Validation of a one-stop carpal tunnel clinic including nerve conduction studies and hand therapy

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ABSTRACT

INTRODUCTION Carpal tunnel syndrome is the most common hand disorder. We describe a pathway that includes clinical assessment, neurophysiological testing, surgery and physical therapy all at the same visit.

METHODS All referrals for carpal tunnel syndrome were screened for inclusion in a 'one-stop' surgeon-led clinic. 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, all on the same day. Baseline and one-year follow-up data were analysed for 57 patients (62 hands).

RESULTS 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. 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). Using a dual theatre model produced a short mean turnaround time of 14.8 minutes (range: 2–37 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 at a single hospital visit while maintaining optimal outcomes and high patient satisfaction.

KEYWORDS

Carpal tunnel syndrome – Outcomes – Prospective – Physical therapy

Accepted 5 August 2011

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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 referral to treatment and reducing the number of patient episodes. An ideal single stage pathway for a common surgical condition would involve direct referral from the general practitioner (GP) to a clinic where diagnostic tests are undertaken and treatment (including surgery) is provided, with patients being able to return home the same day.

Carpal tunnel syndrome (CTS) is the most common hand disorder with a prevalence of 3–6%.^{1,2} 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 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, 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.

While there is widespread agreement that NCS are desirable when assessing patients with median nerve symptoms,¹¹ traditional waiting times for neurophysiological tests lengthen 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

Table 1 Patient demographics

Women	47	5 bilateral
Men	10	0 bilateral
Mean age	56 years	Range: 27–96 years
Mean body mass index	28.7kg/m ²	Range: 18.1–45.9
Wrist ratio	0.72	Range: 0.61–0.81

to those generated by a neurophysiologist using traditional instrumentation.¹² The availability of validated portable NCS devices potentially enables a surgeon to provide treatment based on the history, clinical examination and NCS at a single clinic visit.

We describe the one-year outcomes of a 'one-stop' clinic for the management of CTS.

Methods

Referrals from GPs were screened and unsuitable patients, such as those on warfarin, were routed to the regular outpatient clinics. The remainder were sent an information pack giving details of the same-day surgery service and including symptom and hand function questionnaires (Boston Carpal Tunnel Questionnaire [BCTQ] and Michigan Hand Outcomes Questionnaire [MHQ]) for preoperative 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 MHQ¹⁵ 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). The Picker Institute is an approved survey contractor for National Health Service surveys and pioneered measurement of patient experience surveys.

Patients were also provided with a detailed patient information sheet, approved by the local research ethics committee and including an invitation to participate in outcomes research, to assist with the consent process on the day of treatment. In addition, the patients were contacted by the clinic coordinator to arrange a convenient appointment.

Clinics were held on a Saturday morning and staffed by a receptionist, a nurse, two consultant surgeons and two hand therapists. Two operating theatres were staffed by two theatre nurses and a healthcare assistant. Patients' weight and height were measured by nursing staff to calculate the body mass index (BMI). They were then assessed by a surgeon and those with clinical signs of CTS were referred to the hand therapists for evaluation of 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

Figure 1 Number of patients managed in clinics, shown as mean numbers in three-month periods

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 using an automated portable electrophysiologic device (NeuroMetrix Inc, Waltham, MA, US). The conduction data were electronically transmitted and normalised against an age- and size-matched control database. A report was emailed back within 15 minutes.

Patients were reassessed by the surgeon and a treatment plan was formulated. Those requiring carpal tunnel release on the basis of a clear history, positive provocative signs and abnormal NCS were consented for surgery, given a bupivacaine median nerve wrist block and ushered to the surgery bay. Patients were led into the operating rooms and the arm was prepared and draped by the theatre nurse before surgery was performed under tourniquet control. Typically, a 3cm incision in the axis of the fourth ray was used. The retinaculum was divided and not reconstructed. Two operating theatres were used to maximise efficiency. After release of the tourniquet and haemostasis, the incision was closed with non-absorbable sutures. The nurse applied dressings while the surgeon wrote the operation note and dictated a treatment summary letter for the GP. The sequence was repeated in the adjacent theatre by the same surgeon, ensuring there was no down time between procedures.

The patients were seen immediately afterwards by the hand therapist and received verbal and written instructions with regard to digital mobilisation and aftercare. A high sling was fitted. Patients were advised to contact the coordinator with any post-discharge problems and instructed to return to their GP practice nurse at two weeks for removal of the sutures. To maximise efficiency, both surgeons assessed patients for the first hour of the clinic, after which

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

Questionnaires (<i>n</i> =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)*

IQR = interquartile range

Median differences for Boston Carpal Tunnel symptom severity and functional status scores and Michigan Hand Outcomes subscales of hand function, work, pain, satisfaction and activities of daily living at one year compared to baseline scores showed significant improvement (* $p < 0.0001$, ** $p < 0.0010$).

†For patients with carpal tunnel syndrome, clinically significant improved Michigan scores were recorded for the domains of function (minimal clinically important difference of 13), work (8) and pain (23).²⁹

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

Boston Carpal Tunnel Questionnaire (scored 0–5) (<i>n</i> =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)*

IQR = interquartile range

Median difference for both symptom severity and functional status at three months and one year compared to baseline scores showed significant improvement (* $p < 0.0001$).

one undertook all the surgery while the other continued with patient assessment.

