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# Effectiveness of ultrasound-guided local steroid injection to the wrist for the treatment of carpal tunnel syndrome: Is it worth it?

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## Abstract

**Background:** Carpal tunnel syndrome (CTS) is caused by compression of the median nerve at the wrist level and the most frequent entrapment neuropathy in the upper limb. It can be treated with surgical or non-surgical methods. When nonsurgical treatment is indicated, a local corticosteroid injection into the carpal tunnel can be used to reduce pain and tingling sensation. To assess the clinical outcomes and effectiveness of patient satisfaction following ultrasound-guided steroid injection for the treatment of carpal tunnel syndrome.

**Results:** The study comprises 44 female (73%) and 16 (27%) male patients, with a mean age of 57 (27–84) years. Thirty-one patients were left-handed and 29 right-handed. Twenty-six (43%) injections were performed on the right side, 8 (13%) on the left, and 26 were bilateral. Fifty-six hands of thirty-seven (70%) patients reported significant improvement symptoms, five (8%) had temporary improvement with recurrence, seventeen patients (28%) failed to improve, and one patient's symptoms have resolved before intervention. Among temporary responders and nonresponders, two were referred to the neurologist for further evaluation. Out of twenty patients, fourteen patients (23%) had surgical decompression of carpal tunnel with complete resolution of symptoms, four patients had opted for repeat injections, and two patients refused any further intervention.

**Conclusions:** The use of ultrasound-guided injection for the treatment of mild to moderate carpal tunnel syndrome is a practical procedure before offering surgical treatment. It is also appropriate for the patient with significant medical problems or not willing to undergo surgical intervention. Its ultrasound guide reduces injection-related complications, improves patient satisfaction, is cost-effective, and improves patient compliance.

**Keywords:** Carpal tunnel syndrome, Ultrasound guidance, Steroid injection

## Background

Carpal tunnel syndrome (CTS) is the most common compression neuropathy affecting the upper limb, which results from entrapment of the median nerve in the carpal tunnel [1]. Carpal tunnel syndrome adversely affects daily activities, limits work capacity, and impacts general health and quality of life [2, 3]. In a primary care

population, prevalence has been reported to be 3720 to 5700 per 100,000 people in a year, with an annual incidence of 72 to 8200 per 100,000. CTS is more common in women with a female to male ratio ranging between 0.78 and 9.66 [4].

Classically, carpal tunnel syndrome causes discomfort, paraesthesia, and numbness in the median nerve distribution. Nocturnal symptoms are often clinically significant causing sleep disturbance, and bilateral symptoms occur in more than 50% of patients [2]. The diagnosis is based on clinical history, examination findings, and provocation tests [5]. Two common provocation tests use for

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the diagnosis of carpal tunnel syndrome are Phalen's sign, with a sensitivity of 10 to 73% and specificity of 55–86%, and Tinel's sign with 8–100% page sensitivity and 55–87% specificity [5, 6]. The electrophysiological test is routinely performed to establish the diagnosis by a primary care physician. Surgical management is considered for severe cases as described by Bland JD on the neurophysiological grading scale for carpal tunnel syndrome [6, 7].

There exists no consensus on the best primary care management for mild or moderate carpal tunnel syndrome. Several treatments, supported by clinical guidelines, include night-resting splints and local corticosteroid injection in the carpal tunnel [8, 9]. In severe cases or cases that failed with conservative treatment, surgery is considered the treatment of choice. Several studies reported outcomes following injection, and those were given in clinical settings using anatomical landmarks. Injection into the carpal tunnel reduces pain and tingling sensation. The initial response rate to a single steroid injection is about 70% with an estimate suggesting that 92% may have relapsed by 2 years. Therefore, accurate injection into the carpal tunnel is very important [10]; however, direct injection can cause median nerve injury. The corticosteroid can leak into the surrounding tissue and lead to complications such as fat tissue atrophy and skin color changes [10, 11]. Ultrasound (US) can confirm the correct site for injection within the carpal tunnel, reduce patient discomfort, and minimize median nerve injury and other complications [12].

