ORIGINAL ARTICLE

Neurological Outcome of Carpal Tunnel Decompression in Carpal Tunnel Syndrome

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ABSTRACT

Objective*: To evaluate the outcome of carpal tunnel decompression in Carpal tunnel syndrome.*

Study Design: *Prospective and retrospective observational study.*

Materials and Methods: *This study was conducted at the Department of Neurosurgery, PGMI / AMC / Lahore General Hospital, Lahore, during the period of 4 years from Jan. 2009 to Jan. 2013. All patients with symptoms and signs of carpal tunnel syndrome and with positive nerve conduction study were included in our study. Exclusion criteria was those unfit for surgery such as patients on warfarin and patient with mild symptoms treated with wrist splint and oral analgesic, diabetic, hypothyroid patient, patients in which nerve conduction study points to radiculopathy and patients with history of trauma with carpal bone fracture were excluded from study. Prospective clinical data collected included patient reported outcome measures and satisfaction scores, touch threshold, pinch and grip strength. Patients were assessed clinically, underwent nerve conduction studies and surgery as indicated. Baseline and one – year follow-up data were analysed for 57 patients (62 hands).*

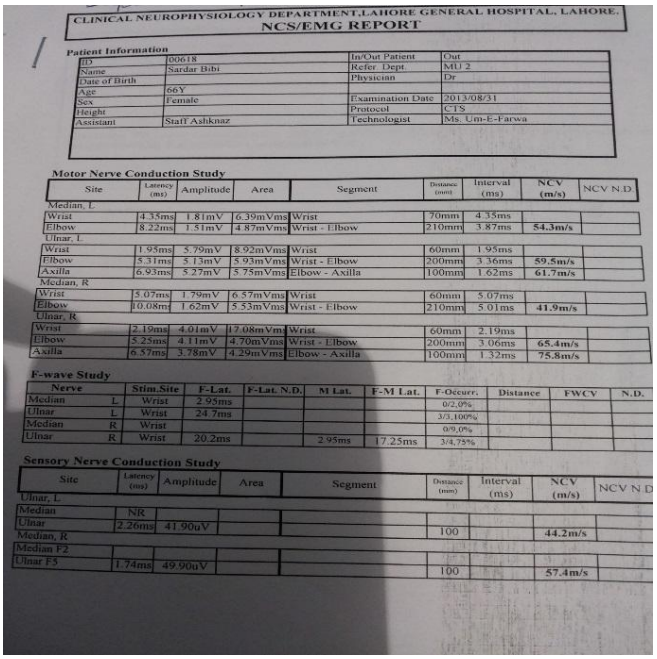
Results: *A total of 57 patients (62 hands) treated with surgery between Jan 2009 and Jan 2013 agreed to participate in the study. Complete data at baseline and 1 year were available for 57 patients (62 hands). There was significant improvement in all domains of the Boston Carpal Tunnel and Michigan Hand Outcomes questionnaires, grip strength and touch threshold. There were no adverse events. Eight patients (14%) requested advice on scar management or had queries regarding the duration of post-operative recovery of sensation and function. The total mean operating time was 12.8 minutes (range: 5–15 minutes) and the mean tourniquet time was 2.5 minutes (range: 1–11 minutes). Patient satisfaction as judged using a Picker questionnaire was very high.*

Conclusions: *A highly efficient clinical service involving both diagnostics and treatment can be delivered through minimum hospital visit and day care surgery while maintaining optimal outcomes and high patient satisfaction.*

Keywords: *Carpal tunnel syndrome, Outcomes, day care surgery, Physical therapy.*

Introduction

Healthcare systems struggle to deliver care for common conditions in a cost effective manner while achieving both optimal outcomes and patient satisfaction. Obvious improvements include shortening the time from first seeing the patient in OPD to treatment and reducing the number of patient OPD visits and hospital stay. We tried to provide such level of care to our patient who presented to us in OPD with signs and symptoms of carpal tunnel syndrome. These patient are usually slightly overweight females who are working ladies and presented to us with tingling in at least two of the first four digits with worsening of the symptoms at night or upon awakening and shaking and rubbing the hand relieves their symptoms. We after examining the patients send them from OPD to neurophysiology



