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Case reports

Occupational carpal tunnel syndrome: clinical insights from a case report

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Abstract

Carpal Tunnel Syndrome (CTS) has emerged as a growing health concern among workers involved in occupations requiring repetitive and precision-based activities. Within the framework of the modern industrial economy, many professions encompass these characteristics, contributing to a notable prevalence of CTS across various occupational sectors. The impact of CTS extends beyond reduced workplace productivity, significantly impairing the quality of life of affected individuals and imposing economic challenges on both employees and employers.

This study presents the case of a 43-year-old female textile assembler, highlighting the risk factors contributing to the onset of the condition, the individualized therapeutic interventions employed, and the long-term progression of the disease. The analysis further investigates effective occupational management strategies aimed at minimizing the burden of CTS. Postoperative management revealed several complications, leading to work-related disability with substantial economic and social ramifications for both the employee and the

employer. This case emphasizes the critical need for comprehensive strategies to address the occupational risks and consequences associated with CTS.

Keywords: *occupational health, carpal tunnel syndrome, repetitive strain injury, workplace ergonomics, occupational disease management*

Introduction

Carpal Tunnel Syndrome (CTS) is a widespread condition with profound functional and psychological impacts on affected individuals. In addition to its immediate effects, CTS may lead to anatomical and physiological changes, either as a direct consequence of the condition or following therapeutic and reparative surgical interventions [1].

In recent years, the prevalence of CTS has risen significantly, particularly among workers in industrial sectors characterized by repetitive tasks and fine motor activities, such as computer work and assembly line operations. This trend reflects the increasing burden of CTS on a variety of professional activities, with notable implications for workplace productivity and work quality [2].

The primary cause of CTS is the compression of the median nerve within the carpal tunnel, resulting in symptoms such as numbness, tingling, pain, and weakness in the areas innervated by the nerve. These typically include the thumb, index finger, middle finger, and the lateral aspect of the ring finger [3,4]. In the United States, approximately 3% of adults are estimated to be affected by CTS, underscoring its significance as both a medical and occupational health issue [5].

Case presentation

This case of Carpal Tunnel Syndrome (CTS) is presented since it exemplifies the typical characteristics of the condition, encompassing clinical symptomatology, the occupational environment requiring fine and repetitive motor tasks, its impact on the patient's quality of life, treatment outcomes, and associated complications.

The patient, a 43-year-old woman, was admitted to the Occupational Medicine Clinic in October 2024. She has 12 years of professional experience as a textile assembler and is employed at a knitting factory, where her work involves repetitive fine motor tasks. Her job primarily entails operating a circular knitting machine used to assemble textile components such as sleeves, shoulders, and cuffs. Knitting, a technological process in which yarns are transformed into loops to create fabric, can be executed in one, two, or three stages, with single-phase operations being common for large-diameter circular machines.

The patient's working posture is predominantly seated, with one foot operating a pedal to control the circular machine. To avoid skipped loops, stitch damage, or the fabric slipping off the needles, she must ensure the correct positioning of the yarn guides. This task frequently necessitates adopting an improper cervical spine posture to align and guide the textile components effectively.

The onset of symptoms occurred approximately two years before admission, manifesting as distal paresthesia in the upper limbs, nocturnal pain, and difficulties in gripping and holding objects. These symptoms significantly affected her performance at work as well as her ability to manage household activities. She underwent outpatient investigations, including soft tissue ultrasound and electromyography (EMG), which confirmed the necessity for surgical intervention.

In May 2023, she underwent surgical decompression of the carpal tunnel on her right hand, followed by the same procedure on her left hand in July 2023.

Investigations

Electroneuromyography (performed in February 2023): Motor stimulation produced responses with normal distal latencies and amplitudes, except for the left median nerve, which exhibited a slightly reduced amplitude compared to the normal range. Conduction velocities (CVN) remained within normal parameters. Sensory responses were also normal, with the exception of the left median nerve, where no response was detected, and the right median nerve, which showed responses below the normal threshold (Table 1 and Table 2).

