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The Professional Future in Operated Carpal Tunnel Syndrome: A Cross-Sectional Study of Recognized Occupational Cases

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Abstract

Background: *Carpal tunnel syndrome (CTS) is frequently present among workers. This syndrome's professional and economic impact makes it a priority in occupational health. We aimed to describe the professional future of workers suffering from occupational CTS after surgery and the factors that could influence their retention at the job.* **Methods:** *A retrospective descriptive study of workers operated on occupational CTS was conducted from 2014 to 2019. The data was collected using pre-established and phone questionnaires to determine their professional future after surgery.* **Results:** *We included 99 workers with operated CTS. They had a mean age of 45±6.5 years, were predominantly female (97%), and had two dependent children in 72.7% of cases. They worked as a seamstress in 44.4% of patients with a mean professional seniority of 18±7.2 years. The professional future was a return to work with a job transfer at 44.4% and job maintenance with ergonomic adjustments at 39.4%. A job loss was noticed in 12.2% of cases. Early retirement was noticed in 8.2%, dismissal in 3%, and resignation in 1% of cases. The factors influencing the professional future were age 50 to 59 years (p=0.01) and dependent children (p=0.02).* **Conclusions:** *In our survey, most operated-CTS workers benefited from a job transfer and kept their job with ergonomic adjustments to their work conditions. Therefore, interventions aiming to improve the professional future of workers operated on CTS by ensuring sufficient staff and adjusting workplaces are needed.*

1. Introduction

Carpal tunnel syndrome (CTS) is the most common peripheral nerve entrapment syndrome frequently present among workers [1]. This syndrome is a major musculoskeletal disorder (MSD) of the upper limbs, leading to harmful adverse effects on workers' health and a high absenteeism rate. The impact of this disease, in terms of disruption of career and economic costs, makes it a priority of health at work [2]. However, there are few epidemiological studies of the prevalence of CTS in Tunisia, and there are mainly case series studies of work-related CTS [3-7]. The pathogenesis of this syndrome is the result of several factors, which are represented primarily by occupational constraints requiring to work in an «assembly line» or a «set pace,» which often makes the worker perform stereotyped and monotonous activities, repetitive movements, carrying heavy loads, and without sufficient rest breaks, linked with individual factors [8]. Therapeutic options are medical in moderate CTS forms and surgical in severe or drug-resistant forms. Moreover, even after suitable medical or surgical treatment,

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the patient may still have functional sequelae which limit his professional skills and cause a problem of professional integration and especially a problem of job retention.

We aimed to describe the professional future of workers suffering from occupational CTS after surgical treatment and the factors that could influence their retention at the job.

2. Methods

2.1. Study Design

It was a cross-sectional retrospective descriptive study that concerned patients with CTS treated surgically and recognized as an occupational disease for six years, from January 1st, 2014, to December 31st, 2019.

2.2. Settings

Data were collected at the National Health Insurance Fund (NHIF) head office in Tunis, where the northern committee for recognizing occupational diseases is. Data collection was based on a pre-established questionnaire. Patients operated on CTS have been identified from a database including all the recognized occupational cases of CTS (operated and non-operated ones) since 2014 and from medical records. An additional phone survey was needed to identify operated patients, specify the decision for medical fitness to work and complete the missing data.

2.3. Participants

During the study period, workers who were operated on CTS recognized as an occupational disease and accepted to answer the questionnaire were included. Workers not operated on or operated on after the study period were excluded. Workers not reached by phone and those who refused to answer the questionnaire were excluded.

2.4. Variables and Data Sources

The questionnaire included four sections on socio-demographic characteristics (age, gender, school level, marital status, dependent children), occupational characteristics (job category, workstation, occupational qualifications, professional seniority in the company, biomechanical occupational constraints, the time before resuming work after surgery) and medical characteristics (medical history, CTS characteristics especially the site, the onset and the evolution of symptoms before surgery, the severity of the disease, the association with other MSD, the postoperative course, and the practice of functional rehabilitation) as well as the assessment of professional outcomes. Participation in the phone survey was voluntary, and anonymity was respected. The administration of the questionnaire by phone could generate reporting bias. Coverage error in phone samples could explain the selection bias and underestimation of the target population.

2.5. Statistical Methods

Data were analyzed using the SPSS 19.0 software. Absolute frequencies and relative frequencies (percentages) were calculated for qualitative variables. Averages, medians, and standard deviations were measured, and extreme values were determined for quantitative variables. The Chi-square test was used to compare percentages of independent series. The two-interval Fischer exact test was used for nominal variables. In all statistical tests, the significance level was set at 0.05.

