Causation of ganglion cysts of the wrist
Evidence Based Review

June 2017

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### Executive Summary

This report examines the available evidence (post-2009) on the causation of ganglion cysts of the wrist. ACC’s Clinical Advisory Panel (CAP) requested a review of the available evidence on causation, and on causal association between wrist ganglions and trauma. This review will inform the continuing discussions on the causation of wrist ganglions.

Ganglion cysts are benign soft tissue tumours, and are one of the most common problems of the hand and wrist. They are mucin filled and lined with collagen fibres. The aetiology of wrist ganglions remains unclear. There are a number of hypotheses regarding causation, but none of these assertions are supported by firm evidence. Some of the more common hypotheses of wrist ganglion causation are: trauma, or a history of trauma; mucinous degeneration; and synovial herniation. There is a paucity of recent and relevant literature that addresses wrist ganglions, their causation, or relevant risk factors. None of the included literature reported whether a single event (e.g. trauma) could lead to the formation of wrist ganglions.

The table below outlines the relevant risk factors explored in relation to wrist ganglions in the available literature.

<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>Main findings</th>
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| Sex                       | - One retrospective case control study found that women were significantly more likely to be diagnosed with a volar wrist ganglion:¹  
  - The unadjusted incidence was 3.72 per 10,000 person-years in female civilian beneficiaries, 1.04 in male civilian beneficiaries, 7.98 in female military personnel, and 3.73 in male military personnel  
  - When controlled for age, women were 2.3 times more likely to have a wrist ganglion  
  - One prospective case control study found that female sex was a significant independent predictor of generalised ligamentous hyperlaxity.²   |
| Activity                  | One prospective case control study compared the prevalence of MRI-identified wrist abnormalities and wrist ROM in asymptomatic and symptomatic computer users:³  
  - Extraosseous ganglions were identified in 66.6% of asymptomatic wrists and in 75% of symptomatic wrists  
  - Distal ECU tendon instability was identified in 58.4% of both symptomatic and asymptomatic wrists  
  - Dominant wrist flexion was significantly greater in the asymptomatic group (68.8 ± 6.7 deg) compared to the symptomatic group (60.7 ± 7.3 deg) (p <.01). |
| Ligamentous hyperlaxity   | One prospective case control study aimed to determine whether symptomatic dorsal wrist ganglions are associated with generalised ligamentous hyperlaxity:²  
  - Patients with symptomatic dorsal wrist ganglions demonstrated significantly increased rates of generalised ligamentous hyperlaxity: 27 of 96 (28%), compared with 12 of the 96 (13%) of the age and sex matched controls  
  - Patients with symptomatic dorsal wrist ganglions were also significantly more likely to demonstrated localised scapholunate hyperlaxity with a positive scaphoid shift test (25% with ganglions, and 1% in controls)  
  - With logistical modelling, patients with dorsal wrist ganglions had 2.9 times greater odds of generalised ligamentous hyperlaxity (95% CI 1.3-6.2), compared with patients without a dorsal wrist ganglion after accounting for patient age and sex. |
| Intraarticular disorders   | One retrospective case series investigated which intraarticular disorders coexist with wrist ganglions, in a population of patients with primary dorsal wrist ganglions who underwent arthroscopic resection:⁴  
  - 21 patients had coexisting intraarticular disorders: 18 Triangular Fibrocartilage Complex (TFCC) tears and 9 intrinsic ligament tears  
  - The coexisting disorders were found to be unrelated to pain, function and recurrence after arthroscopic resection of the ganglion when the intraarticular disorders were treated simultaneously  
  - A prospective case series aimed to determine the prevalence of associated TFCC lesions in 46 patients with painful wrist ganglions:⁵  
  - Arthroscopy identified 22 TFCC lesions (48%) and 2 intracarpal ligament lesions  
  - The TFCC perforations were more commonly associated with radiopalmar ganglions with a positive ulnocarpal stress test result and with recurrent radiopalmar ganglions. |
| Occupation                | A retrospective case control study addressed the incidence and demographic factors associated with volar wrist ganglions in military and civilian beneficiary populations:¹  
  - Military service members were found to have higher rates of volar wrist ganglions diagnoses than their age and sex-matched civilian counterparts  
  - When controlled for age, military personnel have a 2.5-times increased rate of volar wrist ganglions. |

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¹. [Reference 1]  
². [Reference 2]  
³. [Reference 3]  
⁴. [Reference 4]  
⁵. [Reference 5]
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## Abbreviations