Diagnosis: The results are indicative of a cervical preganglionic lesion accompanied by left carpal tunnel syndrome.

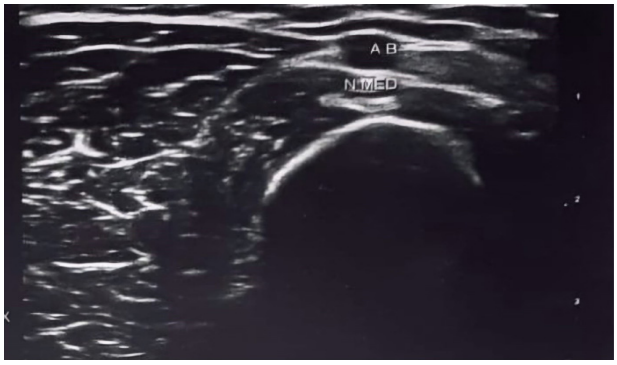
Table 1. Motor Nerve Conduction Study

Nerve/ Sites	Muscle	Latency ms	Amplitude mV	Segments	Dist. cm	Lat Diff ms	Velocity m/s
L Median – APB							
Wrist	APB	4.13	4.1	Wrist - APB	8		
Elbow	APB	7.25	4.5	Elbow - Wrist	19	3.13	60.8
R MEDIAN – APB							
Wrist	APB	3.67	8.8	Wrist - APB	8		
Elbow	APB	7.08	8.6	Elbow - Wrist		3.42	
L Ulnar – ADM							
Wrist	ADM	2.15	10.1	Wrist - ADM	8		
B.Elbow	ADM	5.13	10.2	B.Elbow - Wrist	23	2.98	77.2
A.Elbow	ADM		10.0	A.Elbow-B. Elbow	14	1.75	80.0
R Ulnar – ADM							
Wrist	ADM	2.25	9.2	Wrist - ADM	8		
B.Elbow	ADM	5.56	9.0	B.Elbow - Wrist	21	3.31	63.4
A.Elbow	ADM	6.96	8.5	A.Elbow-B. Elbow	13	1.40	93.1

Table 2. Sensory Nerve Conduction Study

Nerve/ Sites	Rec. Site	Onset Lat ms	Peak lat ms	NP Amp µV	PP Amp µV	Segments	Distance cm	Velocity m/s
R Median - Dig II (Antidromic)								
Wrist	Index	3.33	4.22	8.4	12.4	Wrist - Index	14	42
L MEDIAN - Dig II (Antidromic)								
Wrist	Index	NR	NR	NR	NR	Wrist - Index	14	NR
L Ulnar - Dig V (Antidromic)								
Wrist	Dig V	2.03	2.66	32.8	50.2	Wrist - DigV	14	69
R Ulnar - Dig V (Antidromic)								
Wrist	Dig V	2.03	2.55	22.1	37.6	Wrist - DigV	14	69
L Radial – Superficial (Antidromic)								
Forearm	Wrist	1.61	2.14	32.5	34.5	Forearm - Wrist	10	62
R Radial – Superficial (Antidromic)								
Forearm	Wrist	1.5+6	2.03	31.9	34.8	Forearm - Wrist	10	64

Figure 1 and Figure 2. Musculoskeletal Ultrasound Conduction



Musculoskeletal Ultrasound (April 2023): The right median nerve measured 19 mm² at the retinaculum and 11 mm² at the pronator quadratus muscle. In the distal third of the arm, the right median nerve was compressed between the brachial artery and the humeral cortex. The left median nerve exhibited a bifid configuration at the retinaculum, with a measurement of 13 mm² at this level and 11 mm² at the pronator quadratus muscle (Figure 1 and Figure 2).

Conclusions: Findings indicate moderate compression of the median nerve proximal to the elbow, resulting from its positioning between the brachial artery and the humerus. Bilateral carpal tunnel syndrome was diagnosed with more pronounced symptoms on the right side.