CLINICAL NEUROPHYSIOLOGY DEPARTMENT,LAHORE GENERAL HOSPITAL, LAHORE.
NCS/EMG REPORT

Patient Information

ID	100618	In/Out Patient	Out
Name	Sardar Bibi	Refer Dept.	MU 2
Date of Birth		Physician	Dr
Age	66Y		
Sex	Female	Examination Date	2013/08/31
Height		Protocol	CTS
Assistant	Staff Ashknaz	Technologist	Ms. Um-E-Farwa

Motor Nerve Conduction Study

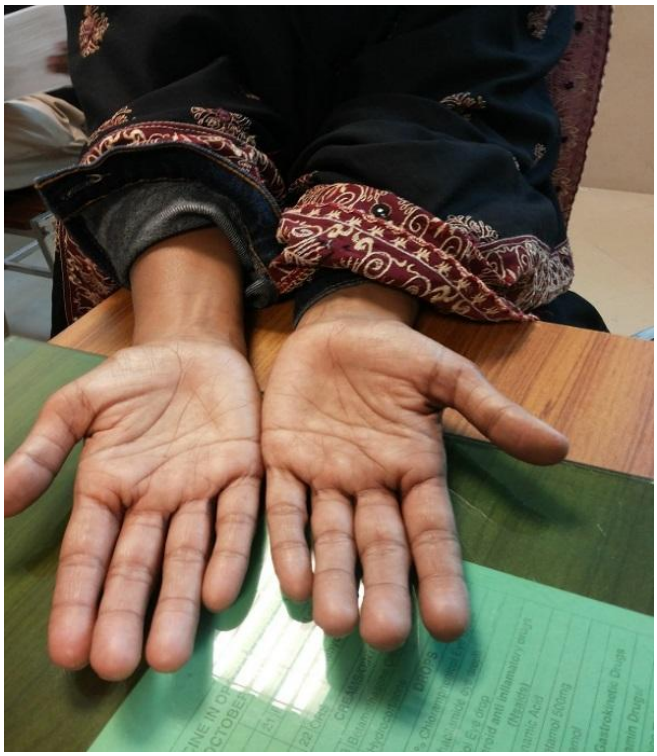
Site	Latency (ms)	Amplitude	Area	Segment	Distance (mm)	Interval (ms)	NCV (m/s)	NCV N.D
Median, L								
Wrist	4.35ms	1.81mV	6.39mVms	Wrist	70mm	4.35ms		
Elbow	8.22ms	1.51mV	4.87mVms	Wrist - Elbow	210mm	3.87ms	54.3m/s	
Ulnar, L								
Wrist	1.95ms	5.79mV	8.92mVms	Wrist	60mm	1.95ms		
Elbow	5.31ms	5.13mV	5.93mVms	Wrist - Elbow	200mm	3.36ms	59.5m/s	
Axilla	6.93ms	5.27mV	5.75mVms	Elbow - Axilla	100mm	1.62ms	61.7m/s	
Median, R								
Wrist	5.07ms	1.79mV	6.57mVms	Wrist	60mm	5.07ms		
Elbow	10.08ms	1.62mV	5.53mVms	Wrist - Elbow	210mm	5.01ms	41.9m/s	
Ulnar, R								
Wrist	2.19ms	4.01mV	17.08mVms	Wrist	60mm	2.19ms		
Elbow	5.25ms	4.11mV	4.70mVms	Wrist - Elbow	200mm	3.06ms	65.4m/s	
Axilla	6.57ms	3.78mV	4.29mVms	Elbow - Axilla	100mm	1.32ms	75.8m/s	