Over the one-year period, 249 patients were referred to the clinic. The majority ($n=205$, 82%) were diagnosed with CTS. Of these, 30 were treated by steroid injection for mild or intermittent symptoms and 175 advised to undergo surgery. Almost all ($n=164$, 94% of those recommended surgery) elected to undergo surgery on the same day. Seven patients deferred surgery to a later date because of work or family commitments and four declined surgery. Five patients (2%) reported that their symptoms had resolved at the time of the consultation and 28 (11%) were diagnosed as not having CTS requiring treatment or having non-nerve compressive disorders and referred back to their GP. Eleven patients (4%) were referred for further formal NCS because they had symptoms and signs consistent with ulnar nerve involvement or cervical radiculopathy.

Preoperative scores of BCTQ and MHQ, touch threshold, grip and pinch were compared to postoperative values at 1

year for 57 patients (62 hands) using the Wilcoxon signed-rank test for non-parametric data. Data were analysed using Prism® (GraphPad 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

A total of 106 patients (120 hands) treated between October 2008 and November 2009 agreed to participate in the study. Of these, 25 patients (28 hands) were lost to follow up and 1 withdrew. For 23 patients (29 hands) the data were incomplete. 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 58 hands (3 of which were revision surgery) and 4 had non-operative treatment comprising steroid (4mg betamethasone) injection and splintage. The mean operating time was 12.8 minutes

Table 4 Selected summary of Picker questionnaire results from 97 patients

<i>Would you recommend this treatment facility to your family and friends?</i>		
Response:	Yes, definitely 86% (n=83)	Yes, probably 11% (n=11)
<i>Overall, how would you rate the care you received at the department?</i>		
Response:	Excellent 65% (n=63)	Very good 28% (n=27)
<i>How well organised was the department you visited?</i>		
Response:	Very well 81% (n=79)	Fairly well 16% (n=16)

(range: 5–15 minutes) and the mean tourniquet time was 2.5 minutes (range: 1–11 minutes). The mean turnaround time for patients from entering to leaving the operating theatre was 14.8 minutes (range: 2–37 minutes). These times progressively reduced as the service became more streamlined.

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). The patient satisfaction scores using Picker surveys were overwhelmingly positive and selected domains are shown in Table 4. Significant improvements were achieved in all physical measures of grip, pinch and touch threshold (Table 5). Grip strength increased by over 40%. Eight patients (14%) requested advice on scar management or had queries regarding the duration of postoperative recovery of sensation and function. The number of patients treated per clinic increased steadily as the pathway became established (Fig 1).

Discussion

Drivers for changes to healthcare delivery include quality, hospital efficiency and enhanced patient experiences. Improvements in quality or at least maintenance of the current standards must accompany any alterations in the provision of healthcare. Although the one-stop clinic model for the management of CTS has been described previously, to our knowledge this study reports on the first true one-stop clinic whereby clinical assessment, NCS and surgical treatment are completed on the same day. 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

Table 5 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)*

IQR = interquartile range; WEST = Weinstein Enhanced Sensory Test. Median difference for grip and pinch strength and touch threshold at one year compared to baseline scores showed significant improvement (* $p < 0.0001$).

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 Almost half of the patients enrolled in the study were lost to follow up and it is therefore possible that our data are not representative of the entire group.

Twelve patients were unwilling to attend one-year follow-up appointments due to transport difficulties. They completed questionnaires but were not included in the analysis due to lack of physical measurement data. A further 15 provided incomplete baseline MHQs. This suggests that 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 Davis²⁵ with regard to age, BMI and wrist ratio and, therefore, representative of patients presenting with CTS in other parts of the UK.

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

Our single stage treatment pathway allows up to 25 patients to be treated in 4 hours by experienced consultant surgeons with short average operating times in a dual theatre model that minimises patient turnaround times. 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 successful treatment of large numbers of patients with CTS has had the additional benefit of releasing weekday theatre availability, leading to a reduction in waiting times for other procedures. Furthermore, holding the one-stop clinic on a Saturday utilises theatre and clinic facilities that are normally unused at weekends.

Importantly, the single stage management of CTS significantly improved capacity in other hospital departments. The introduction of NCS in the one-stop clinic 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 services¹¹ and reducing CTS referrals improves the waiting times for NCS of more complex neurological conditions. Following the introduction of the single stage clinic, referrals of patients with CTS to hand therapy reduced by 53% compared to the previous year, again increasing capacity for patients with complex hand 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 attending the one-stop clinic revealed an overwhelmingly positive response to the service. Our single stage treatment represents a true one-stop clinic and includes assessment, NCS, surgery and postoperative education on aftercare by a hand therapist, 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.¹¹

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 Although the use of a portable NCS system increases the clinical assessment by approximately 15 minutes, portable NCS devices overcome the long waiting times associated with traditional NCS while providing the added benefit of enhanced clinical decision making.

Conclusions

Over the last six months we have extended the indications for referral to our one-stop clinic to include other simple hand disorders such as trigger digits. Our data suggest that the single stage paradigm could be applied successfully to many simple surgical conditions and especially disorders of the hand.

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