Exploring the Link: Carpal Tunnel Syndrome Prevalence After Oophorectomy Systematic Review

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Abstract

Carpal tunnel syndrome (CTS) is a common neurological disorder associated with multiple risk factors. It manifests with pain, paresthesia, dysesthesia, and sensory loss in the first three fingers and the radial half of the fourth finger, which are supplied by the median nerve. Symptoms often worsen at night. Oophorectomy, the surgical removal of one or both ovaries, disrupts hormonal balance and poses risks to overall health, including cognitive impairment and an elevated susceptibility to CTS. This systematic review investigates the prevalence and relationship between bilateral oophorectomy and CTS. A systematic search of electronic databases, including PubMed, Web of Science, and Science Direct, was conducted to identify relevant studies about bilateral oophorectomy and CTS. Twenty studies met the inclusion criteria. Our findings indicate that bilateral oophorectomy increases the risk of developing CTS, with a 1.52-fold higher risk for de novo severe CTS, particularly post-surgery. Variables, such as low body mass index (BMI), nulliparity, and benign ovarian conditions, are linked to a higher risk compared to other groups. We analyzed four studies with varied methodologies, all suggesting a potential association between CTS and post-oophorectomy hormonal changes. Our systematic review shows a significant association between bilateral oophorectomy and an increased risk of developing CTS, particularly within the first year post-surgery. These results highlight the importance of heightened awareness and monitoring of CTS symptoms in women undergoing this procedure, especially those with additional risk factors, such as low BMI and nulliparity. Further research is warranted to elucidate the underlying mechanisms and develop targeted interventions.

Keywords: Systematic review, carpal tunnel syndrome, ovariectomies, women.

Introduction

Carpal tunnel syndrome (CTS) is the most common peripheral nerve entrapment syndrome caused by compression of the median nerve as it passes through the carpal tunnel, an anatomical compartment formed by the carpal bones and the flexor retinaculum [1,2,3]. It typically presents as gradual-onset tingling or numbness in the hand—particularly affecting the first three digits and the radial aspect of the fourth finger—with symptoms that often worsen at night [4,5]. Occupational factors play a significant role in the prevalence of CTS, with repetitive or forceful wrist movements common in certain professions; studies from Riyadh, for instance, have reported CTS symptoms in dentists [7] and teachers [8], while hairdressers and populations in regions like Hail and patients with type 2 diabetes or pregnant women also show considerable rates of the syndrome [6,9,10].

CTS is an idiopathic condition with multiple associated local and systemic risk factors, including genetic predisposition, inflammatory diseases, diabetes mellitus, hypothyroidism, obesity, and pregnancy. The incidence is higher in women, and type 1 diabetes poses an approximately 80% lifetime risk for symptomatic CTS, although the role of obesity remains somewhat inconsistent across studies [9-11]. Clinically, CTS can be acute or chronic—with chronic cases being more common—and its severity ranges from intermittent nocturnal paresthesia to advanced sensory loss, thenar muscle weakness, and atrophy that impair fine motor functions [1,12,13]. Various diagnostic tools, including sensory tests (such as pin sensation, monofilament, and two-point discrimination) and provocation maneuvers (Tinel's and Phalen's tests), assist in clinical assessment, despite variability in their reliability [12,14]. Palpation and targeted strength testing of the wrist and thenar eminence further support diagnosis [14].

Nerve conduction studies remain the gold standard for confirming CTS, offering high sensitivity and specificity by assessing the physiological status of the median nerve, while ultrasonography has become an increasingly reliable, low-cost extension of the clinical examination for visualizing the median nerve and associated anatomical anomalies [15-17]. Initial management of CTS emphasizes patient education and lifestyle modifications, though supporting evidence for these measures is limited; both non-surgical and surgical treatment options are discussed with patients [18-20]. Surgical decompression through transection of the transverse carpal ligament remains the most effective intervention. Various surgical approaches—including minimal, endoscopic, and open techniques—demonstrate comparable long-term outcomes, with studies noting differences in minor complications, recovery times, and transient nerve injuries [13,21–27,24]. Reported surgical complication rates vary, with severe complications being rare, yet the risk of complex regional pain syndrome (CRPS) remains a concern [28-31].

Non-surgical treatments include local corticosteroid injections, which have been shown to reduce both the need for surgery and symptom severity [32,33], as well as laser therapy and therapeutic ultrasound, which demonstrate efficacy in improving nerve conduction and reducing inflammation [34-37]. Musculoskeletal manipulation and wrist splinting are additional strategies aimed at reducing mechanical stress on the median nerve [38].

