

Gender differences in 10746 open carpal tunnel releases – a national registry-based cohort study

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Abstract

Background Carpal tunnel syndrome (CTS) is more common in women than in men. We aimed to investigate gender differences in perceived symptoms and disability before and after open carpal tunnel release (OCTR).

Methods All (n=10746) OCTR's in the Swedish National Quality Register for Hand Surgery (HAKIR) between 2010 and 2016 were included. Outcome was assessed with QuickDASH (short form of Disabilities of Arm, Shoulder and Hand) and 8 symptom-specific questions at baseline and 3 and 12 months postoperatively.

Results There were 67% (7150/10746) women with a mean age of $55 \pm$ SD 17 years (men 59 ± 15 years). Preoperatively, women scored higher than men in QuickDASH (mean 54 ± 21 vs. 44 ± 21 ; $p < 0.0001$). Postoperatively, higher QuickDASH scores were found in women >45 years of age compared to their male counterparts. Pain on load and weakness were scored higher by women than by men at all three time points. In the linear regression analysis, QuickDASH scores were higher among women; 10.2 points (95% CI 8.8-11.6; $p < 0.0001$) preoperative, 6.4 (4.6-8.1; $p < 0.0001$) at 3 months postoperative and 5.7 (3.5-7.9; $p < 0.0001$) at 12 months postoperative, adjusted for age at surgery and diabetes. These differences disappeared when also adjusting for preoperative QuickDASH scores.

Conclusion Women with CTS treated with OCTR rate their disability and symptoms higher than men before surgery, and these differences persist in women above 45 years after surgery, indicating more residual symptoms. Gender differences should be considered when evaluating patients with CTS.

Introduction

Carpal tunnel syndrome (CTS) is common in the general population, with an estimated prevalence of 3-4% (1-3). Older age is a risk factor of both CTS and of worse results after open carpal tunnel release (OCTR) (1, 3-6). However, the influence of gender, especially among the elderly, is less clarified. In the general population, CTS is 1.4 times more common in women than in men, but among older individuals, the prevalence in women is almost four times that in men (3). Several studies have reported that women experience more discomfort and functional impairment before OCTR than men, whereas satisfaction after surgery seems to be independent of gender (7-11). Patients with diabetes experience more symptoms both before and after OCTR, but the relative improvement after surgery is similar to that for patients without diabetes (12, 13).

The National Quality Register for Hand Surgery in Sweden (HAKIR; hakir.se), was implemented in 2010 and provides conditions for large registry studies. Using data from HAKIR linked with data from the Swedish National Diabetes Registry (NDR; ndr.nu), the purpose of this study was to investigate age- and diabetes-adjusted patient-reported functional outcome and patient-rated symptoms, before and after OCTR, in men and women.

Methods

Study design and population

HAKIR has been described previously (12). Since 2010, all seven specialized hand surgery departments and two private units in Sweden register all performed operations on patients above 16 years. The patients provide informed consent prior to inclusion in the registry. Before surgery, 3 and 12 months postoperative the patients are asked to fill in the QuickDASH and HAKIR Questionnaire-8 (HQ-8), either by post or online. The validated, Swedish version of QuickDASH has previously been described in detail and is scored from 0 to 100, with a higher score indicating higher disability (14, 15). The HQ-8-questions consist of eight validated Likert scale-questions, assessing symptoms rather than functional disability (pain at rest, pain at motion without load, pain at load, stiffness, weakness, numbness/tingling, cold sensitivity and ability to perform daily activities) (16). The questions are scored from 0 to 100 in 10 points increments, with 0 indicating no symptoms and 100 indicating worst possible symptoms.