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<th>Description</th>
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<tbody>
<tr>
<td>aIRR</td>
<td>Adjusted incidence rate ratio</td>
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<tr>
<td>CAP</td>
<td>Clinical Advisory Panel</td>
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<td>MWS</td>
<td>Mayo Wrist Score</td>
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<td>ROM</td>
<td>Range of motion</td>
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<tr>
<td>TFCC</td>
<td>Triangular Fibrocartilage Complex</td>
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<td>VAS</td>
<td>Visual Analogue Scale</td>
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1 Background

This evidence review sought to understand the causation of wrist ganglions, and specifically, the causal role of trauma. There is a difference in opinions on whether there is a causal link between a single traumatic event and wrist ganglion cysts. The primary audiences for this report are members of ACC’s Clinical Advisory Panel (CAP), as well as external wrist and hand surgeons. A modified form could also be useful for clinical advisors providing advice on cover, and as a plain language summary for case owners and clients.

ACC’s Clinical Advisory Panel (CAP) has produced a statement on the aetiology of wrist ganglions, in which they referenced a 2009 literature review by Professor Thurston. Thurston’s review noted that the aetiology of wrist ganglions remains controversial, but states that there is no evidence in the literature to support trauma as an aetiologic factor.

This review only includes literature published since 2009; however, there is a paucity of recent and relevant publications.

1.1 Wrist ganglions

Ganglion cysts are benign soft tissue tumours, and are one of the most common problems of the hand and wrist. They are mucin-filled and lined with collagen fibres. There is no clear evidence-based theory on how ganglion cysts form. Most theories suggest that the final stage of ganglion formation involves the combination of small pools of mucin to form the main cyst.

Dorsal ganglions are the most common type of wrist ganglion, with approximately 55% to 70% of ganglions found on this aspect of the wrist. Dorsal ganglions are typically associated with the scapholunate interosseous ligament. Wrist ganglions can also be found on the volar aspect of the wrist, can arise from a flexor tendon sheath in the hand, and are less commonly intraosseous or intratendinous.

Ganglion cysts are more common in younger adults (aged in their twenties to forties), and more common in women than in men. A review on dorsal wrist ganglions suggests that the male incidence rate is 25/100,000, and the female rate 43/100,000.

1.1.1 Clinical presentation and diagnosis

Wrist ganglions are typically one to two centimetre cystic structures, feel similar to a firm rubber ball, and are well tethered in place by their attachment to the underlying joint capsule or tendon sheath. There is no associated warmth or erythema, and the cyst readily transilluminates.

Symptoms of wrist ganglions include aching in the wrist which may also radiate up the patient’s arm, pain with activity or palpation of the mass, decreased range of motion, and decreased grip strength. However, a significant proportion of wrist ganglions are asymptomatic, and a painless mass is a common presenting complaint.

The clinical presentation of wrist ganglions tends to be adequate for diagnosis. One study included in this review had a hand surgeon diagnose dorsal wrist ganglions based on history and physical examination. Another study used MRI to confirm the diagnosis of wrist ganglion and the connection between the ganglion and the radiocarpal or midcarpal joint.

1.1.1.1 Pain

The cause of pain associated with wrist ganglions is unknown. It has been hypothesised that pain is caused by compression of the terminal branches of the posterior interosseous nerve. Studies report varying prevalence of pain in patients with wrist ganglions, ranging from 19% to 70-100% of patients. Reported pain does tend to be mild, however, and predominantly does not interfere with normal daily activities. The authors of a literature review on dorsal wrist ganglions conclude that pain, if present, is more likely to be annoying than debilitating.

1.1.1.2 Treatment

Patients may seek treatment when their ganglions become associated with pain, weakness, interference with activities, and an increase in size.
One systematic review on treatment for wrist ganglions looked at the indications for seeking treatment for a total of 2,239 ganglions. The median percentage of patients presenting with pain, cosmetic concerns and weakness were 71%, 34% and 27%, respectively.10

Nearly 50% of ganglions resolve spontaneously.5 Otherwise, a number of treatment options exist: forceful or controlled rupture, aspiration (which can be combined with the injection of various fluids), and either open or arthroscopic surgical resection.5, 10 Currently, patients with wrist ganglions are usually educated and reassured, with no further intervention suggested. Alternatively, patients may be offered either aspiration or surgical excision (open or arthroscopic) by means of treatment.10

A retrospective case series reported the indications for arthroscopic resection of wrist ganglions in 53 patients. Indications for surgical resection were symptomatic dorsal or volar wrist ganglions with: persistent pain which interfered with activity; at least one prior attempt at aspiration or rupture; and occurrence at a typical or common location in the wrist.4