Furthermore, decreased estrogen levels following bilateral oophorectomy can increase the risk of CTS, particularly when the surgery occurs before menopause. This association is supported by studies linking estrogen deficiency with increased CTS risk, cognitive impairment, reduced sexual desire, and osteoporosis [39-43]. Given the varying incidence and multifactorial nature of CTS, especially in the context of bilateral oophorectomy, further research is warranted to clarify its risk factors and guide improvements in patient management and quality of life.

Methods

The studies included in this review were published in English, did not have a time frame, mentioned CTS as a complication, presented quantitative data for CTS in women, and were randomized controlled trials or cohort studies. We excluded any non-English publications, studies based on evaluation assessment, and those that did not discuss risk factors for CTS.

A systematic search was conducted across multiple electronic databases, including PubMed, Web of Science, ScienceDirect, CENTRAL, and Clinical.Gov, to identify studies examining the association between bilateral oophorectomy and CTS development. The search was conducted in December 2023, with filters set to include only English-language publications across all databases. For PubMed, we also used Medical Subject Headings (MeSH) to refine the results. The search strategy aimed to provide a comprehensive analysis of the relevant literature to ensure a thorough understanding of the relationship between bilateral oophorectomy and the emergence of CTS.

The initial search yielded 20 studies, which were narrowed down to 15 after removing duplicates. Seven of the 15 studies were selected based on the title and abstract by three researchers (M Alqahtani, AM, and AA) using the Rayyan software. Of the selected studies, only four met the inclusion criteria. Two studies were excluded due to inaccessibility [44,45]; one was not available in English, and another was not retrievable. The full text was assessed thereafter, with three researchers (M Alqahtani, AM, and AA) performing the screening and filing their findings in a shared Google docs sheet. One study was excluded due to a lack of access to the required text before the full-text screening [46], resulting in four studies that met both the inclusion and exclusion criteria [40,42,47,48] (Figure 1)

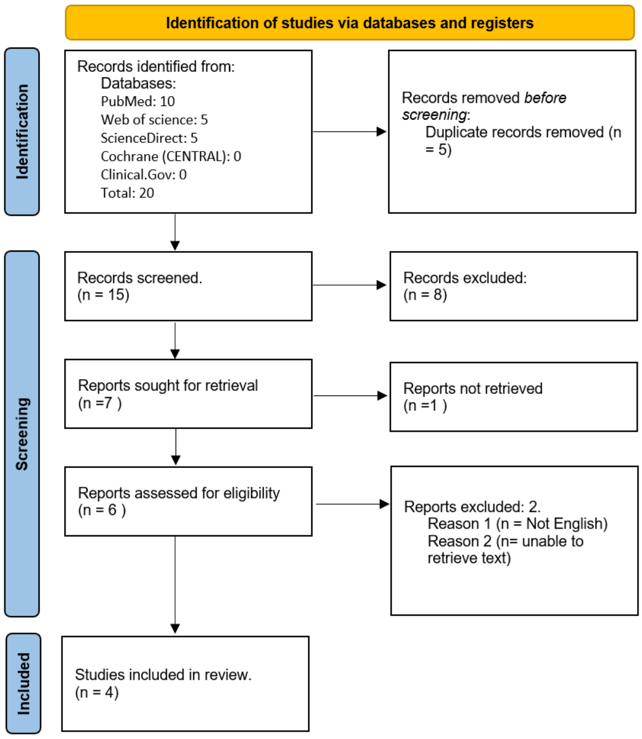

Figure 1. The PRISMA flow diagram outlines the process for identification, screening, and selection of studies included in this systematic review. This diagram conforms with the PRISMA guidelines that ensure clarity in reporting the study selection methodology.

The included articles were screened for bias using the Newcastle–Ottawa scale, which is used to assess the quality of nonrandomized studies, such as cohort studies.

Results of literature search

Table 1 presents the characteristics of the four included retrospective cohort studies [40,42,47,48]. The Table includes key aspects of each study, such as the study design, demographic characteristics, interventions, exposures, outcomes, and results. These elements provide a comprehensive overview of the methodologies and findings of the studies included in the present systematic review.

Table 1: Characteristics of the four studies reporting bilateral ovariectomies included in this systematic review.