3. Results

3.1. Participants

During the study period, 99 workers operated on CTS recognized as an occupational disease and reachable by phone were included among 320 recognized cases (operated and non-operated on). Among the initial workforce, 125 patients were unreachable, 90 were not operated on CTS, four had surgery in 2020, and two refused to answer the questionnaire. The flow chart explaining the study population is shown in Figure 1.

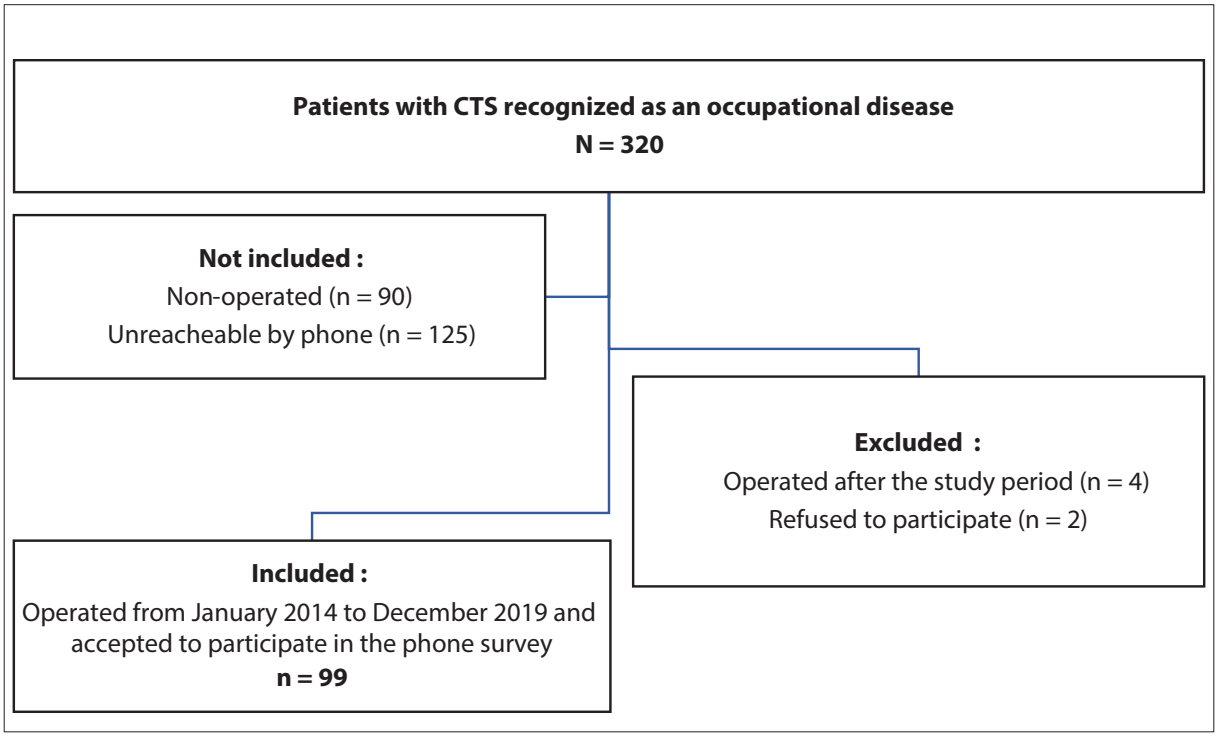

Figure 1. Flow chart of the study population.

3.2. Descriptive Data

3.2.1. Socio-demographic Characteristics

The mean age was 45±6.5 years old, ranging from 31 to 58 years. The 40-49 age range was the most represented (n=56; 56.6%). Our subjects were female (n=96; 97%), with a sex ratio M/F of 0.03. Eighty-six percent of our patients were married, and 72.7 % had at least two dependent children. The educational level was primary in 49.5% and secondary school in 47.5% of cases.

3.2.2. Occupational Characteristics

The socio-demographic and occupational characteristics of the population are shown in Table 1.

CTS was observed in the textile and clothing sector in 52.5% of the cases, followed by the electrical and leather industries in 25.3% and 13.3%, respectively.

The workstation was mainly of a seamstress (n=44; 44.4%), multi-skilled worker (n=24; 24.3%), and packing station (n=16; 16.2%). One dentist and 98 factory workers represented our population. They were qualified workers in 46.5% of cases. The mean job tenure was 20.1± 6.8 years, ranging from 6 to 38 years. The mean job tenure in the workstation, which caused CTS, was 18±7.2 years [5, 32]. Repetitive movements were noticed as the primary occupational constraint among all our included cases, followed by carrying heavy loads in 62.6% of the patients, as shown in Table 1.

