although this is more expensive and less efficient than the alternatives such as day-surgery theatre suites, general practice procedure rooms, outpatient clinic procedure rooms, emergency department minor operations theatres and surgeons' offices (Dillon et al., 2009; Finn and Crook, 1998; Leblanc et al., 2007; Webb and Stothard 2009). There are also variations on infection control guidelines for each location in respect of air conditioning systems, skin preparation and draping, surgical attire and restriction in movement of personnel.

The aim of this study was to systematically review published work to compare surgical site infection (SSI) in surgical procedures on the hand done in different locations.

METHODS

A strategy was designed for a sensitive, inclusive search of Medline, Embase and the Cumulative Index to Nursing and Allied Health Literature (CINAHL) databases for all articles up to November 2015 (Appendices 1-3, available online). Further searches were done specifically looking for links between “field sterility” and hand surgery (Appendix 4, available online). Titles and abstracts were screened by two independent reviewers (NAJ and SI), with arbitration provided by the senior author (DF) when required. Duplicates were removed and a shortlist created using the eligibility criteria highlighted in Table 1. Full texts of all shortlisted articles were then reviewed using the same criteria for final selection as in the systematic review. We included all levels of evidence apart from case reports, because the incidence of infection cannot be calculated from a single case. Data were independently extracted onto a proforma, and disagreements were resolved by consensus discussion between the reviewers and the arbitrator.

RESULTS

Search Results

The PRISMA flow chart shows the combined results from searching all three databases (Figure 1). There were 907 titles initially identified with the search strategies in Appendices 1-3, plus another 293 from Appendix 4. Based on the inclusion and exclusion criteria in Table 1, 46 articles were selected for full text review. It was unclear from most of the abstracts of these articles where the surgery had been done, hence the requirement for reviewing the full text. Only six articles fulfilled the criteria for analysis in the systematic review (Table 2). In five of these, operations were done in a minor procedures room (PR) away from a theatre suite (Denkler, 2005; Derkash et al., 1996; Leblanc et al., 2011; Starker and Eaton, 1995; Webb and Stothard, 2009). In the sixth, surgery was carried out in a day surgery suite separate from the main theatre suite (Kambiz and Blakely, 2004).

Quality of Studies (Table 2)

Two studies were level 3 non-randomized, comparative studies, one retrospective (Denkler, 2005) and one prospective (Webb and Stothard, 2009), both comparing operations in an office PR with operations in an OT. Neither study was methodologically sound and both were open to selection bias. One did not compare similar procedures as open procedures in an OT were compared with percutaneous procedures in a PR for the same conditions (Webb and Stothard, 2009). As a result, a meta-analysis could not be done.

The remaining four studies were level 4 case series; three prospective (Kambiz and Blakely, 2004; Leblanc et al., 2011; Starker and Eaton, 1995) and one retrospective (Derkash et al., 1996). The three prospective series benefited from large numbers and clear methodology. The methodology of the retrospective study was not explained and it contained a very small number of patients, too small to reflect an accurate incidence of SSI.

Type of surgery, sterility and anaesthesia (Table 2)

Starker and Eaton (1995) studied closed manipulations and K-wiring of long bone hand fractures in an Emergency Department (ED) PR. They used iodine skin preparation and sterile drapes for all procedures but did not state the methods of anaesthesia. The other studies looked at elective soft tissue hand procedures although Kambiz and Blakely (2004) included trapeziectomies.

Leblanc et al. (2011) used Wide Awake Local Anaesthesia and No Tourniquet (WALANT) for 1,504 carpal tunnel decompressions with a standardized procedure protocol across all centres involved. Denkler (2005) compared open Dupuytren's fasciectomy carried out under WALANT in an office PR with the same procedure by the same surgeon under regional blockade with a tourniquet in an OT. All operations in the other studies were also done under local anaesthesia apart from a small cohort in the study of Kambiz and Blakely (2004) who had a general anaesthetic (GA), although further details were not provided.

Webb and Stothard (2009) compared 104 percutaneous office procedures under local anaesthesia (needle fasciotomy for Dupuytren's, needle release of trigger finger or aspiration and injection of ganglia) with 54 open procedures in an OT (Dupuytren's fasciectomy, open trigger release or open excision of ganglia). They did not state how the OT patients were anaesthetised or the methods of skin preparation.

SSIs and confounding factors (Table 2)

Three of the six studies reported no SSIs (Derkash et al., 1996; Starker and Eaton, 1995; Webb and Stothard, 2009). In the study of Starker and Eaton (1995) study on emergency Kirschner (K)-wiring the K-wires were left proud of the skin. A confounding factor is that 12 of the 68 patients were admitted post-operatively for intravenous antibiotics for 2-3 days as the fractures were either open, or there were traumatic wounds close to the wires.

Webb and Stothard (2009) reported no SSIs in the 104 percutaneous office procedures, and also reported 0% infection for the 54 open OT procedures. Details of these OT procedures in regards to sterility, anaesthesia and confounding factors were not stated. Derkash et al. (1996) also reported 0% infection in 26 carpal tunnel decompressions in 4 years. Although the treatment was standardized throughout, the power of the study not adequate to accurately establish infection rates.

Kambiz and Blakely (2004) reported 1.1% incidence of SSIs from 993 patients having different elective operations that they were able to follow up for a minimum of 6 weeks. Although the procedures were all done in a day surgery theatre rather than a PR as in the

other studies, the surgeons did not wear sterile gowns or masks for any of the cases apart from the nine trapeziectomies. They also stated they did not use laminar flow or give prophylactic antibiotics for any case. They used alcoholic chlorhexidine, sterile drapes and sterile gloves for all cases.