Between 2010 and 2016, patients \geq 18 years that had undergone OCTR due to primary CTS (KKÅ97 operation code ACC51 and ICD-10 diagnosis code G560) and were registered in HAKIR, were eligible for inclusion. OCTR was accepted for inclusion when the diagnosis code G560 was the primary or secondary but not as a tertiary diagnosis. Data on diabetes status was retrieved from NDR through personal identifying numbers. NDR is a digital, nationwide quality register that includes patients aged 18 and above with diabetes (17, 18). The register provides information on a wide range of diabetes-related parameters, previously described in detail (12, 19). Each patient provides informed consent for inclusion in the register.

Statistical methods

Continuous data is presented as means and standard deviations (SD). Non-parametric continuous data is presented as median and interquartile range [IQR]. When appropriate, 95% confidence interval (CI) was calculated. The changes in QuickDASH and HQ-8 scores between baseline and postoperative scores were analyzed with Mann-Whitney U test. Nominal data was compared using the Chi-squared test.

To assess the relationship between gender and disability, we performed multivariate linear regression analyses with QuickDASH score as the dependent variable and gender as the independent variable, adjusting for age at surgery (continuous variable), presence of diabetes (dichotomized as diabetes or non-diabetes) and preoperative QuickDASH score (continuous variable) at baseline, 3 months and 12 months. The change in QuickDASH between baseline and 12 months was additionally analyzed with age- and diabetes adjusted multivariate linear regression analyses.

To further explore the effect of age and gender, we divided the patients into three groups according to age; 18-44, 45-64 and \geq 65 years. Clinical factors were taken into consideration when the grouping was made; the risk of CTS increase during pregnancy as well as after menopause in women and is believed to be under the influence of hormonal changes (20-22). The youngest age group (18-44 years) includes

fertile women, whereas the middle age group (45-64 years) includes postmenopausal women. In Sweden, the normal age for retiring is 65 years, thus the age groups 18-44 years and 45-64 years include working age populations. Each included hand was treated as a separate statistical entity. IBM SPSS Statistics version 24 (SPSS Inc., Chicago, IL, USA) was used for all calculations. A p-value of <0.05 was considered statistically significant.

Ethics

This study has been approved by the Regional Ethical Review Boards in Lund, Sweden (2016/931 and Stockholm, Sweden (2017/2023-31).

Results

Study population

In total, 10770 OCTR were registered in HAKIR between 2010 and 2016. We excluded patients <18 years of age (n=22) and patients with incorrect data registration in HAKIR (n=2). Bilateral OCTR was performed in 1717 patients (578 men and 1139 women), with a mean time between the first and second surgery of 105 days (95% CI 98-113). Thus, the study population consisted of 10746 hands on 9029 patients, 67% (n=7150) were women with a mean age of 55± SD 17 years, and 3596 (33%) were men with a mean age of 59±15 years. In the youngest age group (18-44 years) there was no difference in the proportion of patients with diabetes between men and women, whereas in the older age groups diabetes was more common in men (Table 1).

Nonrespondents

Response rates for QuickDASH and HQ-8 were 3597/10746 (33%) cases at baseline, 2824/10010 (28%) at 3 months and 2037/8297 (25%) at 12 months.

There were no differences in gender distribution between responders and non-responders, but non-responders were slightly younger than responders [data already published, (12)]. There were no differences in the proportion of patients with diabetes between responders and non-responders (data not shown).

QuickDASH results

Women scored higher than men in QuickDASH at all time points (preoperative mean 54±21 vs. 44±21, 3 months postoperative 30±22 vs. 24±21 and 12 months postoperative 26±24 vs. 21±23; p-value all occasions <0.0001). This difference remained across all groups preoperatively when dividing the population by age (Table 1). There was no statistically significant difference between men and women among patients aged 18-44 years in the 3 months postoperative QuickDASH, whereas women scored higher than men among patients aged 45-64 years and ≥65 years of age (Table 1). The same results were seen at 12 months postoperatively (Table 1). Change in QuickDASH from preoperative to 12 months

postoperative only differed between men and women aged 45-64 years, where the change was larger (i.e. larger improvement) among women than men (Table 1).