3.2.3. Medical Characteristics

Personal medical history of obesity, hypothyroidism, hypertension, and diabetes has been found in 25.3%, 10.1%, 9.1%, and 6.1% of cases, respectively. Another MSD in the same upper limb combined with CTS was found in three workers. Two of them had shoulder tendinopathy, and one had epicondylitis.

Table 1. Socio-demographic and occupational characteristics of the population (n=99).

Variables	n. (%)
Age range, years	
30-39	22 (22.2)
40-49	56 (56.6)
50-59	21(21.2)
Gender	
Female	96 (97)
Male	3 (3)
Marital status	
Single	5 (5.1)
Married	86 (86.9)
Divorced	8 (8.1)
Dependents children	
0	20 (20.2)
1	7 (7.1)
>=2	72 (72.7)
Educational level	
Primary	49 (49.5)
Secondary	47 (47.5)
University	3 (3)
Sector of activity	
Textile and clothing	52 (52.5)
Electrical industry	25 (25.3)
Leather industry	13 (13.3)
Other	9 (8.9)
Job category	
Factory worker	98 (99)
Dentist	1 (1)
Workstation	
Seamstress	44 (44.4)
Multi-skills	24 (24.3)
Packing station	16 (16.2)
Quality control	7 (7.1)
Head of unit	4 (4)
Pressing	3 (3)
Dentist	1 (1)
Occupational qualification	
Qualified	46 (46.5)
Not qualified	53 (53.5)
Biomechanical occupational constraints	
Repetitive movements	99 (100)
Carrying heavy loads	62 (62.6)
Awkward postures	80 (80.8)
Prolonged pressure on the carpal tunnel	76 (76.8)

The CTS was bilateral in 70.7% of the cases, and 82.8% of the unilateral cases (24 out of the 29 patients) affected the dominant hand. The damage of CTS was severe in 19.2%, moderate in 13.1% of the cases, and not specified for the remaining cases. The identified symptoms were mainly paresthesia, pain, muscular weakness, and hypoesthesia in 89.9%, 68.7%, 58.6%, and 37.4% of the cases, as shown in Table 2. The average duration of symptoms progression before surgery was 3.3±3.03 years

Table 2. Medical characteristics of the population (n=99).

Variables	n. (%)
Medical history	
Diabetes	6 (6.1)
Hypertension	9 (9.1)
Obesity	25 (25.3)
Dysthyroidism	10 (10.1)
Others	17 (17.3)
CTS site	
Unilateral	29 (29.3)
Bilateral	70 (70.7)
In Dominant hand	94 (94.9)
CTS severity	
Moderate	13 (13.1)
Severe	19 (19.2)
Not mentioned	67 (67.7)
CTS symptoms	
Paresthesia	89 (89.9)
Pain	68 (68.7)
Muscular weakness	58 (58.6)
Hypoesthesia	37 (37.4)
Positive Tinel's and Phalen's tests	72 (72.7)
Associated MSD	
Shoulder tendinitis	2 (2)
Epicondylitis	1 (1)
Back and neck pain	6 (6.1)
Other	1 (1)
CTS hand surgery	
Unilateral	71 (71.7)
Simultaneous in both hands	27 (27.3)
Simultaneous with other MSD	2 (2)
Evolution of symptoms after surgery	
Complete resolution	35 (35.4)
Recurrence	26 (26.3)
Partial improvement	39 (39.4)
No improvement	25 (25.2)

with extremes from 3 months to 18 years. The hand surgery was unilateral in 71.7% of the cases. It was simultaneous in both hands in 27.3% and concurrent with another MSD in 2% of the cases.

Among participants, 7% reported postoperative wound infection. The evolution of the symptoms was favorable, with a complete resolution of symptoms in 35.4% of the cases within 8.4 months on average (a minimum of seven days and a maximum period of 36 months). A recurrence of symptoms was noticed in 26.3% of the cases within 10.6 months on average after surgery. Further surgery was indicated for one patient among the recurrent cases. A partial improvement of the symptoms was noticed in 39.4% and no improvement in 25.2% of the cases. Functional rehabilitation was done in 60.6% of the cases and immediately after surgery for 49.5%. The average time before returning to work after surgery was 3.36 months (from 1 to 24).