Leblanc et al. (2011) presented a multicentre series of 1,504 carpal tunnel decompressions performed under WALANT and in a sterile field. SSIs occurred in 0.4%. The study of Kambiz and Blakely (2004) had a subgroup of 458 patients with carpal tunnel decompression, with exactly the same percentage of SSIs. They used local anaesthesia but provided no further details regarding tourniquet use.

Denkler (2005) reported an unusually high number of SSIs in both groups in his study on open Dupuytren's fasciectomy: 11.7% for those done in an OT and 8.5% for those done in the office. The difference was not statistically significant, but the study was under-powered for detecting a difference in SSIs. The procedure was standardized in both locations with the same surgeon. Some of the OT group received prophylactic antibiotics although the numbers were not recorded. Patients in each group were well matched for numbers of smokers, diabetics, and revision cases. A small and similar proportion of patients in each group had a Penrose drain inserted subcutaneously as decided by the surgeon. One of these patients suffered a deep infection but none of the other patients with drains became infected. The unusually high number of infections was unexplained.

DISCUSSION

Operating theatres (OT) have strict infection control guidelines for environmental cleaning and disinfection, sterilization of instruments, air handling and personnel management. Despite this, infections affect 2%–15% of all surgical patients and surgical site infections (SSIs) contribute to perioperative morbidity, poor surgical outcomes and total healthcare expenditure (Castella et al., 2006; Umscheid et al., 2011; Yezli et al., 2014).

In 1979, 10% of all surgical procedures in the USA were done as outpatient procedures compared with 80% in 2006, a quarter of them being done in the surgeon's office (Horton et al., 2006). This major change has been driven by demands for convenience, efficiency and privacy. Although surgeons in the UK National Health Service (NHS) appear to be more cautious in adopting these efficiency savings, there is a moral imperative to maximize efficiency in any healthcare system.

The hand is similar to the face in that it is blessed with a rich blood supply. Hand surgeons are privileged to operate in an anatomic region that is less vulnerable to infection than most sites of the body (Calkins, 1998). Many hand surgeons believe that full theatre sterility is unnecessary for most procedures and they can safely be carried out elsewhere, especially if done under local anaesthesia. The common goal of 'office-based surgery' is to streamline patient pathways even more so than day-case surgery, akin to a visit to one's dentist. However, there is a wide spectrum of definitions of 'office-based procedures' from those

done in a full theatre suite adjacent to a clinic to procedures done on an examination couch within the clinic or office itself.

Ambulatory Surgery Centres pre-dated office-based surgery in the USA and were a highly regulated method of freeing up surgical time in main hospital OTs (Schaefer et al., 2010; Vila et al., 2003). The switch to less well regulated “office-based” surgery has led to several problems and litigation in the USA although none of this has been related to procedures under local anaesthesia (Clayman and Caffee, 2006; Clayman and Seagle, 2006; Hausman et al., 2008; Liberman, 2001; Quattrone, 2000).

When considering SSIs from operations in different locations, it is important to define the attributes of each location for air conditioning systems, cleaning practices and regulations about the movement of personnel (Ayliffe, 1991; Flanagan et al., 2011). Various terms for the location of operations have been used in studies, such as OT, day-surgery suite, office, PR or emergency department. Unfortunately, there is no standardization between studies regarding the sterility attributes each room, making comparisons impossible.

The UK Department of Health guidelines for air conditioning systems in various clinical areas state that 25 air changes per hour (ACPH) are required in an OT “for sterility”, 15 ACPH are required in day surgery suites and OT anaesthetic rooms “to control anaesthetic gases” and ten ACPH are required in a clinic PR or plaster room “to control odours” (Department of Health Estates and Facilities Division, 2007; Department of Health NHS Estates, 2004). For comparison, the US guidelines state that both OTs and day-surgery centres must have 15 ACPH (American Institute of Architects, 1996; Mangram et al., 1999). No guidance is offered

as to which procedures can be safely carried out in each area, and there is no clinical evidence for these policies referenced within these documents, only further guidelines.

The six studies we analysed reported very low infection rates after elective and trauma hand procedures outside a main OT environment. The quality of evidence was low throughout and the studies were too heterogeneous, with too many confounding factors, to allow many comparisons between them.

The quality of evidence provided from these six studies is not sufficient to change surgeons' practices or satisfy infection control organizations that a global change of practice is required. However, infection rates are undoubtedly low, even when performing surgery out of the main OT environment. Infection control regulations that are applied in other orthopaedic and plastic surgical procedures may not necessarily be required for hand surgical procedures. There is debate about whether sterile gowns, hats and masks are required, although surgeons may prefer to wear these to protect themselves from splashes of blood and bodily fluids. It is important that any changes in practice remain properly regulated and with an SSI surveillance program implemented (Calkins, 1998; Castella et al., 2006; Gastmeier et al., 2002; Horton et al., 2006; Mangram et al., 1999).

This review should prompt further research in this area, with better quality studies including randomized controlled trials. As infection rates are low, trials would need to be large enough to have sufficient power to detect a difference, which may require multi-centre trial involvement. In the mean time, clinicians operating outside a main OT environment should audit SSIs and better define any potential confounding factors such as air conditioning, skin preparation and draping, surgical attire and the use of prophylactic antibiotics (Haley et al.,

1985). With this information, meaningful comparisons may be made and guidelines for safe, efficient and cost effective practice produced.

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FIGURE LEGENDS

Figure 1. PRISMA flow diagram.