HQ-8 results

In both men and women, numbness/tingling, pain on load and cold sensitivity were the most prominent symptoms before surgery (Table 2). Women scored higher than men on pain on load and on weakness at all three occasions (Table 2). Women also scored higher than men on pain on motion without load, numbness/tingling in fingers and ability to perform daily activities before surgery and at three months after surgery, but at 12 months after surgery no differences were found (Table 2). For pain at rest and stiffness, women scored higher than men preoperatively but there were no differences postoperatively (Table 2). For cold sensitivity, there was no gender difference preoperatively nor at 3 months postoperatively, but men scored higher than women at 12 months postoperatively (Table 2). HQ-8 scores in different age groups are illustrated in Figure 1.

Multivariate linear regression analysis

Being a woman predicted higher QuickDASH scores at baseline compared to being a man; 10.2 points (95% CI 8.8-11.6; $p < 0.0001$), as well as at 3 months postoperative; 6.4 (95% CI 4.6-8.1; $p < 0.0001$) and at 12 months postoperative; 5.7 (95% CI 3.5-7.9; $p < 0.0001$), adjusted for age at surgery and diabetes. However, when analyzing gender effects on the postoperative QuickDASH scores at 3 and 12 months, adjusting for age at surgery, diabetes and preoperative QuickDASH score, there were no differences between men and women; 0.45 (95% CI -1.7-2.6; $p = 0.69$) at 3 months and 0.06 (95% CI -2.7-2.8; $p = 0.97$) at 12 months. Female gender was associated with a larger improvement in QuickDASH scores from baseline to 12 months with 4.5 points (95% CI 1.4-7.5; $p = 0.005$). When adjusting for preoperative scores, this association disappeared (-0.06; 95% CI -2.8-2.7; $p = 0.97$).

Discussion

In this large register study of patients who underwent OCTR between 2010–2016, women rated their preoperative functional disability higher than men, irrespective of age and prevalence of diabetes. Women also rated their preoperative symptoms in terms of pain, weakness, stiffness and numbness/tingling higher than men.

Electrophysical data was not available for the study population and thus we do not know whether there were any gender differences in preoperative nerve conduction. However, in previous reports women reported more discomfort and symptoms related to CTS than men, although men had greater changes on preoperative neurography (7, 9, 23).

That women with CTS rate their disability and symptoms higher than men have previously been described, but not explained (8–11). Padua et al argued for a greater tolerance to carpal tunnel discomfort among men, whereas Greenslade et al pointed out that several questions in the patient-

reported outcome measures commonly used concern household chores, such as making beds and gardening, which more often are performed by women (9, 10). Another explanation could be that women wait longer to seek healthcare and thus have more discomfort at the time of seeking medical care.

In the present report, women above 45 years still rated their functional disability higher than men up to 12 months after surgery, whereas there was no gender-related difference in functional outcome among the younger patients. Hobby et al evaluated symptoms and functional disability with the Boston Carpal Tunnel Questionnaire (BCTQ) before and 6 months after surgery in 97 patients and found that women reported significantly worse preoperative symptoms and disability than men, but there was no difference in postoperative scores (8). Greenslade et al prospectively evaluated 57 patients and found higher preoperative DASH scores in women than in men, but no difference in functional disability 3 months after surgery (10). Age was not adjusted for in these reports.

Others have found that older age correspond to worse outcome after OCTR (6, 10). However, the possible effect of gender was not taken into consideration in these reports, and considering the gender distribution among the elderly with CTS, where women outnumber men, a confounding effect of age should be taken into account (3). Compared to previous studies, our large data material allowed for subgroup analyses according to age and gender and we found that there was a relationship between age and worse postoperative functional disability among women, but not among men.