### 1.1.2 Aetiology of wrist ganglions

The aetiology of wrist ganglions remains unclear.2, 4, 5, 7, 8 There are a number of hypotheses on the underlying cause of wrist ganglions, but no consensus. More common hypotheses on the causation of wrist ganglions are: trauma, or a history of trauma2, 4, 5, 8, mucinous degeneration4, 5, “capsular rent”8, 11, and synovial herniation.4, 5 The synovial herniation theory is difficult to support, as there is no synovial lining in ganglion cysts themselves.1, 8, 11

Other hypotheses include:

- 1-way valve mechanism5
- Intra-articular abnormalities2
- Chronic or acute damage to a portion of the scapholunate ligament of the joint capsule, leading to tissue expansion2
- A modified theory of trauma, where the joint capsule is weakened, and chronic or acute damage leads to a capsular defect2
- Inflammatory responses2
- Stress or injury to extracapsular tissues2
- Intracarpal ligament abnormalities5

#### 1.1.2.1 Trauma/history of trauma

Whilst trauma is listed as a possible cause of wrist ganglions in a number of articles, there is no clear evidence to confirm this assertion. A literature review on dorsal wrist ganglions states that a “history of trauma is elicited in at least 10% of cases and is considered a causative factor although the pathogenesis remains unclear.”8 The review does not provide evidence to support trauma as a causative factor. One of the included studies asserts that ganglion cysts “can arise following trauma but often are considered idiopathic without any clear inciting event.”2

Thurston maintains that there is no evidence to support either a specific prior traumatic event, nor repeated minor trauma, as aetiologic factors in the formation of wrist ganglions.7 McKeon et al also state that the theory of traumatic origin is controversial.2

#### 1.1.2.2 Mucinous degeneration

The mucinous degeneration hypothesis posits that ganglions develop from connective tissue by myxoid degeneration and disintegration of collagen fibres. Ganglions result from increasing amounts of mucinous fluid which accumulates through the growing liquefaction of collagen fibres, and the surrounding densifying collagen bundles that form a delimiting capsule.7 Joint stress may lead to mucoid degeneration of adjacent extra-articular connective tissue, leading to fluid accumulation and then cyst formation.8, 11
1.1.2.3 ‘Capsular rent’

The ‘capsular rent’ theory suggests that joint stress leads to a rent in the joint capsule, allowing leakage of synovial fluid into the peri-articular tissue. The subsequent reaction of this fluid with local tissue creates the gelatinous cystic fluid and the formation of the cyst wall.8,11

In support of this theory, some authors have hypothesised that joint pathology is the underlying cause of cyst formation. Joint abnormalities are thought to lead to altered biomechanics, eventual weakening of the capsule, leakage of fluid, and then cyst formation. However, no correlation between the presence of intraarticular joint pathology and postoperative cyst recurrence can be demonstrated.8,11

2 Methods

A search of the following sources was carried out in December 2016:

- Medline
- Pre-Medline
- Embase
- PubMed
- TRIP database

A further search of Google Scholar was carried out in March 2017.

Search terms included: wrist ganglion, wrist ganglions, dorsal wrist ganglion cyst, trauma, single traumatic injury, single trauma event, cause, risk factors.

2.1.1 Inclusion criteria

- Types of studies: primary studies published after 2009
- Types of participant: any human participants with wrist ganglion or other wrist abnormalities

2.1.2 Exclusion criteria

- Articles published before 2009
- Case studies/reports, literature reviews, medical reports
- Articles where study populations were children
- Articles not in English

2.2 Levels of evidence

Studies that met the criteria for inclusion in this report were assessed for their methodological quality using the Scottish Intercollegiate Guideline Network (SIGN) level of evidence system, as outlined below.

<table>
<thead>
<tr>
<th>Levels of evidence</th>
<th>Description</th>
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<tbody>
<tr>
<td>1++</td>
<td>High quality meta analyses, systematic reviews of randomized controlled trials (RCTs), or RCTs with a very low risk of bias</td>
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<tr>
<td>1+</td>
<td>Well conducted meta analyses, systematic reviews, or RCTs with a low risk of bias</td>
</tr>
<tr>
<td>1-</td>
<td>Meta analyses, systematic reviews, or RCTs with a high risk of bias</td>
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<tr>
<td>2++</td>
<td>High quality systematic reviews of case-control or cohort studies. High quality case-control or cohort studies with a very low risk of confounding or bias and a high probability that the relationship is causal</td>
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<tr>
<td>Rating</td>
<td>Description</td>
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<tr>
<td>2+</td>
<td>Well conducted case control or cohort studies with a low risk of confounding or bias and a moderate probability that the relationship is causal</td>
</tr>
<tr>
<td>2-</td>
<td>Case control or cohort studies with a high risk of confounding or bias and a significant risk that the relationship is not causal</td>
</tr>
<tr>
<td>3</td>
<td>Non-analytic studies, e.g. case reports, case series</td>
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<tr>
<td>4</td>
<td>Expert opinion</td>
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</table>

3 Findings

There were very few studies that were eligible to be included in this evidence review, demonstrating the lack of evidence on the causation of wrist ganglions. None of the studies included directly addressed the causation of wrist ganglions, and the included studies were of low quality.