This retrospective study was to evaluate the effectiveness of symptoms relief, reduce surgical intervention, and patient satisfaction following ultrasound-guided injection steroid injection for the treatment of carpal tunnel syndrome.

## Methods

We retrospectively studied 60 patients who underwent local steroid injection under ultrasound guidance by the musculoskeletal radiologist between June 2017 and June 2018. All patients had nerve conduction studies, and

reports were based on the universally accepted grading system (Table 1). Inclusion criteria were all patients with a confirmed diagnosis of carpal tunnel syndrome both clinically and mild and moderate grade in nerve conduction studies [7], who failed to improve symptoms using conservative options in the form of analgesia and splint for 3 months. Exclusion criteria were patients with negative nerve conduction study and severe compression reported in nerve conduction study [7] and secondary causes for clinical symptoms. The audit has been registered, and the local ethical committee has approved it.

Patients were counseled about the steroid injection, and the procedure was explained in detail, including the benefits and drawbacks. Once they agreed, a request was made for a muscular-skeletal-radiologist to perform a US-guided injection. Patients were advised to wear splints until the injection could be administered. A specific protocol was used, and verbal consent was obtained before the procedure. Patients were assessed using a visual analog scale (VAS) and the Boston Carpal Tunnel Questionnaire (BCTQ) severity scale at 6 weeks, 3 months, 6 months, and 12 months.

## Procedure

A mixture of 40 mg methylprednisolone and 1% lidocaine hydrochloride was injected under aseptic precaution by using US guidance (ACUSON Sequoia system powered by BioAcoustic technology). The patient was advised to use their hand as normal without any restriction.

## Results

This was a retrospective study of 86 hands in 60 patients who underwent ultrasound-guided injection for carpal tunnel syndrome following failed conservative treatment between June 2017 and June 2018. The study comprises 44 female (73%) and 16 (27%) male patients, with a mean age of 57 (27–84) years. Thirty-one patients were left-handed and 29 right-handed. Most of the patients were retired, and 7 were unemployed/housewives; other occupations included builders (2), hairdressers (2), chefs (2),

**Table 1** Grading of nerve conduction studies for carpal tunnel syndrome (Bland JD [7])

Grade	Findings
Normal (grade 0)	
Very mild (grade 1)	CTS demonstrable only with most sensitive tests
Mild (grade 2)	Slow digit sensory nerve action potentials (SNAP) and normal terminal motor latency
Moderate (grade 3)	Slow and attenuated digit SNAP + sensory potential preserved with motor slowing, distal motor latency to abductor pollicis brevis (APB) < 6.5 ms; prolonged terminal latencies
Severe (grade 4)	Sensory potentials absent but motor response preserved, distal motor latency to APB < 6.5 ms
Very severe (grade 5)	Terminal latency to APB > 6.5 ms
Extremely severe (grade 6)	Sensory and motor potentials are effectively unrecordable (surface motor potential from APB < 0.2 mV amplitude)

drivers (1), and nurses (4). There were 26 (43%) injections performed on the right hand, 8 (13%) on the left, and 26 (43%) were bilateral. Electrophysiological tests confirmed 66 hands with a moderate grade and 20 hands with a mild grade compression.

Fifty-six hands of thirty-seven (61%) patients reported significant improvement symptoms, five (8%) had temporary improvement with recurrence, seventeen patients (28%) failed to improve, and one patient's symptoms have improved/ resolved before intervention. Among the patients in the "no or temporary response group," there were some observations found correlated with their comorbidities such as diabetes mellitus (3), cervical spine pathology (1), previous wrist surgery due to fracture ORIF wrist (1), elbow joint arthritis (1), previous shoulder surgery (1), and hyperthyroidism (1). Eight (13%) of nonresponders have had no significant past medical history.

Twenty patients were offered surgery after 4 months, and two were referred to a neurologist for associated cervical radiculopathy among the 22 patients who were temporary responders and nonresponders. Fourteen patients (23%) had surgical decompression of the carpal tunnel, which resulted in complete symptom resolution; four patients chose repeat injections, and three patients refused any further intervention. At the 6-month follow-up, patients with resolved or improved symptoms were discharged.