F-wave Study

Nerve		Stim.Site	F-Lat.	F-Lat. N.D.	M Lat.	F-M Lat.	F-Occurr.	Distance	FWCV	N.D.
Median	L	Wrist	2.95ms				0/2,0%			
Ulnar	L	Wrist	24.7ms				3/3,100%			
Median	R	Wrist					0/9,0%			
Ulnar	R	Wrist	20.2ms		2.95ms	17.25ms	3/4,75%			

Sensory Nerve Conduction Study

Site	Latency (ms)	Amplitude	Area	Segment	Distance (mm)	Interval (ms)	NCV (m/s)	NCV N.D
Ulnar, L								
Median		NR						
Ulnar	2.26ms	41.90uV			100		44.2m/s	
Median, R								
Median F2								
Ulnar F5	1.74ms	49.90uV			100		57.4m/s	



(a) *NCS* (b) *Hands of affected patient*

Figure 1: *Carpal tunnel syndrome. Bilateral more in right hand.*

department and ensure that nerve conduction study should be done on the single visit and reporting on the same day of NCS and patient is given the time for surgery on next available operation theatre list. After surgery patients remains in recovery room for 2 – 3 hours and then patients are discharged on the same day.

Carpal tunnel syndrome (CTS) is the most common hand disorder with a prevalence of 3–6%.[1,2] Carpal tunnel syndrome is more common in female who are obese, diabetic or hypothyroid and working ladies but it can occurs in males also especially in those male who do repetitive movements at wrist or repetitive forceful grasping or pinching of tools or use of vibrating tools. Although more than 40,000 patients undergo surgical decompression in the UK each year,[3] approximately 0.7% of the population has undiagnosed CTS that would benefit from surgery, suggesting that the condition is undertreated.[4] In our country patients of CTS also remains undiagnosed or treated with wrong diagnosis with no relief of their symptoms with loss of money and also time due to repeated visits and progression of the disease to advance stage. When CTS progresses to advance stage then patients comes to us in majority of cases. So we conducted a study in our department of neurosurgery unit 1, Lahore general hospital, Lahore to benefit our such patients.

Furthermore, over 44% of patients with presumed CTS require in excess of 31 days off work per annum.[5] Analysis of the costs of CTS treatment, including indirect non-healthcare costs such as loss of productivity caused by absence from work, led to the conclusion that established CTS is best treated by surgery.[6] Surgery has also been shown to be superior to non-operative treatment for patients with symptoms of CTS without changes due to denervation.[7] These factors have driven the development of efficient pathways for surgical treatment of the disorder however this disease can be treated with wrist splinting and oral analgesic or local injection of steroids. However, although the treatment of CTS at a single stage has been described by a number of authors,[8-10] closer analysis reveals that the clinical pathways described either involved more than one visit, mainly because nerve conduction studies (NCS) required a separate visit, or treatment was provided without neurophysiological testing. We treated all our patient after getting nerve conduction studies and with reporting from neurophysician. There is widespread agreement that NCS are desirable when assessing patients with median nerve symptoms,[11] traditional waiting times for neurophysiological tests len-

gthen the clinical pathway and prevent the evaluation and treatment of CTS at a single clinic visit. Recent advances in diagnostic neurophysiology have greatly simplified the testing of peripheral nerve function. The automated systems provide increased availability and the data are comparable to those generated by a neurophysiologist using traditional instrumentation.[12] The availability of NCS devices potentially enables a surgeon to provide treatment based on the history, clinical examination and NCS. We describe the 4 – year experience of treating the patient of carpal tunnel syndrome on the basis of history, clinical examination and nerve conduction study. We treated our patient on the basis of severity of symptoms and findings on nerve conduction study by wrist splitting, oral analgesic, local injection of steroids or surgical decompression of median nerve by releasing the carpal tunnel.

MATERIALS AND METHODS

INCLUSION CRITERIA

- Patient with signs and symptoms of carpal tunnel syndrome.
- Positive nerve conduction study.

EXCLUSION CRITERIA

- Unsuitable patients, such as those on warfarin.
- Patients with mild symptoms who improved with wrist splinting and oral analgesic.
- Uncontrolled diabetic patients.