3.1 Causation

No studies included in this review directly addressed the causation of wrist ganglions. The aetiology of wrist ganglions remains unclear.2, 4, 5, 7, 8

3.2 Risk factors

3.2.1 Sex

One retrospective case control study found that women are significantly more likely to be diagnosed with a volar wrist ganglion, regardless of age or military status. In the military cohort, female military personnel had an adjusted incidence rate ratio (aIRR) of 2.2 relative to their male colleagues. In the civilian cohort, women had an aIRR of 3.6 relative to men.1 This study addressed wrist ganglions that occur in the volar region only, and therefore the findings cannot be applied to dorsal wrist ganglions.

| Sex | - In one study, the unadjusted incidence rate of volar wrist ganglion was 3.72 per 10,000 person-years in female civilian beneficiaries, 1.04 in male civilian beneficiaries, 7.98 in female military personnel, and 3.73 in male military personnel.1
|     | - When controlled for age, women have a 2.3-times increased rate.
|     | - One prospective case control study found that female sex was a significant independent predictor of generalised ligamentous hyperlaxity.2 |

3.2.2 Computer use

Burgess et al compared the prevalence of MRI-identified wrist abnormalities and wrist ROM between asymptomatic and symptomatic computer users.3 Computer users were defined by daily computer use for a minimum of four hours per day for at least three years. The majority of participants were employed in clerical or computer programming occupations. Burgess et al state that computer use is often associated with an increased prevalence of hand and wrist disorders, but note that the relationship is controversial because of the frequent lack of identifiable pathology.

Burgess et al used MR images of the wrists of 14 computer users with chronic wrist pain and of 10 asymptomatic controls to identify wrist abnormalities. Extraosseous ganglions were identified in 66.6% of asymptomatic wrists and in 75% of symptomatic wrists. Intraosseous ganglions were identified in 45.8% of asymptomatic wrists and in 75% of symptomatic wrists, and were significantly larger in size in the symptomatic wrists. The most frequent location of the ganglions in asymptomatic wrists was adjacent to the pisotriquetral joint, and volar to the radioscapohoid articulation in symptomatic wrists.3
Wrist range of motion varied across the two groups; mean right wrist flexion in the asymptomatic group (68.8 ± 6.7 deg) was significantly greater than the symptomatic group (60.7 ± 7.3 deg).

The study demonstrated that a variety of wrist abnormalities are common in computer users. The study identified mild tenosynovitis of the wrist extensors in two asymptomatic wrists, and five symptomatic wrists. Persistent median artery was identified bilaterally in 1 asymptomatic subject and in 1 subject with symptoms consistent with carpal tunnel syndrome. Other MRI findings included:

- Mild-moderate radiocarpal joint effusion (2 asymptomatic, 1 symptomatic)
- Perforation or central thinning of the triangular fibrocartilage (4 asymptomatic)
- Areas of edema and/or sclerosis (1 asymptomatic, 2 symptomatic)
- Low signal lesion in the volar lunate (1 symptomatic)
- Partial scapholunate ligament tear (1 symptomatic)
- Humpback scaphoid (1 asymptomatic)

### Computer use

<table>
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<tr>
<th>One prospective case control study compared the prevalence of MRI-identified wrist abnormalities and wrist ROM:³</th>
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### 3.2.3 Ligamentous hyperlaxity

One prospective case control study aimed to determine whether symptomatic dorsal wrist ganglions are associated with generalised ligamentous hyperlaxity.² It was found that patients with symptomatic dorsal wrist ganglions demonstrated significantly increased rates of generalised ligamentous hyperlaxity. Among those with ganglions, 27 of 96 (28%) exhibited generalized ligamentous hyperlaxity, compared with 12 of the 96 (13%) age and sex matched controls. Further analysis confirmed that participants demonstrating generalised ligamentous hyperlaxity were significantly younger, and that there was an association between hyperlaxity and the presence of a dorsal wrist ganglion for males.²

Patients with symptomatic dorsal wrist ganglions were also significantly more likely to demonstrate localised scapholunate hyperlaxity with a positive scaphoid shift test; there was a 25% positive scaphoid shift test rate in those with ganglions, compared to 1% in controls.²

Logistical modelling used to predict generalised hyperlaxity found that significant independent predictors included female sex, younger age, and the presence of a dorsal wrist ganglion.²

Although the association between symptomatic dorsal wrist ganglions and generalised ligamentous hyperlaxity does not prove causation, the authors suggest that the same underlying pathological entity might cause both wrist ganglions and ligamentous hyperlaxity. This entity could be abnormal formation or organisation of dense regular connective tissue.² Further research is needed to determine whether this association is causative.