## Discussions

Carpal tunnel syndrome occurs due to compression of the median nerve at the wrist which causes pain, tingling, and altered sensation or numbness on the thumb, index, middle, and radial half of the ring finger. Carpal tunnel syndrome is routinely classified as mild, moderate, or severe, although criteria for this categorization are not well established, and there is a lack of an accepted gold standard for diagnosis, particularly regarding the inclusion of electrophysiological tests [1, 5–7, 13].

In some countries, including the UK, primary care access to nerve conduction studies is variable or limited. As such, these investigations are typically reserved for indeterminate diagnoses and are not always required routinely in primary care for mild or moderate cases to guide decisions regarding initial conservative treatment [6, 13, 14].

Steroid injection has a good short-term effect [13–15]. Gelberman et al. reported that the maximal improvement in symptoms occurred 1 month to 2 months after steroid injection [16]. Landmark-guided (also known as blind) corticosteroid injection was used in the trial as this technique is the standard used in primary care where access to ultrasound is usually rare

[16–18]. Steroid injection is effective mainly through its local anti-inflammatory mechanism [5].

But Hui, A-C et al. [19] and Celik, G. et al. [20] and Hofer, M. et al. [21] found that the long-term effect of steroid injection is not good enough and some patients cannot avoid surgery or multiple injections eventually. Therefore, sometimes, it is still necessary to decompress the transverse ligament carpal ligament of the wrist to reduce compression mechanically. But the surgical release is often rejected by patients due to its scar neuroma and complex medical conditions. US-guided corticosteroid injections are of similar efficacy in reducing symptoms and improving function and electrophysiological findings in carpal tunnel syndrome and reducing injection-related complications.

Smith et al. [22] developed the ulnar approach methods for the performance of US-guided carpal tunnel injection in which the transducer is placed transversely along the wrist crease at the entrance to the carpal tunnel, and the needle is passed into the skin on the ulnar side of the proximal carpal tunnel at the level of the distal wrist crease. Technically, the ulnar approach combines the advantages of longitudinal needle visualization with the flexibility of transverse carpal tunnel imaging. In addition, this approach is easy to learn.

Racasan and Dubert reported median nerve irritation following carpal tunnel injection as a frequent problem and identified the fact that the median nerve extends ulnar to the palmaris longus tendon in most hands. They reported that the safest location of injection is through the flexor carpi ulnaris tendon [10]. Although steroid injections are routinely administered for CTS, direct needle injury of the median nerve is the major complication of these injections. The safest location of the injection remains controversial. Several cases of median nerve injury during CTS injection have been reported [11].

## Limitations

In our series, radiologists used ultrasound to identify the structure and location before injecting steroids. This helped safe insertion of the needle in the carpal tunnel without causing damage to neighboring tissue and enables visualization of the distribution of the injected substance. Our study is limited by the small number of patients in the cohort and the lack of longer follow-up. We recommend that additional research with larger samples with longer follow-up and to exclude systemic causes of neuropathy be conducted in the future to achieve more accurate and comprehensive results. Efficacy and outcome were only evaluated subjectively, without the use of a validated score.

## Conclusions

The use of ultrasound-guided injection for the treatment of mild to moderate carpal tunnel syndrome is an effective, safe, and practical procedure to reduce pain intensity and symptom severity, thereby improving hand functionality. It is also appropriate for the patient with significant medical problems or not willing to undergo surgical intervention. It reduces injection-related complications, improves patient satisfaction, is cost-effective, and improves patient compliance. We believe that the satisfaction rate can still improve by appropriate diagnosis and correct patient selection.

## Abbreviations

CTS: Carpal tunnel syndrome; US: Ultrasound.

## Acknowledgements

No.

## Authors' contributions

The first two authors involved in data collection and writing up, the next two authors contributed in writing up, and the last author did the corrections. The authors read and approved the final manuscript.

## Funding

No funding.

## Availability of data and materials

Yes.

## Declarations

### Ethics approval and consent to participate

Local governance ethical approval done with permission number 8588.

### Consent for publication

Yes from all authors.

### Competing interests

The authors declare no competing interests.

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Received: 14 January 2022 Accepted: 13 March 2022

Published online: 05 April 2022

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