Study design			Demographic characteristics			Exposure	Outcome(s)	Results			Conclusion	prevalence
First author	**Country/city**	**Study design**	**Sample size**	**Age (years)**	**Sex**	**Control**	**Primary**	**Data on Outcomes**	**OR (95% CI) - RR**	**P value**		
Starlinger et al., 2021 [40]	USA, Minnesota	Population-based cohort study	1,653 with bilateral oophorectomy and 1653 age-matched women	Range: ≤45–49	Women	Women who did not have oophorectomy matched for number and age	Increased risk of CTS after oophorectomy and differences in women with certain characteristics	Increased overall risk of de novo severe CTS after bilateral oophorectomy	Any type: 1.52 (95% CI 1.24–1.87); severe CTS: adjusted HR 1.65, 95% CI 1.20–2.25, ARI 4.0%	P<0.001	Bilateral oophorectomy prior to menopause was likely associated with the development of de novo severe CTS	Out of 1653 patients, 479 were diagnosed with CTS
Stevens et al., 1992 [42]	USA, Minnesota	Incidence cohort	1,016 patients (78.5% women)	Range: 45–54	Men (21.5%) and women (78.5%)	No control group	Not reported	In 39 women, onset of CTS symptoms months or years after bilateral oophorectomy(36 used oral contraceptives)	Not reported	Not reported	High incidence of CTS in perimenopausal women suggests that symptom development is likely associated with changes in ovarian function or use of exogenous estrogens	Out of 1016 patients with CTS 39 had bilateral oophorectomy
Björkqvist et al., 1977 [47]	Finland	Prospective cohort study	32 patients	Range: 36–54; mean: 47.1	Women	10 ovariectomized patients received estrogen; the other 10 did not receive any therapy	Whether maximal peripheral nerve conduction velocities change as a result of ovariectomy	Three of 32 patients developed CTS symptoms and electrophysiological signs within	Not reported	Not reported	Potential link between ovariectomy and CTS development, as indicated by the emergence of symptoms and	Out of 32 patients 3 developed CTS

								months post-surgery, suggesting a potential link between ovariectomy and syndrome onset. No significant differences between the groups that received therapy			electrophysiological signs in a subset of patients post-surgery	
Pascual et al., 1991 [48]	Spain	Retrospective case-control study	53 patients	Range: 36–44; mean: 40.43	Women	70 healthy menstruating women matched for age	Possible relationship of CTS with menopause and oophorectomy	17 of 53 women (32.07%) fulfilled the criteria for CTS	Relative risk for the oophorectomized group, 4.25; 95% CI 1.47–12.61	P<0.002	Increased incidence of CTS after oophorectomy; high CTS incidence in the first year post-surgery strengthens the relationship between the procedure and condition	Out of 53 oophorectomized women 17 Developed CTS

CTS, carpal tunnel syndrome; CI, confidence interval; HR, hazard ratio; RR, relative risk.

The methodological quality of the included studies was assessed using the Newcastle–Ottawa Scale, which evaluates studies based on eight items across four categories: selection, ascertainment, causality, and reporting. The scale scores range from 0 to 9, with scores of 7−9 indicating a high-quality study with a low risk of bias, scores of 4−6 indicating fair-quality studies with a moderate risk of bias, and scores of 0−3 indicating low-quality studies with a high risk of bias. Any studies rated as low quality would be excluded from the review. No studies were excluded after the screening (Table 2).

Table 2. Assessment of the risk of bias using the Newcastle–Ottawa scale [40,42,47,48]

Article	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Rating	Risk of Bias
Starlinger et al.[40]	*	*	*	*	**	*	*	*	High Quality Study (9)	Low risk
Stevens et al. [42]	*	*	No description	No description of the source	*	*	No	No designation	Moderate Quality Study (4)	Moderate risk
Björkqvist et al. [47]	*	*	No description	No description of the source	*	*	No	No designation	Moderate quality study (4)	Moderate risk
Pascual et al. [48]	*	*	*	*	*	*	*	*	High quality study (8)	Low risk

Selection: Q1, Representativeness of the exposure cohort; Q2, Selection of the non-exposure cohort; Q3, Ascertainment of exposure; Q4, Demonstration that outcome of interest was not present at the start of the study. **Comparability:** Q5, Comparability of the cohort based on the design or analysis **Outcome: Q6**, Assessment of outcome; Q7, Was follow-up long enough for outcomes to occur? Q8, Adequacy of follow-up of cohorts asterisks (*) means fulfilled the criteria.