### Ligamentous hyperlaxity

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<td>- With logistical modelling, patients with dorsal wrist ganglions had 2.9 times greater odds of generalised ligamentous hyperlaxity (95% CI 1.3-6.2), compared with patients without a dorsal wrist ganglion after accounting for patient age and sex.</td>
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### 3.2.4 Intraarticular disorders

Kang *et al* investigated what intraarticular disorders coexisted with dorsal wrist ganglions, and whether they influenced pain, function and recurrence after arthroscopic ganglion resection. They reviewed 41 patients with primary dorsal wrist ganglions who underwent arthroscopic resection, and assessed VAS pain scores and Mayo Wrist Scores (MWS) at a number of time points post-operatively. Twenty-one of the included patients had coexisting intraarticular disorders; there were 18 triangular fibrocartilage complex (TFCC) tears and nine intrinsic ligament tears. Nine patients were also found to have ganglion stalks. The authors found no difference in mean VAS pain scores or MWS preoperatively or at two years after surgery between patients with or without coexisting intraarticular disorders. There was also no difference between recurrence of ganglions and the presence of coexisting intraarticular disorders.

Langner *et al*, in a prospective case series, aimed to determine the prevalence of associated triangular fibrocartilage complex (TFCC) lesions in patients with painful wrist ganglions. The authors stated that several studies have described intracarpal ligament lesions as the underlying cause of pain in wrist ganglions. They hypothesised that, as popliteal cysts in the knee are widely recognised indicators of intra-articular pathology, painful wrist ganglions are also indicators of an underlying joint abnormality, despite their different histology. Forty-six patients with painful wrist ganglions and who had arthroscopic resection surgery in the study period were included in the study. Arthroscopy identified TFCC abnormalities with corresponding synovitis in 48% of patients (12 radiopalmar, 10 dorsal). Nineteen of these lesions were traumatic, and three were degenerative. There were 11 TFCC lesions in both the primary and recurrent ganglion groups. The TFCC perforations were more commonly associated with radiopalmar ganglions with a positive ulnocarpal stress test result and with recurrent radiopalmar ganglions. Patients in this study had simultaneous arthroscopic treatment of ganglions and TFCC lesions, so conclusions cannot be drawn on whether TFCC lesions are the underlying cause of ganglions.

### Intraarticular disorders

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  - 21 patients had coexisting intraarticular disorders: 18 TFCC tears and 9 intrinsic ligament tears  
  - The coexisting disorders were found to be unrelated to pain, function and recurrence after arthroscopic resection of the ganglion when the intraarticular disorders were treated simultaneously.  
| |
| A prospective case series aimed to determine the prevalence of associated TFCC lesions in 46 patients with painful wrist ganglions:  
  - Arthroscopy identified 22 TFCC lesions (48%) and 2 intracarpal ligament lesions  
  - The TFCC perforations were more commonly associated with radiopalmar ganglions with a positive ulnocarpal stress test result and with recurrent radiopalmar ganglions. |

### 3.2.5 Occupation

Balazs *et al* addressed the incidence and demographic factors associated with volar wrist ganglions in military and civilian beneficiary populations. The study found that military service members have higher rates of volar wrist ganglions diagnoses than their age and sex-matched civilian counterparts. When controlled for age, this study found that military personnel have a 2.5-times increased rate of volar wrist ganglions. Within the military cohort included in this study, female sex, branch of military service and career progression were all independently associated with a higher incidence of a volar wrist ganglion. Senior career progression had almost double the risk of development of volar wrist ganglion, relative to junior career progression, with an aIRR of 1.92. The study design did not enable the authors to draw conclusions on the reason(s) for a higher incidence of volar wrist ganglions in military personnel. The authors state they are unaware of any studies that have attempted to quantify the frequency or strenuousness of wrist-loading activities in either military or general civilian populations.

This study addressed wrist ganglions that occur in the volar region, rather than the dorsal region, so these findings cannot be applied to dorsal wrist ganglions. This study was retrospective, so could not assess causation.