Magnetic Resonance Imaging (MRI) of the Cervical Spine (June 2023): The imaging revealed a cervical vertebral static disorder. Herniated discs at C3, C4, and C5 were observed in contact with the C4, C5, and particularly the C6 nerve roots bilaterally within the foraminal space.

Following bilateral surgical interventions, the patient returned to work at the same workplace. To minimize strain on the radiocarpal joint, she adjusted her hand movements, inadvertently leading to overuse of the thumb. This overuse caused inflammation of the tendon and its sheath, resulting in bilateral flexor tendon blockage in the thumb. The patient reported experiencing pain, stiffness, and a sensation of locking during thumb flexion or extension, consistent with a diagnosis of "trigger thumb" [6].

Stenosing Tenosynovitis (Trigger Finger) is a condition characterized by the locking or catching of a finger during flexion. This condition is most commonly observed in the thumb or the ring finger [7].

Risk factors identified in the patient's history include repetitive hand use, fine motor movements, female gender (as the condition is more prevalent in women), and prior surgical intervention for carpal tunnel syndrome. Trigger finger is recognized as a potential complication, particularly within the first six months post-surgery [8,9].

The treatment for "trigger finger" involves surgical decompression. This procedure entails releasing the tendon sheath and/or excising the inflamed or scarred tissue through a small incision [10,11].

Following the initial surgical intervention, the patient required two additional procedures for trigger finger decompression: one performed on the right thumb in January 2024 and another on the left thumb in March 2024.

By the time of admission in October 2024, the patient exhibited bilateral wrist stiffness as a sequela of carpal tunnel surgery, accompanied by cervical pain (cervicalgia) and dizziness.

Clinical Examination: The patient was normoweight, with visible postoperative scars on the anterior aspect of the radiocarpal joints and bilateral thumbs. Additionally, restricted mobility of the thumbs was noted.

Treatment: During hospitalization, the patient received a regimen consisting of nonsteroidal anti-inflammatory drugs (NSAIDs), gabapentin, and a comprehensive nutritional supplement designed to support nervous system health. Medical rehabilitation procedures were also recommended to aid recovery.

Occupational Medicine Assessment: The legal process for reporting and officially recognizing occupational diseases was initiated for carpal tunnel syndrome and cervical disc herniation. The patient was advised to consider a workplace change and explore opportunities for professional retraining.

Discussion

Over the past 20 years, Carpal Tunnel Syndrome (CTS) has emerged as a significant occupational health issue. This trend is attributed to shifts in work profiles over recent decades and the evolving demands of the labor market, prompting extensive research into the condition [12,13].

Like any occupational disease, CTS leads to increased healthcare costs, workers' compensation claims, and, notably, a decline in workplace productivity alongside a reduction in overall well-being for affected individuals [14].

The demand for medical services, rehabilitation, surgical interventions, and work-related disability caused by CTS results in increased costs for both employees and employers [15,16,17].

The management of a patient with CTS involves a range of measures, including lifestyle modifications such as reducing repetitive activities both at work and in daily life, as well as the use of ergonomic devices. Unfortunately, there is insufficient evidence to robustly support the effectiveness of these interventions [18].

It is estimated that approximately 10% of individuals will develop CTS during their lifetime, characterized by sensory and/or motor symptoms resulting from median nerve compression. This condition has substantial economic and healthcare ramifications [19].

The decision to return to the same workplace must be carefully considered, as maintaining professional activity under identical conditions may contribute to the progression of disease-related complications. Furthermore, a detailed cost-benefit analysis is essential to evaluate the potential economic impact of absenteeism resulting from medical issues [20].

Conclusion

In conclusion, the presented case aligns with the general findings in the specialized literature regarding the risk factors contributing to the development of CTS, including fine and repetitive movements, female gender, and prolonged exposure to occupational risk factors. It also reflects the primary signs and symptoms, as well as their temporal progression.

The applied treatment adhered to established therapeutic protocols, and the complications observed were consistent with those commonly associated with surgically treated CTS. Notably, this case highlights a significant decline not only in work performance but also in the patient's quality of life, as she was unable to perform household tasks, leading to increased personal expenses.

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