Discussion

This systematic review aimed to provide an overview of CTS prevalence after bilateral oophorectomy. A recurring theme in multiple studies is that bilateral oophorectomy increases the risk of developing CTS, particularly in specific subgroups of women. In a population-based cohort study conducted in Minnesota in 2021, Starlinger et al. [40] found that women who underwent bilateral oophorectomy had a 1.52-fold higher risk of developing severe de novo CTS than matched controls. Women with lower BMI, nulliparous women, and those who underwent surgery for benign ovarian disorders were identified as being at the highest risk. The observed pattern suggests a potential hormonal link, as CTS may result from the sudden reduction in estrogen levels after oophorectomy. This temporal relationship between surgery and CTS onset mirrors perimenopausal hormonal fluctuations and is highlighted in studies that show a significant increase in CTS cases during the first year post-oophorectomy. Pascual et al. [48] conducted a retrospective case-control study in Spain in 1991, providing further evidence of this temporal association. Their study demonstrated that, compared to controls, women who underwent oophorectomy had a 4.25-fold higher incidence of CTS, with a particularly noticeable rise within the first year postoperatively.

Due to the complex nature of CTS, hormonal changes alone may not fully explain the elevated risk after oophorectomy. Numerous studies have demonstrated that chronic conditions, such as diabetes mellitus, rheumatoid arthritis, and prolonged occupational exposure to vibrations or repetitive hand movements, can also contribute to the development of CTS. Additionally, trauma, sprains, and wrist fractures are recognized risk factors. The observation that 39 women with CTS had a history of bilateral oophorectomy, with symptoms manifesting months or years after the surgery, as reported by Stevens et al. [42] in a 1992 incidence cohort study in Minnesota, suggests the potential long-term influence of both hormonal and non-hormonal factors. Furthermore, evidence linking a high incidence of CTS to pregnancy, a period of significant hormonal fluctuations, underscores the intricate interplay of multiple contributing factors.

The body of evidence emphasizes the need for further research, particularly since the therapeutic effect of estrogen in the management of CTS remains unclear. Björkqvist et al. [47] conducted a prospective cohort study in Finland in 1977 and found that three of the 32 women who underwent ovariectomies developed CTS symptoms within months of the procedure. However, no significant differences were observed based on estrogen therapy. Future research should focus on distinguishing between hormonal and non-hormonal variables and on examining their complex interactions. Additionally, investigating the efficacy of preventive measures and interventions should be prioritized to develop more efficient strategies for managing CTS. These efforts will help better identify patients at risk, reduce the need for invasive interventions, and provide appropriate counseling. This will ultimately improve our understanding of the relationship between oophorectomy and CTS and lead to enhanced patient care.

Conclusion

Several studies have attempted to explore the complex association between oophorectomy and CTS, but no definitive causal link has been established. Factors, such as small sample sizes and the absence of control groups in early studies, have limited our ability to draw firm conclusions. Additionally, confounding variables, such as the use of oral contraceptives, have further complicated efforts to identify a clear relationship. While recent studies have included larger sample sizes, their observational nature restricts the strength of the conclusions. Consequently, the present review has limitations despite aiming to comprehensively evaluate the topic. Key limitations in the present study include the inaccessibility of certain studies or databases, the exclusion of non-English publications, and reliance on titles and abstracts for screening. Future research should incorporate a broader range of databases and focus on larger, well-controlled studies using robust methodologies that account for multiple variables. Meta-analyses and systematic reviews will also be valuable in synthesizing the available evidence and addressing knowledge gaps. Such efforts are essential to improving our understanding of the potential relationship between oophorectomy and CTS and to informing future clinical practice.

This systematic review highlights a significant association between bilateral oophorectomy and an increased risk of developing CTS, particularly among women with lower BMI, nulliparity, and benign ovarian conditions. The evidence indicates that the risk is particularly elevated during the first year post-surgery, possibly due to abrupt hormonal changes, especially estrogen deficiency. This temporal relationship suggests a potential role for estrogen in the pathophysiology of CTS. However, it is important to acknowledge the multifactorial nature of CTS, which includes contributions from non-hormonal factors, such as pre-existing medical conditions and occupational exposures.

The studies reviewed present a consistent pattern, but limitations, such as small sample sizes, retrospective designs, and potential biases, must be acknowledged. The exclusion of non-English and inaccessible studies highlights the need for a more comprehensive search strategy in future research. Despite these limitations, the findings emphasize the importance of heightened vigilance and proactive management for women undergoing bilateral oophorectomy, particularly those with additional risk factors for CTS.

Future research should aim to clarify the complex interplay between hormonal and non-hormonal factors in CTS development and investigate the efficacy of preventive strategies, including hormone replacement therapy. This approach will enhance our understanding and improve the management of CTS in women post-oophorectomy, ultimately contributing to better patient outcomes and quality of life.

Disclosure

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