<table>
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<th>Occupation</th>
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| - Military service members were found to have higher rates of volar wrist ganglions diagnoses than their age and sex-matched civilian counterparts.  
- When controlled for age, military personnel have a 2.5-times increased rate of volar wrist ganglions. |
4 Discussion

4.1 Nature and quality of the evidence

Only a small number of studies met inclusion criteria for this report, limiting the evidence base from which to draw conclusions. All of the included studies are of low quality, due to the study designs: prospective case control, prospective case series, retrospective case series, and retrospective case control. Retrospective studies cannot examine causation, only association. In addition, two of the three prospective studies did not randomly select patients to be included in the study population; instead, those included were consecutive patients presenting to the authors’ respective medical facilities. The third prospective study recruited subjects through advertisements posted in a number of settings, but only had a small sample size (14 symptomatic computer users, and 10 asymptomatic computer users).

4.2 Summary of findings

The studies included in this review were subject to a number of limitations, and few consistent findings emerged. A number of associated factors were investigated, but the evidence is of low quality.

One retrospective case series found that women are significantly more likely to be diagnosed with volar wrist ganglion. When controlled for age, women have a 2.3-times increased rate.

One prospective case control study found that a variety of wrist abnormalities are common in computer users, and identified extraosseous ganglions in 66.6% of the wrists of asymptomatic computer users, and 75% of the wrists of symptomatic computer users.

A prospective case control study found that symptomatic dorsal wrist ganglions were associated with both generalised ligamentous hyperlaxity and a positive scaphoid shift test. Patients in this study with symptomatic dorsal wrist ganglions demonstrated significantly increased rates of generalised ligamentous hyperlaxity: 27 of 96 (28%), compared with 12 of the 96 (13%) of the age and sex matched controls.

Two studies (one retrospective and one prospective case series) examined intraarticular disorders and their association with wrist ganglions, demonstrating that the two commonly coexist. In the retrospective study, 21 (of 41) patients had coexisting intraarticular disorders: 18 TFCC tears and 9 intrinsic ligament tears. These disorders were found to be unrelated to pain, function and recurrence after arthroscopic resection of the ganglion when the intraarticular disorders were treated simultaneously. With a study population of 46, the prospective study identified 22 TFCC lesions and 2 intracarpal ligament lesions.

One study found that, when controlled for age, military personnel have a 2.5-times increased rate of volar wrist ganglions.

5 Conclusion

Overall, the current report demonstrates the global lack of evidence on the causation of wrist ganglions. The aetiology of wrist ganglions remains unclear. There is no new evidence on their causation, and the existing evidence on ganglions is of low quality.

None of the included literature reported whether a single event (e.g. trauma) could lead to the formation of wrist ganglions.

The literature included in this review hypothesises that there could be associations between wrist ganglions and sex, computer use, ligamentous hyperlaxity, intraarticular disorders, and military occupation. However, there is very limited evidence for each potential risk factor, and the studies were unable to demonstrate causation. Further studies are needed to better understand the nature of these relationships.
6 References


7. Thurston AJ. Ætiology of extraosseous wrist ganglia; the published evidence. *Orthopaedics and Trauma.* 2009;23(3):186-188.


<table>
<thead>
<tr>
<th>Study</th>
<th>Methodology</th>
<th>Results</th>
<th>Quality assessment</th>
<th>Conclusions</th>
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</table>
| **McKeon et al, 2013.**     | **Number of participants:**  
n=192 (96 patients with symptomatic dorsal wrist ganglions; 96 age and sex matched controls)  
**Exclusion criteria:**  
• Lack of English proficiency  
• Mental status prohibiting study consent  
**Relevant characteristics:**  
Dorsal wrist ganglion group:  
average age of 31y (range 10-69y), 61 female subjects (64%).  
Control group: average age of 30y (range 10-69y), 61 female subjects (64%).  
**Measures:**  
• Scaphoid shift test  
• Examination to determine Beighton score (generalised hyperlaxity was defined as a Beighton score of 4 or greater)  | Patients with symptomatic dorsal wrist ganglions demonstrated significantly increased rates of generalised ligamentous hyperlaxity. Among those with ganglions, 27 of 96 (28%) exhibited generalised ligamentous hyperlaxity, compared with 12 of the 96 (13%) age and sex matched controls. Patients with symptomatic dorsal wrist ganglions were also significantly more likely to demonstrate localised scapholunate hyperlaxity with a positive scaphoid shift test (25% positive scaphoid shift test with ganglions, compared to 1% in controls). | Appropriate and clearly focused question  
Cases and controls from comparable populations  
Same exclusion criteria for cases and controls  
Percentage of each group participated  
Comparison made between participants and non-participants  
Cases clearly defined and differentiated from controls  
Clearly established controls are non-cases  
Measures taken to prevent knowledge of primary exposure influencing case ascertainment  
Exposure status measured in a standard, valid and reliable way  
Main potential confounders are  | Author conclusions:  
Symptomatic dorsal wrist ganglions were associated with both generalised ligamentous hyperlaxity and a positive scaphoid shift test. Although an association between wrist ganglions and ligamentous hyperlaxity does not prove causation, the possibility of the same underlying pathological entity causing both can be envisioned. |

**Reviewer comments:** Low quality study design. Process for selection of controls is unclear.  
**Level of evidence:** 2-
### Kang et al, 2013.