TABLES

Table 1. Inclusion and exclusion criteria for article screening

Table 2. Papers selected from systematic review for analysis. See separate landscape file

APPENDICES (available online)

Appendix 1. Search strategy for Medline database.

Appendix 2. Search strategy for Embase database.

Appendix 3. Search strategy for CINAHL database.

Appendix 4. Secondary search strategy for Medline, Embase and CINAHL databases.



Figure 1: PRISMA 2009 Flow Diagram

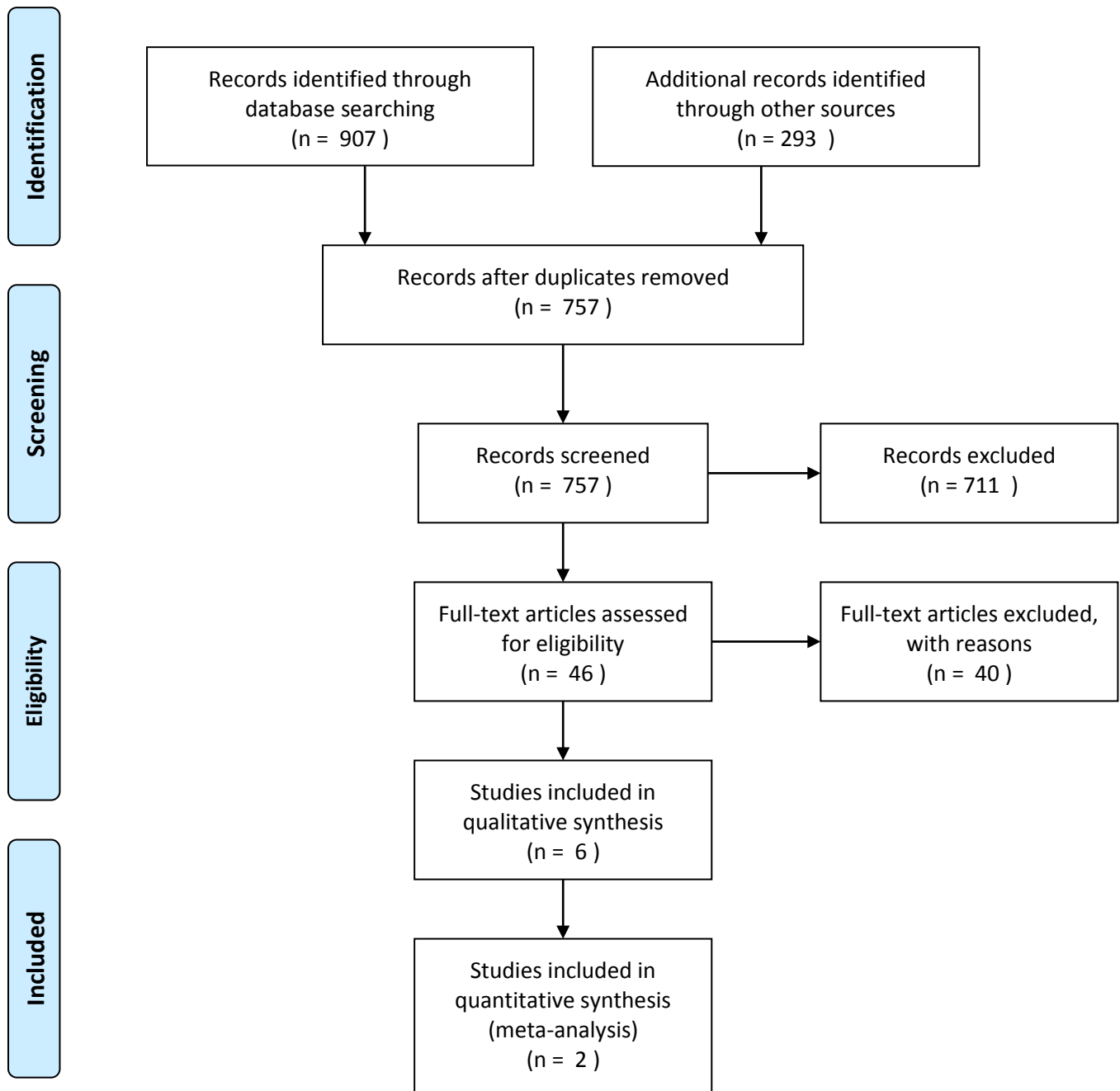


Table 1. Inclusion and exclusion criteria for screening of publications.

Include papers mentioning:	Exclusion criteria
Infection rates (with defined criteria and confirmed by surgical team)	Case reports
AND discussing location of surgery away from operating theatres (office, day surgery suite, procedure room, outpatient clinic, general practice, emergency department)	Irrelevant papers i.e. nothing to do with hand surgery or surgical site infection
AND relating to hand, wrist or elbow surgery	Non-English language papers

Table 2. Papers selected from systematic review for analysis.