The remainder were sent an information pack giving details of surgery and its complication and expected results and including symptom and hand function questionnaires (Boston Carpal Tunnel Questionnaire (BCTQ) and Michigan Hand Outcomes Questionnaire (MHQ) for pre-operative completion as well as a patient satisfaction (Picker) questionnaire.

The BCTQ[13,14] is a disease specific patient completed questionnaire quantifying symptoms and function with items rated on a scale of 1 to 5. Lower scores imply milder symptoms and less functional impairment. The MHQ_{15} measures the domains of pain, function, work, satisfaction and cosmesis. High pain scores indicate greater pain, while in the other four domains, high scores denote better hand performance. Patient satisfaction was assessed using a Picker questionnaire (Appendix 1, published online). This study was approved by the ethical committee of the hospital and informed consent was taken from the patients. Patients' weight and height were measured to calculate the body mass index (BMI). They were then assessed by a neurosurgeon and those with clinical signs of CTS were evaluated for the hand strength, sensory thresholds and completion of NCS. Patients who gave their informed signed consent were recruited to the study.

Wrist ratio (the ratio of wrist depth to width) was measured with callipers. Grip strength was measured using a Jamar dynamometer and tip pinch strength using a pinch gauge.[16] Touch thresholds of the volar thumb and index fingers were evaluated with the Weinstein Enhanced Sensory Test.[17] The monofilaments provide increasing increments of pressure. Monofilament values were converted to a five – point ordinal scale, with the 2.83 monofilament ranked 5 and the 6.65 monofilament ranked 1. The mean of the thumb and index finger scores was analysed to generate the touch threshold score for the hand. NCS were performed and the conduction data were electronically transmitted and normalised against an age – and size – matched control database. Reporting of NCS done by a neurophysician.

Patients were reassessed by the neurosurgeon and after discussing the NCS with neurophysician, a treatment plan was formulated. Those requiring carpal tunnel release on the basis of a clear history, positive provocative signs (phalen test and tunnel sign) and NCS indicating the carpal tunnel syndrome were consented for surgery. All pros and cons of the surgery were explained to the patient and informed consent also taken for regional block. When the disease is bilateral and is at the painful stage, we operated the painful hand first and when disease has progressed beyond the painful stage with sensory loss and muscle atrophy then we operated the better hand first. We never do the surgery in both hands in single sitting.

Operative Procedure

We do the surgery under regional anaesthesia by median nerve wrist block with bupivacaine. Patients were led into the operating rooms and the arm was prepared and draped before surgery was performed under tourniquet control. **Typically, a 3 cm incision in the axis of the fourth digit was used. The retinaculum was divided** and not reconstructed. Median nerve was decompressed. After release of the tourniquet and haemostasis, the incision was closed with non-absorbable sutures and dressings was done. A high sling was fitted to all our patients.

The patients were seen immediately afterwards

and verbal and written instructions with regard to digital mobilisation and aftercare was given to all patients. Patients were advised to contact for any post-discharge problems and instructed to return at one weeks for removal of the sutures.

Pre-operative scores of BCTQ and MHQ, touch threshold, grip and pinch were compared with post-operative values at 1 year for 57 patients (62 hands) using the Wilcoxon signed – rank test for non-parametric data. Data were analysed using Prism® (Graph Pad Software Inc, La Jolla, CA, US). Of the cohort of 57 patients, 42 patients (44 hands) also completed a postal BCTQ at 3 months.

RESULTS

Over the three-year period, 87 patients suggestive of CTS was seen in OPD. The majority (n = 70, 80.46%) were diagnosed with CTS. Of these, 8 were treated by steroid injection for mild or intermittent symptoms and 62 advised to undergo surgery. Almost all (n = 57, 91.93% of those recommended surgery) elected to undergo surgery on the next available operation theatre list. Four patients deferred surgery to a later date because of work or family commitments and one patient refused surgery. Two patients (2.30%) reported that their symptoms had resolved at the time of the consultation and 11 (12.64%) were diagnosed as not having CTS requiring treatment or having non-nerve compressive disorders. Four patients (4.60%) were referred for further formal NCS because they had symptoms and signs consistent with ulnar nerve involvement or cervical radiculopathy.