**Study design:**
Retrospective case series

**Objective:**
To investigate which intraarticular disorders coexist with dorsal wrist ganglions, and whether they influence pain, function, and recurrence after arthroscopic ganglion resection.

<table>
<thead>
<tr>
<th>Study</th>
<th>Methodology</th>
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<th>Quality assessment</th>
<th>Conclusions</th>
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<tbody>
<tr>
<td></td>
<td>Retrospectively reviewed 41 patients with primary dorsal wrist ganglions who underwent arthroscopic resection.</td>
<td>21 patients had other coexisting intraarticular disorders: 18 triangular fibrocartilage complex tears and 9 intrinsic ligament tears. All coexisting disorders were treated simultaneously. Two years after surgery, the mean VAS pain score decreased from 2.4 to 0.6, and mean grip strength increased from 28 to 36kg of force. The mean active flexion-extension showed no change. The mean MWS improved from 74 to 91. Three ganglions recurred. There was no difference in mean VAS pain score and MWS preoperatively and at 2 years after surgery or recurrence of ganglions between patients with or without coexisting lesions.</td>
<td>identified and taken into account</td>
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<td>Confidence intervals provided</td>
<td>+</td>
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<td>Quality of study in minimising risk of bias or confounding</td>
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<td>Clear evidence of association between exposure and outcome</td>
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<td>Study results directly applicable to patient group targeted</td>
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<td></td>
<td><strong>Reviewer comments:</strong> Low quality study design. Given this was retrospective and used patient records to identify wrist ganglions, study may be more susceptible to inaccurate diagnoses. Study only included patients who underwent arthroscopic resection. Minimum follow-up of 24 months, but all data was</td>
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</table>

**Number of participants:** n=41

**Exclusion criteria:**
- Volar wrist ganglions
- A history of previous surgery on the wrist, including ganglion resection
- A history of fracture around the wrist
- Pre-existing arthritis
- Static carpal instability on preoperative plain radiographs
- Impairment of cognitive function to complete a questionnaire
<table>
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</table>
|       | • Workers compensation issues  
         • Inadequate follow-up (<24 months) | | Clearly established controls are non-cases  
         Measures taken to prevent knowledge of primary exposure influencing case ascertainment  
         Exposure status measured in a standard, valid and reliable way  
         Main potential confounders are identified and taken into account  
         Confidence intervals provided  
         Quality of study in minimising risk of bias or confounding  
         Clear evidence of association between exposure and outcome  
         Study results directly applicable to patient group targeted | obtained from medical records.  
         Level of evidence: 3 |
|       | Relevant characteristics:  
         • 13 men, 28 women  
         • Mean age at time of surgery was 33.7y (range, 19-59y)  
         • Average duration of ganglion symptoms before surgery was 17.8 months (range, 6-72 months) | | |
|       | Measures:  
         • TFCC tears were classified using the Palmer system  
         • Obtained VAS pain scores and Mayo Wrist Scores (MWS) preoperatively and at 2 weeks, 6 weeks, 3 months, 6 months, 1 year, and annually thereafter postoperatively. | | |
Study design:  
Prospective case series | From January 2008 to June 2010, all patients referred to department for treatment of primary of recurrent wrist ganglions were included in the study. A ganglion was classified as recurrent if it had been previously treated by open surgery. Eligible | All ganglions were successfully resected. Overall, arthroscopy identified 22 TFCC lesions (48%) and 2 intracarpal ligament lesions. The TFCC perforations were more commonly associated with radiopalmar ganglions with a positive ulnocarpal stress test result and with recurrent radiopalmar ganglions. At 1-year follow-up, all | Appropriate and clearly focused question  
Cases and controls from comparable populations | Author conclusions: Arthroscopy allows for the simultaneous treatment of ganglions and other pathologies. Therefore, arthroscopy should be contemplated as the primary treatment option for patients |
**Objective:**
To prospectively determine the prevalence of associated triangular fibrocartilage complex (TFCC) lesions in patients with painful wrist ganglions.

**Number of participants:**
n=46

**Inclusion criteria:**
- All patients referred to participating department for treatment of primary or recurrent wrist ganglions
- Aged between 18 and 80 years
- Radiopalmar or dorsal wrist ganglions
- Painful ganglion; functional limitation
- MRI had to reveal a connection to the radiocarpal or dorsal midcarpal joint or to the scapholunate ligament

**Exclusion criteria:**
Patients were excluded if the ganglion arose from any other joint or had an intraosseous origin or if cosmetic aspects were the primary reason for treatment.