3.2.4. Professional Future

The professional future of the workers after returning to work following CTS surgery is given in Table 3. Our participants benefited from a job transfer in 44.4% of cases. Job maintenance at the same workplace with ergonomic adjustment has been implemented in 39.4% of patients, and 4% of the workers retained their job without workstation adjustment. A job loss was noticed in 12.2% of cases**.** Understaffing and the lack of suitable workstations were the main reasons for job maintenance at the same workplace without ergonomic interventions.

3.3. Other Analyses

When looking at the factors that can influence the professional future, we found that being 50 to 59 was significantly higher among workers who lost their jobs (58% of the job losses, p=0.01) than those who kept their jobs. The frequency of workers with at least two dependent children was significantly greater in the group retained at their jobs (p=0.02). Among the twelve workers who have lost their j12.2%), CTS was bilateral in eight patients who experienced symptom progression for over two years of evolution and was favorable in only three cases. In three cases, work was resumed within three months after surgery. However, no significant relationship was found between the professional future and patients' occupational or medical characteristics.

4. Discussion

4.1. Key Results

We identified in this study the recognized occupational cases of operated CTS, and we noticed an important rate of workers who kept their jobs after the surgery. The professional future was mainly a return to work with a job transfer at 44.4% and job maintenance with ergonomic adjustment at 39.4%. A job loss was noticed in 12.2% of cases. Early retirement was noticed in 8.2%, dismissal in 3%, and resignation from work in 1% of cases. The factors influencing the professional future were age 50 to 59 years (p=0.01) and dependent children (p=0.02).

Table 3. The professional future of the workers operated on occupational CTS (n=99).

Professional future	**n. (%)**
Return to work with a job transfer	44 (44.4)%
Job maintenance at the same workplace with ergonomic adjustment	39 (39.4)%
Job maintenance at the same workplace without ergonomic adjustment	4 (4)%
Resignation	1 (1)%
Early retirement	8 (8.2)%
Dismissal	3 (3)%

4.2. Interpretation

This study included a middle-aged population (45±6.5 years old), mainly in the 40-49 age range, and predominantly female, having at least two dependent children. As for the level of education, most of the participants had primary and secondary education. They mainly worked in the textile industry. A medical history of obesity, hypothyroidism, High blood pressure, and diabetes was found.

Our population's characteristics were similar to those found in previous studies among operated and non-operated CTS patients. Our results matched with those of a Tunisian study, including 106 patients suffering from CTS and treated by surgery [4]. Indeed, it has been reported in a case-control study on individual risk factors of carpal tunnel syndrome by Guan et al. that age is a risk factor for developing CTS [9]. Considering gender as a risk factor, female predominance has also been reported in previous studies [4, 10]. Women with CTS were likely to have moderate manual work, and men with CTS were likely to work in offices [10]. In this line, according to a national survey about occupational exposures in Tunisia between 2009 and 2013, the "gesture" constraints have been mostly found among women in 75.5% of cases [11]. Concerning the educational level, according to a case-control study led in India, it has been reported that the educational level was considered a CTS risk factor [12]. It is explained by the fact that low school-level workers are often regarded as unskilled workers and are more exposed at their workstations to postural constraints, resulting in MSD. According to previous studies, the textile and clothing sector is the largest source of occupational CTS [4, 9]. This sector, one of the foundations of the Tunisian economy and employability, exposes workers to many biomechanical risk factors of CTS. These factors are mainly working on assembly lines and having repetitive movements [8]. Concerning medical affections as risk factors for CTS, the results of a study by Guan W et al. [9] showed that wrist injury, diabetes mellitus, and hypothyroidism are all risk factors of CTS and that hypertension could be a protective factor in an early stage of CTS. In a study by Roquelaure et al. [13], diabetes mellitus and obesity were twice more frequent among CTS cases than in the general population. Unfortunately, in our study no, medical condition was found as a key factor in the professional future of workers with CTS.

As for the professional future, 44.4% of our participants benefited from a job transfer, and 39% kept their work position by adjusting their work conditions. A job loss was noticed in 12.2% of cases, and 4% of the workers retained their job without ergonomic adjustment. According to a study by Kho et al., 89% of patients returned to full-time work after surgery [14]. Parot et al. showed that 90 % of patients resumed their job after surgery when their study timeline [15]. According to Aloui et al., job loss has been observed in 9.6% of cases, whereas 26.5% of patients had kept the same positions [6]. Moreover, another Tunisian study found nearly the same job loss rates [7].