The largest improvement in postoperative QuickDASH score occurred within 3 months after surgery, although there was a tendency for continued improvement up to 12 months after OCTR in our material. The significant difference in change in QuickDASH scores from baseline to 12 months between men and women adjusted for age and diabetes, disappeared after adjusting for preoperative QuickDASH score in the multivariate linear regression analyses, indicating that the overall relative improvement after OCTR was not dependent on gender or diabetes, but could be subject to a ceiling effect. However, when analyzing the subgroups, changes in QuickDASH score from baseline to 12 months were similar between men and women aged 18–44 and 65 and above, whereas the relative improvement in women aged 45–64 was significantly higher than in men. Changes in female sex hormones around menopause have been proposed to influence the high incidence of CTS among women (23). Kim et al observed an up-regulation of estrogen receptor alpha and beta (ER α and ER β) in the tenosynovial tissue of postmenopausal women with idiopathic CTS (24). In addition, Al-Rousan et al observed a protective effect of menopausal hormone therapy on the incidence of CTS among postmenopausal women (20). Mitake et al speculated that hormone-induced edema in the tenosynovium could increase the intra-carpal tunnel pressure in female patients, resulting in a less neurodegenerative pathogenesis compared to neuropathy seen for example in CTS patients with diabetes (23). If this is the case, an OCTR could be expected to be an efficient intervention in patients with edema-induced CTS and could partly explain the larger improvement in women around menopause, that we observed.

Women consequently scored their symptoms in terms of weakness and pain on load higher than men. It is possible that these variables are influenced by carpometacarpal I joint osteoarthritis, which is more

common in women than in men, particularly in the elderly (25). Hand osteoarthritis is also associated with prevalence of CTS (26). Concomitant hand conditions might affect the QuickDASH scores, since it is not a disease specific instrument. However, the study by Hobby et al (n = 97, 75 women) used the disease specific BCTQ and found no gender differences in postoperative score, although women scored their symptoms higher preoperatively (8). Greenslade et al assessed the responsiveness of the DASH questionnaire compared to BCTQ in patients with CTS and found DASH to be a reliable, responsive and practical outcome measure in patients with CTS (10). The normative QuickDASH values in the general population also differs according to age and gender, as pointed out by Aasheim et al (27). The normative values are higher among the elderly and among women (27). It is also debatable whether the seen differences between genders are clinically significant. Recently, the minimal clinically important difference (MCID) in QuickDASH for CTS was reported to be 10.4 points, hence our results are just slightly higher than the MCID (28). There is not yet an established MCID for HQ-8.

The main strength of this study is the large study population. The main limitation is the response rate. However, the response rate is similar to response rates of other large registries (29, 30), and the non-responders did not differ substantially from the responders in our material.

HAKIR contains no clinical information, and hence the only variable on concomitant disease that we could include, was diabetes. We did not have data on smoking status, obesity, thyroid disease, rheumatoid arthritis or other possible confounders.

Conclusions

In summary, women with CTS generally rated their functional disability and symptoms higher than men. Symptom resolution after OCTR was independent of gender among younger patients, but women above 45 years still rated their functional disability higher than men up to one year after surgery. Gender differences should be considered when evaluating patients before and after carpal tunnel release.

Abbreviations

BCTQ
Boston Carpal Tunnel Questionnaire
CI
Confidence interval
CTS
Carpal tunnel syndrome
DASH
Disability of Arm, Shoulder and Hand
HAKIR
Swedish National Quality Register for Hand Surgery
HQ-8

HAKIR Questionnaire-8
IQR
Interquartile range
MCID
Minimal clinical important difference
NDR
Swedish National Diabetes Registry
OCTR
Open carpal tunnel release
QuickDASH
Short form of Disabilities of Arm, Shoulder and Hand
SD
Standard deviation

Declarations

Ethics approval and consent to participate

The study protocol has been approved by the Regional Ethical Review Boards in Lund, Sweden (registration number 2016/931) and Stockholm, Sweden (registration number 2017/2023-31). All patients provide informed consent to participate in NDR and HAKIR. The study was conducted in accordance to the declaration of Helsinki.