Authors	Quality	Location of surgery	Type of surgery	Sterility	Anaesthetic	Number of patients	Incidence of SSI
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Webb and Stothard (2009)	Level 3. Prospective comparative, non-randomized	Office vs OT	Dupuytren's, trigger digits and ganglions. Percutaneous operations in office vs open operations in theatre	Skin preparation but no drape in office. Not stated for OT.	LA for office. Not stated for OT.	OT = 54. Office = 104.	0% both groups
Denkler (2005)	Level 3. Retrospective comparative single surgeon series	Office vs OT	Open Dupuytren's fasciectomy	Same preparation + drape in both. Some OT patients given prophylactic antibiotics. None in office	WALANT in office. Regional block in OT	OT = 42 digits in 26 patients. Office = 60 digits in 40 patients.	OT = 11.7%, all superficial. Office = 8.5%, three superficial + one deep
Leblanc et al. (2011)	Level 4. Prospective, non-comparative, multi-centre case series.	Outpatient clinic procedure room	Open CTD (standardized peri-operative procedures between centres)	Field sterility for all. Square drape, alcoholic chlorhexidine preparation. No sterile gowns, hats or antibiotics.	WALANT for all.	1,504	0.4%, all superficial.
Starker and Eaton (1995)	Level 4. Prospective, non-comparative, single-centre case series.	Emergency department procedure room	Closed manipulation and Kirschner wiring of long bone fractures in the hand	Iodine preparation + sterile drapes for all. Twelve patients with open fractures admitted for IV antibiotics after operations.	Not stated	71 fractures in 68 patients in 1 year	0%
Kambiz and Blakely	Level 4.	Dedicated day	Elective hand surgery: CTD,	Surgical greens, sterile	53 GA cases.	993 patients in	1.1%

(1996)	Prospective, non-	surgery suite	triggers, Dupuytren's,	gloves, alcoholic	All others under	2 years by two	
	comparative, single-		ganglions, De Quervain's,	chlorhexidine and cloth	LA or Bier's block.	surgeons	
	centre case series.		tennis/golfers elbow, cubital	drapes for all. Sterile gowns			
			tunnel releases,	for nine trapeziectomies			
			trapeziectomies, others.	only. No hats, masks,			
				antibiotics or laminar flow			
				for any.			
Derkash et al. (1996)	Level 4.	Office procedure	CTD under wrist block +	Betadine and sterile drapes	LA wrist block	26 wrists in 20	0%
	Retrospective case	room	tourniquet	for all with sterile wrist		pts in 4 years	
	series			tourniquet			

CTD: carpal tunnel decompression; GA: general anaesthetic; OT: operating theatre; LA: local anaesthetic; SSI: surgical site infection; WALANT: wide awake local anaesthesia and no tourniquet.

Appendix 1: Search strategy for Medline database.

1	(surg* or operat*).ti,ab.	1988531
2	exp GENERAL SURGERY/	36136
3	exp SURGICAL PROCEDURES, OPERATIVE/	2565059
4	1 or 2 or 3	3692966
5	(decompress* or releas*).ti,ab.	655900
6	4 or 5	4257107
7	(hand* adj3 (surg* or operat*)).ti,ab.	9710
8	CARPAL TUNNEL SYNDROME/	7478
9	"carpal tunnel*".ti,ab.	8311
10	8 or 9	9712
11	6 and 10	4164
12	GANGLIONECTOMY/	610
13	((ganglion* adj3 (excis* or remov*)) or ganglionectom*).ti,ab.	1680
14	GANGLION CYSTS/	677
15	(excis* or remov*).ti,ab.	617665
16	14 and 15	140
17	ganglion*.ti,ab.	63056
18	14 or 17	63222

19	4 and 18	11811
20	12 or 13 or 16 or 19	12486
21	exp HAND/	73739
22	(hand* or finger* or wrist* or thumb*).ti,ab.	571999
23	21 or 22	597578
24	exp HAND BONES/	9281
25	(metacarpal* or carpal* or phalan*).ti,ab.	26784
26	24 or 25	31783
27	23 or 26	611038
28	4 and 27	118361
29	DUPUYTREN CONTRACTURE/	2391
30	dupuytren*.ti,ab.	2429
31	29 or 30	2852
32	4 and 31	1177
33	fasciectomy*.ti,ab.	324
34	32 or 33	1297
35	TRIGGER FINGER DISORDER/	293
36	("flexor tendon*" adj3 entrap*).ti,ab.	16
37	("trigger finger*" or "trigger thumb*" or "trigger digit*" or "snapping finger*" or "stenosing tenosynovit*).ti,ab.	872

38	35 or 36 or 37	938
39	releas*.ti,ab.	622953
40	4 or 39	4249548
41	38 and 40	523
42	DE QUERVAIN DISEASE/ ("de quervain*" or "blackberry thumb*" or "text* thumb*" or "gamer* thumb*" or "washerwoman* sprain*" or "mothers wrist*" or "mommy* thumb*").ti,ab.	116
43	thumb*" or "washerwoman* sprain*" or "mothers wrist*" or "mommy* thumb*").ti,ab.	639
44	("radial styloid" adj3 tenosynovit*).ti,ab.	7
45	42 or 43 or 44	665
46	4 and 45	227
47	"first extensor compartment".ti,ab.	55
48	6 and 47	38
49	exp ULNAR NERVE COMPRESSION SYNDROMES/	851
50	"guyon syndrome".ti,ab.	3
51	ULNAR NERVE/	6496
52	(ulnar adj3 nerve*).ti,ab.	6803
53	51 or 52	9942
54	(compress* or entrap*).ti,ab.	137000
55	53 and 54	1414

56	49 or 50 or 55	1901
57	6 and 56	992
58	"cubital tunnel*".ti,ab.	693
59	6 and 58	463
60	TENNIS ELBOW/	1332
61	((epicondyl* adj3 (lateral* or medial*)) or "tennis elbow*").mp. or "golfer* elbow*".ti,ab. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]	2976
62	60 or 61	2976
63	6 and 62	1257
64	(interphalan* or inter-phalan* or ip or dip or pip or metacarpophalang* or metacarpo-phalang* or meta-carpo-phalang* or meta-carpophalang* or mcp).ti,ab.	166536
65	ARTHRODESIS/	7297
66	fusion*.ti,ab.	162031
67	65 or 66	167465
68	64 and 67	1199
69	COLLES' FRACTURE/	746
70	FINGER PHALANGES/	792
71	exp CARPAL BONES/	7488