**Relevant characteristics:**
- 35 women, 11 men
- Mean age 36 ± 11y (range, 18-57y)

**Results:**
patients were meaningfully improved in terms of pain and disabilities in daily life.

**Quality assessment:**
- Same exclusion criteria for cases and controls
- Percentage of each group participated
- Comparison made between participants and non-participants
- Cases clearly defined and differentiated from controls
- Clearly established controls are non-cases
- Measures taken to prevent knowledge of primary exposure influencing case ascertainment
- Exposure status measured in a standard, valid and reliable way
- Main potential confounders are identified and taken into account
- Confidence intervals provided
- Quality of study in minimising risk of bias or confounding

**Conclusions:**
with painful ganglions of the wrist if they are in a radiopalmar location with a positive ulnocarpal stress test and for patients with recurrent radiopalmar ganglions, which are also highly associated with TFCC abnormalities.

**Reviewer comments:**
Low quality study due to study design. Study could not assess whether TFCC lesions are the underlying cause of wrist ganglions because patients included in study were having simultaneous arthroscopic treatment for ganglion and TFCC lesion.

**Level of evidence:** 3
### Burgess et al., 2010.


**Study design:** Prospective case control

**Objective:** To compare the prevalence of MRI-identified abnormalities in the wrists of symptomatic versus asymptomatic computer users; and to compare wrist range of motion between symptomatic and asymptomatic computer users.

<table>
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<td>Burgess et al., 2010.</td>
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<td><strong>Number of participants:</strong> n=24 (14 symptomatic computer users; 10 asymptomatic controls)</td>
<td>Extraosseous ganglions were identified in 66.6% of asymptomatic wrists and in 75% of symptomatic wrists. Intraosseous ganglions were identified in 45.8% of asymptomatic wrists and in 75% of symptomatic wrists, and were significantly (p &lt; .05) larger in the symptomatic wrists. Distal ECU tendon instability was identified in 58.4% of both asymptomatic and symptomatic wrists. Dominant wrist flexion was significantly greater in the asymptomatic group (68.8 ± 6.7 deg.) compared to the symptomatic group (60.7 ± 7.3 deg.), p &lt; .01. There was no significant correlation between wrist flexion and intraosseous ganglion burden (p = .09).</td>
<td>Clear evidence of association between exposure and outcome</td>
<td></td>
<td>Author conclusions: This study demonstrates that a variety of wrist abnormalities are common in computer users and that only intraosseous ganglions prevalence and size differed between asymptomatic and symptomatic wrists. Flexion was restricted in the dominant wrist of the symptomatic group, but the correlation between wrist flexion and intraosseous ganglion burden did not reach significance. Flexion restriction may be an indicator of increased joint loading, and identifying the cause may help to guide preventive and therapeutic interventions.</td>
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<td>was measured with an electrogoniometer.</td>
<td>The unadjusted incidence of volar wrist ganglions is 3.72 per 10,000 person-years (0.04%/y) in female civilian beneficiaries, 1.04 per 10,000 person years (0.01%/y) in male civilian beneficiaries, 7.98 per 10,000 person-years (0.08%/y) in female military personnel, and 3.73 per 10,000 person-years (0.04%/y) in male military personnel. When controlled for age, military personnel have a 2.5-times increased rate of volar wrist ganglions, and women have a 2.3-times increased rate. In the military cohort, female sex, branch of service, and seniority were</td>
<td>Measures taken to prevent knowledge of primary exposure influencing case ascertainment</td>
<td>wrist ganglions, but more generally on wrist abnormalities identified through MRI. Extraosseous ganglions were the most common abnormality identified in this study.</td>
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<td>Balazs et al, 2016.</td>
<td>The Journal of Hand Surgery 41(11): 1064-1070.</td>
<td>Study results directly applicable to patient group targeted</td>
<td>Y</td>
<td>Level of evidence: 2-</td>
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<tr>
<td>Study design: Retrospective case control</td>
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<td>Objective:</td>
<td>To identify the incidence and</td>
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<td>demographic factors associated with volar wrist ganglions in both military and civilian beneficiary populations.</td>
<td></td>
<td>significantly associated with the diagnosis of a volar wrist ganglion when controlled for age. In the civilian beneficiary cohort, only female sex was significant.</td>
<td></td>
<td>Reviewer comments: Low quality study design. Given this was retrospective and used patient records to identify wrist ganglions, study may be more susceptible to inaccurate diagnoses. Study focuses on incidence, and does not identify risk factors outside of sex and military service. <strong>Level of evidence: 2-</strong></td>
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Study results directly applicable to patient group targeted