A total of 57 patients (62 hands) treated with surgery between Jan 2009 and Jan 2013 agreed to participate in the study. Complete data at baseline and 1 year were available for 57 patients (62 hands). The patient demographics are shown in Table 1.

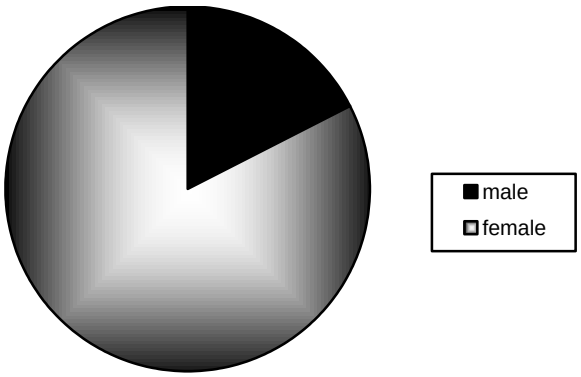
Carpal tunnel release was performed in 57 patients (62 hands). The mean operating time was 12.8 minutes (range: 5 – 15 minutes) and the mean tourniquet time was 2.5 minutes (range: 1 – 11 min).

Table 1: *Patient Demographics.*

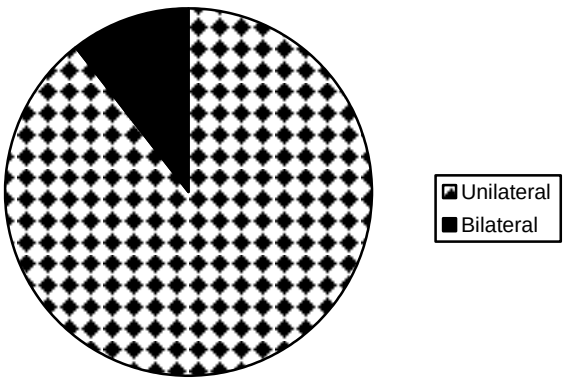
Women	47	5 bilateral
Men	10	0 bilateral
Mean age	56 years	Range: 27 – 96 years
Mean body mass index	28.7 kg/m^2	Range: 18.1 – 45.9
Wrist ratio	0.72	Range: 0.6 1 –0.81

Outcome

Statistically significant improvements were achieved in all domains of both questionnaires (Table 2). While the BCTQ score at 3 months after surgery improved significantly from the baseline score, there was little further improvement up to 12 months (Table 3). Significant improvements were achieved in all physical measures of grip, pinch and touch threshold (Table 4). Grip strength increased by over 40%. Eight patients (14%) requested advice on scar management or had queries regarding the duration of post-operative recovery of sensation and function.



Male:Female



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Summary of Boston Carpal Tunnel and Michigan Hand Outcomes questionnaire results.

DISCUSSION

Improvements in quality or at least maintenance of the

Table 2: *Summary of Boston Carpal Tunnel and Michigan Hand Outcomes questionnaire results.*

Questionnaires (*n* = 62 hands)	**Baseline Median (IQR)**	**1 – Year Median (IQR)**
Boston Carpal Tunnel *(scored 1 – 5)*		
Symptom severity score	2.7 (2.4 – 3.5)	1.5 (1.0 – 2.0)*
Functional status score	2.4 (1.8 – 3.2)	1.4 (1.0 – 2.0)*
Michigan Hand Outcomes *(scored 0 – 100)*		
Hand function	45 (35 – 66)	75 (64 – 88)*†
Work	60 (35 – 95)	80 (60 – 96)**†
Pain	60 (35 – 80)	10 (0 – 36)*†
Satisfaction	29 (21 – 46)	84 (57 – 100)*
Activities of daily living (treatment hand)	70 (35 – 90)	90 (80 – 100)*

Table 3: *Summary of Boston Carpal Tunnel Questionnaire results at baseline, 3 months and 1 year.*