72	METACARPAL BONES/	1013
73	(phalan* or carpal* or metacarpal* or scaphoid* or lunate* or triquetrum* or pisiform* or trapezium* or trapezoid* or capitat* or hamat*).ti,ab.	38754
74	("distal radius" adj3 fractur*).ti,ab.	2936
75	69 or 70 or 71 or 72 or 73 or 74	43938
76	exp FRACTURE FIXATION/	49327
77	fixation*.ti,ab.	111943
78	76 or 77	141634
79	75 and 78	5183
80	"extensor tendon*".ti,ab.	1795
81	repair*.ti,ab.	252754
82	4 or 81	3826404
83	80 and 82	1137
84	"nail bed*".ti,ab.	1043
85	82 and 84	419
86	(terminalisation* or terminalization*).ti,ab.	36
87	23 and 86	7
88	LACERATIONS/	2095
89	exp HAND INJURIES/	16915
90	WRIST INJURIES/	5448

91	(wound* or lacerat* or cut or cuts or trauma or injur*).ti,ab.	911040
92	88 or 91	911484
93	exp WOUNDS/ and INJURIES/	66068
94	88 or 91 or 93	931229
95	23 and 94	43523
96	89 or 90 or 95	56988
97	4 and 96	26545
98	11 or 20 or 28 or 34 or 41 or 46 or 48 or 57 or 59 or 63 or 68 or 79 or 83 or 85 or 87 or 97	137531
99	procedure room*.ti,ab.	166
100	Ambulatory Care/	37650
101	ambulatory.ti,ab.	63859
102	(minor op* adj3 (room* or theatre* or unit*)).ti,ab.	18
103	(day case surg* adj3 (room* or theatre* or unit*)).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]	19
104	(day care surg* adj3 (room* or theatre* or unit*)).ti,ab.	13
105	(dermatolog* adj3 (room* or theatre* or unit*)).ti,ab.	385
106	Outpatients/	10013
107	outpatient*.ti,ab.	122747

108 (office adj3 procedur*).ti,ab.	1375
109 Office Visits/	5854
110 (field adj3 steril*).ti,ab.	259
111 (office* adj3 surg*).ti,ab.	1112
112 (office-based adj3 surg*).ti,ab.	286
113 (operat* adj3 room*).ti,ab.	21056
114 (non-operating adj3 theatre*).ti,ab.	2
115 non-theatr*.ti,ab.	3
116 Primary Health Care/	58886
117 exp General Practice/	66522
118 Physicians, Family/	14977
119 Physicians, Primary Care/	1713
120 (general pract* or primary care or family physician* or family practi* or primary health care).ti,ab.	162263
121 gp.ti,ab.	30759
99 or 100 or 101 or 102 or 103 or 104 or 105 or 106 or 107 or 108 or 109 or 122 110 or 111 or 112 or 113 or 114 or 115 or 116 or 117 or 118 or 119 or 120 or 121	443333
123 98 and 122	4128
124 exp Infection/	667865
125 infect*.ti,ab.	1344557

126 pus.ti,ab.	5422
127 Suppuration/	6846
128 Surgical Wound Infection/	30773
129 (postoperativ* adj3 infect*).ti,ab.	9684
130 (post-operativ* adj3 infect*).ti,ab.	1241
131 (surg* adj3 infect*).ti,ab.	16188
132 Surgical Wound Dehiscence/	6761
133 dehiscence.ti,ab.	9577
134 suppurat*.ti,ab.	14545
135 124 or 125 or 126 or 127 or 128 or 132 or 133 or 134	1748698
136 123 and 135	528
137 office visit*.ti,ab.	3854
138 out-patient*.ti,ab.	13982
99 or 100 or 101 or 102 or 103 or 104 or 105 or 106 or 107 or 108 or 109 or	
139 110 or 111 or 112 or 114 or 115 or 116 or 117 or 118 or 119 or 120 or 121	435503
or 137 or 138	
140 98 and 135 and 139	337

Appendix 2: Search strategy for Embase database.

1	(surg* or operat*).ti,ab.	2570155
2	exp *hand surgery/	5241
3	exp *surgery/	1951556
4	exp *surgical technique/	392702
5	1 or 3 or 4	3644055
6	1 or 2	2572397
7	(decompress* or releas*).ti,ab.	781789
8	5 or 7	4325286
9	(hand* adj3 (surg* or operat*)).ti,ab.	15297
10	2 or 5	3644055
11	7 or 10	4325286
12	*carpal tunnel syndrome/	7593
13	"carpal tunnel*".ti,ab.	9922
14	12 or 13	10840
15	11 and 14	4489
16	*ganglionectomy/	297
17	((ganglion* adj3 (excis* or remov*)) or ganglionectom*).ti,ab.	1851
18	*ganglion cyst/ or wrist ganglion/	675

19	(excis* or remov*).ti,ab.	758256
20	18 and 19	170
21	ganglion*.ti,ab.	71068
22	18 or 21	71207
23	10 and 22	9723
24	16 or 17 or 20 or 23	10671
25	exp *hand/	27229
26	(hand* or finger* or wrist* or thumb*).ti,ab.	723999
27	25 or 26	731365
28	exp *hand bone/	6003
29	(metacarpal* or carpal* or phalan*).ti,ab.	31667
30	28 or 29	34455
31	27 or 30	747907
32	10 and 31	134651
33	*Dupuytren contracture/	2377
34	dupuytren*.ti,ab.	2687
35	33 or 34	2950
36	10 and 35	1237
37	fasciectomy*.ti,ab.	360
38	36 or 37	1389