Consent for publication

Not applicable.

Availability of data and materials

The datasets generated and analyzed in the current study are available in the HAKIR (www.hakir.se) and the NDR (www.ndr.nu) repositories.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

EB contributed to the interpretation of the data, drafting and revising of the manuscript. MZ contributed to the analysis, interpretation of the data and revising of the manuscript.

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Tables

Table 1. Comparison between men and women operated for CTS with OCTR divided into age groups.

		18-44 years			45-64 years			≥65 years		
		Men	Women	P-value	Men	Women	P-value	Men	Women	P-value
		(n=666)	(n=2016)		(n=1577)	(n=3177)		(n=1353)	(n=1957)	
Diabetes		53 (8)	140 (7)	0.38	272 (17)	334 (11)	<0.0001	333 (25)	377 (19)	<0.0001
n (%)										
QuickDASH	Preop	44±21	54±21	<0.0001	43±21	53±21	<0.0001	45±21	56±21	<0.0001
	Mean ±SD	(n=230)	(n=629)		(n=545)	(n=1123)		(n=469)	(n=601)	
	3m postop	21±18	26±21	0.08	25±21	29±22	0.001	25±22	33±23	<0.0001
		(n=107)	(n=401)		(n=392)	(n=831)		(n=437)	(n=656)	
	12m postop	19±23	22±22	0.1	21±23	24±24	0.04	21±23	30±24	<0.0001
		(n=769)	(n=299)		(n=258)	(n=590)		(n=319)	(n=495)	
Change in	0-12 months	26±24	29±21	0.4	21±19	29±21	0.002	23±24	25±22	0.5
		(n=29)	(n=131)		(n=109)	(n=262)		(n=145)	(n=219)	
	Mean±SD									

Numbers presented as n (%) or mean±SD as stated. CTS; carpal tunnel syndrome, OCTR; open carpal tunnel release, SD; standard deviation

Table 2. HAKIR Questionnaire-8 (HQ-8) results in men and in women operated for CTS with OCTR.

All numbers presented as median [interquartile range]. CTS; carpal tunnel syndrome, HQ; HAKIR questionnaire, IQR; interquartile range, OCTR; open carpal tunnel release

		Men*	Women**	P-value
HQ-1 Pain on load median [IQR]	Preop	50 [15-70]	60 [30-80]	<0.0001
	3 m postop	26 [10-50]	30 [10-53]	0.03
	12 m postop	10 [0-30]	20 [0-40]	0.01
HQ-2 Pain on motion without load median [IQR]	Preop	30 [10-50]	40 [13-60]	<0.0001
	3 m postop	10 [0-20]	10 [0-30]	0.006
	12 m postop	1 [0-20]	2 [0-20]	0.5
HQ-3 Pain at rest median [IQR]	Preop	40 [10-63]	50 [20-70]	<0.0001
	3 m postop	3 [0-20]	3 [0-20]	0.6
	12 m postop	1 [0-18]	1 [0-20]	0.7
HQ-4 Stiffness median [IQR]	Preop	30 [10-60]	40 [10-61]	0.004
	3 m postop	13 [1-36]	12 [1-34]	0.6
	12 m postop	10 [0-30]	10 [0-30]	0.5
HQ-5 Weakness median [IQR]	Preop	40 [17-70]	54 [30-76]	<0.0001
	3 m postop	20 [10-50]	30 [10-50]	<0.0001
	12 m postop	10 [0-40]	20 [1-41]	<0.0001
HQ-6 Numbness/tingling in fingers median [IQR]	Preop	71 [57-90]	80 [64-90]	<0.0001
	3 m postop	10 [0-30]	3 [0-30]	0.001
	12 m postop	10 [0-40]	7 [0-30]	0.05
HQ-7 Cold sensitivity median [IQR]	Preop	50 [10-78]	50 [10-79]	0.9
	3 m postop	7 [0-30]	3 [0-30]	0.06
	12 m postop	10 [0-40]	2 [0-30]	0.01
HQ-8 Ability to perform daily activities median [IQR]	Preop	50 [20-70]	55 [30-77]	<0.0001
	3 m postop	10 [0-36]	19 [1-40]	0.005
	12 m postop	3 [0-30]	10 [0-30]	0.05