Boston Carpal Tunnel Questionnaire *(scored 0–5)* (*n* = 44 hands)	**Baseline Median (IQR)**	**3 – Month Median (IQR)**	**1 – Year Median (IQR)**
Symptom severity score	2.6 (2.3 – 3.2)	1.6 (1.3 – 2.1)*	1.5 (1.0 – 2.0)*
Functional status score	2.1 (1.5 – 2.9)	1.4 (1.1 – 2.0)*	1.4 (1.0 – 2.0)*

Table 4: *Summary of physical measurements.*

Assessment (*n* = 62 hands)	**Baseline Median (IQR)**	**1 – Year Median (IQR)**
Grip treatment hand (kg)	15.0 (5.8 – 24.0)	23.0 (16.0 – 28.0)*
Pinch (kg)	3.4 (2.5 – 5.0)	4.5 (4.0 – 6.1)*
WEST Touch Threshold		
Hand	4.0 (3.4–4.5)	4.5 (4.0 – 5.0)*

current standards must accompany any alterations in the provision of healthcare. Our data show that at one year there was a significant improvement in absolute indicators of hand function such as pinch grip and digital tip sensation and our results compare favourably with previous studies.[18] Patient reported outcomes are important indicators of change; the MHQ showed clinically significant improvement in all domains and the improvements in the BCTQ were equivalent to those published by other centres.[19,20]

There was no further improvement in symptoms using the BCTQ between three months and one year after carpal tunnel release, suggesting that future studies could be conducted with only a three-month follow-up period. This may reduce the loss of patients. Mallick et al also found that there was no significant improvement in the BCTQ scores between two and six months after treatment.[21] The MHQ may have been perceived as being too onerous to complete. While some studies have reported follow-up rates in excess of 95%[18,19,22] several UK – based studies have reported rates similar to ours.[20,23,24] Our population was very similar in demographics to that described by Farmer and Davis[25] with regard to age, BMI and wrist ratio and, therefore, representative of patients presenting with CTS in our country.

While we cannot be certain that all patients who developed any adverse events were identified as there were no early post-operative follow-up visits, of those who completed the study follow-up period, only eight required additional advice regarding scar management. No patients required readmission.

However, operating on CTS on a day case basis alone does not realise substantially improved benefits. A review of day theatre use in our hospital revealed that only 4 – 6 procedures on average were performed on a 4 – hour operating list dedicated to carpal tunnel patients. Effective theatre use can realise substantial savings and optimising theatre usage is probably the largest single efficiency improvement for a hospital as each hour of theatre time costs £1,200.[26]

The management of CTS through OPD and day care surgery significantly improved capacity in other hospital departments. The introduction of NCS in our department has led to a fall in the number of referrals to the neurophysiology department for conventional NCS in our trust by 30%. Patients with CTS are the largest group referred to neurophysiology services[11] and reducing CTS referrals improves the waiting times for NCS of more complex neurological conditions.

Delivering high quality care while reducing events that do not add value to patients, such as unnecessary hospital attendances, is becoming increasingly important.[27] The Picker scores of patients revealed an overwhelmingly positive response to our service. Our treatment protocol includes assessment, NCS, surgery and post-operative education on aftercare, avoids unnecessary attendances and contrasts sharply with the traditional pathway where the patient attends on multiple occasions and often has a considerable waiting time for NCS.

Previous descriptions of surgeon – led accelerated pathways for CTS[7,9] did not include NCS. Many surgeons do not routinely request NCS and base their management plan on clinical assessment alone. The desirability of data from NCS in patients with CTS remains controversial. However, there are data suggesting that neurophysiological studies combined with clinical assessment improves the specificity for diagnosis of CTS to 85% (sensitivity: 90%) compared to 40% for clinical assessment alone.[28]

CONCLUSIONS

According to my study surgical release of carpal tunnel is an effective and safe procedure. All patient showed maximum improvement in symptoms immediately after surgery and signs also improved in 3 months.

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