39	*trigger finger/	239
40	("flexor tendon*" adj3 entrap*).ti,ab.	15
41	("trigger finger*" or "trigger thumb*" or "trigger digit*" or "snapping finger*" or "stenosing tenosynovit*).ti,ab.	932
42	39 or 40 or 41	960
43	releas*.ti,ab.	740907
44	10 or 43	4314535
45	42 and 44	528
46	*De Quervain tenosynovitis/	118
47	("de quervain*" or "blackberry thumb*" or "text* thumb*" or "gamer* thumb*" or "washerwoman* sprain*" or "mothers wrist*" or "mommy* thumb*).ti,ab.	751
48	("radial styloid" adj3 tenosynovit*).ti,ab.	8
49	46 or 47 or 48	778
50	10 and 49	247
51	"first extensor compartment*.ti,ab.	63
52	11 and 51	42
53	*cubital tunnel syndrome/	1137
54	"guyon syndrome".ti,ab.	3
55	*ulnar nerve/	2925
56	(ulnar adj3 nerve*).ti,ab.	8327

57	55 or 56	9169
58	(compress* or entrap*).ti,ab.	168602
59	57 and 58	1615
60	53 or 54 or 59	2341
61	10 and 60	1086
62	"cubital tunnel*".ti,ab.	804
63	10 and 62	493
64	*tennis elbow/ ((epicondyl* adj3 (lateral* or medial*)) or "tennis elbow*").mp. or "golfer* elbow*".ti,ab. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword]	1461
65		3982
66	64 or 65	3982
67	10 and 66	1439
68	(interphalan* or inter-phalan* or ip or dip or pip or metacarpophalang* or metacarpo-phalang* or meta-carpo-phalang* or meta- carpophalang* or mcp).ti,ab.	145333
69	*arthrodesis/	4439
70	fusion*.ti,ab.	185218
71	69 or 70	188183
72	68 and 71	1286

73	*Colles fracture/	649
74	*finger phalanx/	270
75	exp *carpal bone/	3644
76	*metacarpal bone/	2099
	(phalan* or carpal* or metacarpal* or scaphoid* or lunate* or	
77	triquetrum* or pisiform* or trapezium* or trapezoid* or capitat* or hamat*).ti,ab.	45258
78	("distal radius" adj3 fractur*).ti,ab.	3346
79	73 or 74 or 75 or 76 or 77 or 78	49920
80	exp *fracture fixation/	35089
81	fixation*.ti,ab.	127145
82	80 or 81	145082
83	79 and 82	4584
84	"extensor tendon*".ti,ab.	2029
85	repair*.ti,ab.	309519
86	10 or 85	3805289
87	84 and 86	1235
88	"nail bed*".ti,ab.	1361
89	86 and 88	450
90	(terminalisation* or terminalization*).ti,ab.	50

91	27 and 90	10
92	laceration/	7207
93	exp *hand injury/	12034
94	*wrist injury/	2735
95	(wound* or lacerat* or cut or cuts or trauma or injur*).ti,ab.	1159840
96	92 or 95	1161313
97	exp *injury/	889194
98	92 or 95 or 97	1628583
99	27 and 98	75198
100	93 or 94 or 99	78360
101	10 and 100	32765
102	15 or 24 or 32 or 38 or 45 or 50 or 52 or 61 or 63 or 67 or 72 or 83 or 87 or 89 or 91 or 101	151434
103	*operating room/	7972
104	procedure room*.ti,ab.	298
105	*ambulatory care/	12222
106	ambulatory.ti,ab.	83849
107	(minor op* adj3 (room* or theatre* or unit*)).ti,ab. (day case surg* adj3 (room* or theatre* or unit*)).mp. [mp=title,	22
108	abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword]	32

109 (day care surg* adj3 (room* or theatre* or unit*)).ti,ab.	17
110 (dermatolog* adj3 (room* or theatre* or unit*)).ti,ab.	596
111 *outpatient/	8648
112 outpatient*.ti,ab.	180833
113 out-patient*.ti,ab.	22124
114 (office adj3 procedur*).ti,ab.	1705
115 office visit*.ti,ab.	5372
116 (field adj3 steril*).ti,ab.	345
117 (office* adj3 surg*).ti,ab.	1303
118 (office-based adj3 surg*).ti,ab.	317
119 (operat* adj3 room*).ti,ab.	27398
120 (non-operating adj3 theatre*).ti,ab.	3
121 non-theatr*.ti,ab.	9
122 exp *primary health care/	44998
123 *general practice/	38972
124 *general practitioner/	16715
125 (general pract* or primary care or family physician* or family practi* or primary health care).ti,ab.	204165
104 or 105 or 106 or 107 or 108 or 109 or 110 or 111 or 112 or 113 or	
126 114 or 115 or 116 or 117 or 118 or 120 or 121 or 122 or 123 or 124 or	505391
125	

127 exp *infection/	1895788
128 infect*.ti,ab.	1625382
129 pus.ti,ab.	7192
130 *suppuration/	115
131 *surgical infection/	11845
132 (postoperativ* adj3 infect*).ti,ab.	12022
133 (post-operativ* adj3 infect*).ti,ab.	2095
134 (surg* adj3 infect*).ti,ab.	21315
135 *wound dehiscence/	1980
136 dehiscence.ti,ab.	11815
137 suppurat*.ti,ab.	15948
138 127 or 128 or 129 or 130 or 131 or 135 or 136 or 137	2738358
139 102 and 126 and 138	478

Appendix 3: Search strategy for CINAHL database.