Furthermore, by studying the factors that could influence the professional future, we found that being 50 to 59 was significantly higher among workers who lost their jobs (58 % of the job losses, p=0.01) compared to those who kept their jobs. The same results have been found in a Tunisian study in which job loss was linked to age [11]. In another study, job loss has been significantly linked to age over 43 years (p=0.042) and marital status [6]. Also, according to Samson, the quality of recovery after a CTS surgery depends on the patient's age [16]. The health deterioration in old workers could explain these findings, the decline in functional abilities, and the physical weakening related to high physical demands at work. Another factor that may influence our study's professional future was having at least two dependent children, which was significantly greater in the group who have retained their jobs (p=0.02). The increase in job retention with the presence of dependent children could be explained by the fact that these workers would rather keep their jobs to support their children.

Except for these two socio-demographic factors, no occupational or medical characteristic was found as a key factor in the professional future. Other factors were found in the literature. In a study by Parot et al., the results have shown that the concomitant presence of multiple MSDs and at least a simultaneous surgical operation on another MSD of the upper limb relate to a poorer prognosis in terms of

resuming work [15]. This issue has not been raised in our study, probably because of the limited number of patients with another MSD on the upper limb.

According to the same study, the executives had a better professional prognosis than the less qualified workers [15]. Another study has also identified the professional qualifications and the electromyogram data as factors influencing the professional future of workers who had a CTS operation [4]. The lack of a significant relationship between professional future and professional qualifications in our study could be explained by the fact that our participants were almost workers in the same occupational category. Among the reasons identified as a difficulty for workstation adjustments, the lack of suitable work positions, and the understaffing were found in our series. Difficulties of professional rehabilitation in the sectors where manual work is needed, such as the textile and clothing industry, could be the reason for job loss. Another reason that could explain these professional outcomes is the educational level of the workers; most of the workers had a low level of education and for whom job training would be difficult. Indeed, the reasons for delayed return to work after CTS surgery were inconsistent in the literature. In the study by Mahfoudh et al. [4], the occupational future of the operated workers was correlated with the professional qualification and the type of sensory and/or motor damage median nerve on electromyogram. Whilean in the study by Kho et al. [14], job type, motor nerve conduction velocity, and bilateral surgery were not predictive of delayed return to work interval after CTS surgery. Unfortunately, no occupational factor was associated in our results with the professional future after CTS surgery.

According to Samson, the quality of recovery after surgery depends on the age of the median nerve compression [16]. A delay in treatment could cause a negative post-operational evolution which could impact the professional future [17]. This evolution, characterized by an incomplete improvement of symptoms, was linked to delayed surgical treatment [18] and hard manual work [19] and was observed the most among patients with diabetes [20, 21].

According to our study, nce the professional future. Unfor influence the professional futuretunately, these are non-modifiable factors. However, it can be considered that the professional future of operated-CTS workers can be influenced by work conditions and the lack of ergonomic interventions at the workstation leading to job loss. Indeed, re-exposure to the same work constraints after returning to work could represent a factor of poor prognosis, both for the individual and for the company, in terms of impaired quality of life, lower productivity, and absenteeism. The collaboration between the actors in the prevention of health and safety at work for an adapted reintegration and retention at job of operated-CTS workers appears necessary.

4.3. Limitations

We must point out some limitations of our study, such as its retrospective design, the lack of completeness of information in the database, reporting bias during the phone surveys, and the high rate of unreachable patients by phone. Thus, a larger number of operated cases could have been included. The study's cross-sectional nature also prevented a long-term follow-up. Therefore, these limitations should be considered in the interpretation of our data. Longitudinal and analytical studies could help to assess the role of work-related risk factors on the professional future of workers with CTS and to limit inclusion bias due to the voluntary nature of the study.

4.4. Generalizability

In our study, we assessed the professional future of workers suffering from occupational CTS after surgical treatment and the factors that could influence their retention at the job. We can conclude that CTS has a significant professional impact, including job loss and retention at a job without ergonomic adjustments. The sampled population and selection criteria limit the generalizability of our results. Longitudinal studies would be needed to establish the causal relationship between professional risk factors and the professional future of the workers operating on CTS.

5. Conclusion

In our survey, most of the operated-CTS workers benefited from a job transfer and kept their work

with the ergonomic adjustment of their work conditions. However, non-negligible rates of job loss and job retention without workstation arrangements were found. Given the lack of suitable workplaces for those who lost their jobs, interventions aiming to improve the professional future of workers operated on CTS by ensuring sufficient staff and adjusting workplaces are needed. Each company should elaborate its preventive measures based on analyzing work conditions to ensure a suitable rehabilitation program for workers suffering from CTS.

Informed Consent Statement: Informed consent was obtained from all subjects.

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Declaration of Interest: The authors declare no conflict of interest.

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