*Men (preoperative n=1237, at 3 months n=939 and at 12 months n=662)

**Women (preoperative n=2366, at 3 months n=1923 and at 12 months n=1421)

Figures

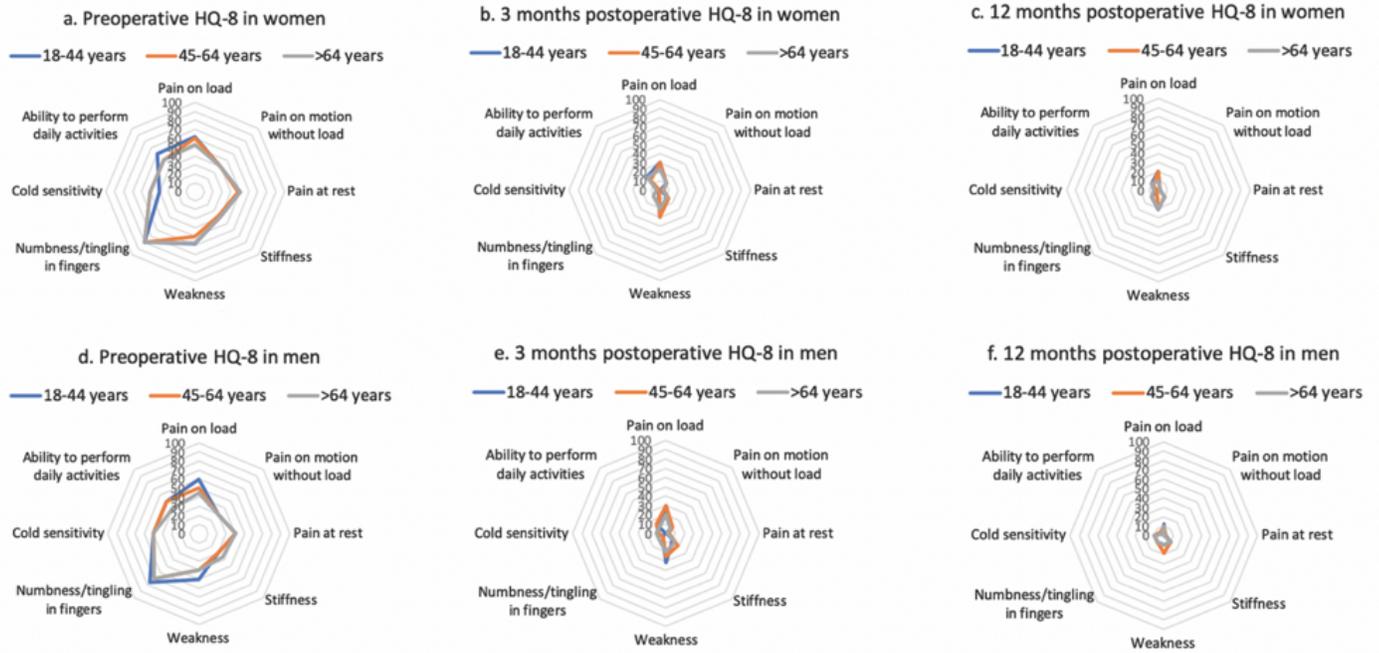


Figure 1

HAKIR questionnaire-8 (HQ-8) results in women (a-c) and men (d-f) operated for carpal tunnel syndrome with open carpal tunnel release, divided into age groups (18-44 years, 45-64 years and >64 years) preoperatively and at 3 and 12 months postoperatively.