1. CINAHL; (surg* OR operat*).ti,ab; 172483 results.
2. CINAHL; HAND SURGERY/; 456 results.
3. CINAHL; SURGERY, ELECTIVE/; 2054 results.
4. CINAHL; 1 OR 2 OR 3; 173619 results.
5. CINAHL; (decompress* OR releas*).ti,ab; 22317 results.
6. CINAHL; 4 OR 5; 191789 results.
7. CINAHL; (hand* adj3 (surg* OR operat*)).ti,ab; 1225 results.
8. CINAHL; CARPAL TUNNEL SYNDROME/; 1632 results.
9. CINAHL; "carpal tunnel*".ti,ab; 1432 results.
10. CINAHL; 8 OR 9; 1928 results.
11. CINAHL; 6 AND 10; 430 results.
12. CINAHL; GANGLIONECTOMY/; 10 results.
13. CINAHL; ((ganglion* adj3 (excis* OR remov*)) OR ganglionectom*).ti,ab; 41 results.
14. CINAHL; GANGLION CYSTS/; 92 results.
15. CINAHL; (excis* OR remov*).ti,ab; 26991 results.
16. CINAHL; 14 AND 15; 17 results.
17. CINAHL; ganglion*.ti,ab; 1321 results.
18. CINAHL; 14 OR 17; 1355 results.
19. CINAHL; 4 AND 18; 246 results.
20. CINAHL; 12 OR 13 OR 16 OR 19; 276 results.
21. CINAHL; exp HAND/; 7533 results.
22. CINAHL; (hand* OR finger* OR wrist* OR thumb*).ti,ab; 59722 results.

23. CINAHL; 21 OR 22; 62052 results.
24. CINAHL; CARPAL BONES/ OR METACARPAL BONES/; 509 results.
25. CINAHL; (metacarpal* OR carpal* OR phalan*).ti,ab; 2467 results.
26. CINAHL; 24 OR 25; 2803 results.
27. CINAHL; 23 OR 26; 63444 results.
28. CINAHL; 4 AND 27; 7425 results.
29. CINAHL; DUPUYTREN'S CONTRACTURE/; 200 results.
30. CINAHL; dupuytren*.ti,ab; 163 results.
31. CINAHL; 29 OR 30; 233 results.
32. CINAHL; 4 AND 31; 74 results.
33. CINAHL; fasciectomy*.ti,ab; 30 results.
34. CINAHL; 32 OR 33; 86 results.
35. CINAHL; TRIGGER FINGER DISORDER/; 74 results.
36. CINAHL; ("flexor tendon*" adj3 entrap*).ti,ab; 2 results.
37. CINAHL; ("trigger finger*" OR "trigger thumb*" OR "trigger digit*" OR "snapping finger*" OR "stenosing tenosynovitis").ti,ab; 118 results.
38. CINAHL; 35 OR 36 OR 37; 141 results.
39. CINAHL; releas*.ti,ab; 19531 results.
40. CINAHL; 4 OR 39; 190876 results.
41. CINAHL; 38 AND 40; 59 results.
42. CINAHL; DE QUERVAIN DISEASE/; 70 results.
43. CINAHL; ("de quervain*" OR "blackberry thumb*" OR "text* thumb*" OR "gamer* thumb*" OR "washerwoman*

sprain*" OR "mothers wrist*" OR "mommy* thumb*").ti,ab; 102 results.

44. CINAHL; ("radial styloid" adj3 tenosynovit*).ti,ab; 0 results.

45. CINAHL; 42 OR 43 OR 44; 118 results.

46. CINAHL; 4 AND 45; 30 results.

47. CINAHL; "first extensor compartment*".ti,ab; 3 results.

48. CINAHL; 6 AND 47; 1 results.

49. CINAHL; ULNAR NERVE COMPRESSION SYNDROMES/; 24 results.

50. CINAHL; "guyon syndrome".ti,ab; 0 results.

51. CINAHL; ULNAR NERVE/; 524 results.

52. CINAHL; (ulnar adj3 nerve*).ti,ab; 570 results.

53. CINAHL; 51 OR 52; 826 results.

54. CINAHL; (compress* OR entrap*).ti,ab; 10458 results.

55. CINAHL; 53 AND 54; 156 results.

56. CINAHL; 49 OR 50 OR 55; 172 results.

57. CINAHL; 6 AND 56; 61 results.

58. CINAHL; "cubital tunnel*".ti,ab; 89 results.

59. CINAHL; 6 AND 58; 46 results.

60. CINAHL; TENNIS ELBOW/; 774 results.

61. CINAHL; epicondyl* adj3 (lateral* OR medial*) OR ("tennis elbow*" OR "golfer* elbow*") AND .ti,ab; 1206

results.

62. CINAHL; 60 OR 61; 1575 results.

63. CINAHL; 6 AND 62; 230 results.

64. CINAHL; (interphalan* OR inter-phalan* OR ip OR dip OR pip OR metacarpophalang* OR metacarpo-phalang*

OR meta-carpo-phalang* OR meta-carpophalang* OR mcp).ti,ab; 3011 results.

65. CINAHL; ARTHRODESIS/; 1413 results.

66. CINAHL; fusion*.ti,ab; 5477 results.

67. CINAHL; 65 OR 66; 6402 results.

68. CINAHL; 64 AND 67; 77 results.

69. CINAHL; "colles fracture*".ti,ab; 77 results.

70. CINAHL; CARPAL BONES/; 387 results.

71. CINAHL; METACARPAL BONES/; 144 results.

72. CINAHL; (phalan* OR carpal* OR metacarpal* OR scaphoid* OR lunate* OR triquetrum* OR pisiform* OR

trapezium* OR trapezoid* OR capitat* OR hamat*).ti,ab; 3793 results.

73. CINAHL; ("distal radius" adj3 fractur*).ti,ab; 504 results.

74. CINAHL; 69 OR 70 OR 71 OR 72 OR 73; 4505 results.

75. CINAHL; FRACTURE FIXATION/; 4567 results.

76. CINAHL; fixation*.ti,ab; 8652 results.

77. CINAHL; 75 OR 76; 10794 results.

78. CINAHL; 74 AND 77; 485 results.

79. CINAHL; "extensor tendon*".ti,ab; 175 results.

80. CINAHL; repair*.ti,ab; 15148 results.

81. CINAHL; 4 OR 80; 182179 results.

82. CINAHL; 79 AND 81; 96 results.

83. CINAHL; "nail bed*".ti,ab; 68 results.

84. CINAHL; 81 AND 83; 21 results.
85. CINAHL; (terminalisation* OR terminalization*).ti,ab; 1 results.
86. CINAHL; 23 AND 85; 1 results.
87. CINAHL; TEARS AND LACERATIONS/; 1932 results.
88. CINAHL; exp HAND INJURIES/; 3052 results.
89. CINAHL; (wound* OR lacerat* OR cut OR cuts OR trauma OR injur*).ti,ab; 144942 results.
90. CINAHL; 87 OR 89; 145792 results.
91. CINAHL; exp WOUNDS AND INJURIES/; 151382 results.
92. CINAHL; 87 OR 89 OR 91; 227464 results.
93. CINAHL; 23 AND 92; 10580 results.
94. CINAHL; 88 OR 93; 11537 results.
95. CINAHL; 4 AND 94; 2578 results.
96. CINAHL; 11 OR 20 OR 28 OR 34 OR 41 OR 46 OR 57 OR 59 OR 63 OR 68 OR 78 OR 82 OR 84 OR 86 OR 95; 8500 results.
97. CINAHL; "procedure room*".ti,ab; 47 results.
98. CINAHL; AMBULATORY CARE/; 6421 results.
99. CINAHL; ambulatory.ti,ab; 11145 results.
100. CINAHL; ("minor op*" adj3 (room* OR theatre* OR unit*)).ti,ab; 4 results.
101. CINAHL; ("day case surg*" adj3 (room* OR theatre* OR unit*)).ti,ab; 10 results.
102. CINAHL; dermatolog* adj3 (room* OR theatre* OR unit*).ti,ab; 7 results.
103. CINAHL; OUTPATIENTS/; 32618 results.
104. CINAHL; outpatient*.ti,ab; 24273 results.
105. CINAHL; (office adj3 procedur*).ti,ab; 256 results.

106. CINAHL; OFFICE VISITS/; 2540 results.
107. CINAHL; (field adj3 steril*).ti,ab; 61 results.
108. CINAHL; (office* adj3 surg*).ti,ab; 333 results.
109. CINAHL; (office-based adj3 surg*).ti,ab; 109 results.
110. CINAHL; (operat* adj3 room*).ti,ab; 3645 results.
111. CINAHL; (non-operating adj3 theatre*).ti,ab; 0 results.
112. CINAHL; non-theatr*.ti,ab; 2 results.
113. CINAHL; PRIMARY HEALTH CARE/; 32251 results.
114. CINAHL; FAMILY PRACTICE/; 11592 results.
115. CINAHL; PHYSICIANS, FAMILY/; 8824 results.
116. CINAHL; ("general pract*" OR "primary care" OR "family physician*" OR "family practi*" OR "primary health care").ti,ab; 47034 results.
117. CINAHL; gp.ti,ab; 4912 results.
118. CINAHL; 97 OR 98 OR 99 OR 100 OR 101 OR 102 OR 103 OR 104 OR 105 OR 106 OR 107 OR 108 OR 109 OR 110 OR 111 OR 112 OR 113 OR 114 OR 115 OR 116 OR 117; 135030 results.
119. CINAHL; 96 AND 118; 619 results.
120. CINAHL; exp INFECTION/; 82839 results.
121. CINAHL; infect*.ti,ab; 100030 results.
122. CINAHL; pus.ti,ab; 381 results.
123. CINAHL; exp SUPPURATION/; 4574 results.
124. CINAHL; suppurat*.ti,ab; 452 results.
125. CINAHL; SURGICAL WOUND DEHISCENCE/; 628 results.

126. CINAHL; dehiscence.ti,ab; 864 results.

127. CINAHL; 120 OR 121 OR 122 OR 123 OR 124 OR 125 OR 126; 148741 results.

129. CINAHL; out-patient*.ti,ab; 1397 results.

130. CINAHL; "office visit*".ti,ab; 1207 results.

131. CINAHL; 118 OR 129 OR 130; 136448 results.

132. CINAHL; 96 AND 127 AND 131; 92 results

Appendix 4: Secondary search strategy for Medline, Embase and CINAHL databases.

1. (Hand AND Surgery).ti,ab; 18147 results.
2. (field AND sterility).ti,ab; 320 results.
3. 1 AND 2; 3 results.
4. Infection.ti,ab; 809186 results.
5. 1 AND 4; 911 results.
6. Rate*.ti,ab; 2034324 results.
7. 5 AND 6; 290 results.