A cost analysis of staged and simultaneous bilateral carpal tunnel release

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Published online: 26 July 2012
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Introduction

Carpal tunnel syndrome is the most common peripheral nerve entrapment syndrome with an estimated prevalence of 1 % of the adult population in the USA [14, 16]. Symptoms occur bilaterally in 56–87 % of cases [2, 11, 15]. When conservative measures fail, surgical division of the transverse carpal ligament is indicated, making carpal tunnel release the most common procedure performed by upper extremity surgeons, with an estimated cost above 2 billion dollars per year in the USA alone [13].

Excellent results have been reported using both traditional open and newer endoscopic methods [3, 4, 6, 17]. Prior reports have described similar results with both staged and simultaneous surgical intervention regardless of the technique utilized [5, 18]. Fehringer et al. [5] retrospectively compared the cost effectiveness and outcome of simultaneous vs. staged bilateral single incision endoscopic carpal tunnel release and demonstrated a decrease in cost, quicker return to work, and no difference in satisfaction. Other studies have compared the results of both open and endoscopic techniques performed simultaneously in the same patient with no apparent advantage to the more costly endoscopic

approach [6]. It remains unclear whether staged or simultaneous bilateral open carpal tunnel release is the more cost-effective alternative. The purpose of this study was to determine if simultaneous bilateral open carpal tunnel release is more cost effective than a staged procedure, with fewer days missed from work and similar patient satisfaction.

Materials and Methods

A retrospective chart review was performed on all patients undergoing bilateral carpal tunnel release between April 2001 and April 2002. All patients underwent bilateral open carpal tunnel release for the treatment of carpal tunnel syndrome using the standard mini-open technique. Five different hand surgeons performed surgery, all using a similar technique. All surgeons involved allowed patients to choose bilateral or unilateral staged carpal tunnel release based on a standard discussion of the risks and benefits of each procedure. Direct cost data was obtained for all patients from the billing department and the physicians' office. Indirect costs and patient satisfaction were assessed via a telephone questionnaire for patients who were available for follow-up.

Of the 126 patients who underwent bilateral carpal tunnel release during the study period, 73 patients had staged procedures (group A), and 53 had simultaneous procedures (group B). All patients had clinical histories and physical findings consistent with bilateral carpal tunnel syndrome. All but eight patients had positive electrodiagnostic studies, which confirmed the diagnosis. Patient demographics are presented in Table 1. There was no statistical difference in the distribution of age, gender, occupation, self-employment status, or associated medical conditions between groups. More hands in group A than group B underwent concomitant surgical

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Table 1 Demographic information

	Number of Pts	Age (years)	M–F	BWC	Concomitant procedure
Staged	73	48 (28–77)	27:46	19	13 hands
Simultaneous	53	48 (21–80)	19:34	3	1 hand

Pts patients, *M* male, *F* female

procedures such as A-1 pulley release or release of the first dorsal compartment (13 in group A vs. one in group B, $p \leq 0.01$) (Table 2). Nineteen patients in group A (26 %) filed a Bureau of Workers Compensation (BWC) claim, compared to six patients in group B (6 %) ($p \leq 0.01$). Most patients underwent monitored anesthesia care, with no statistically significant difference between groups. A minimum follow-up of 1 year was present for all contacted patients.

Direct cost data was obtained for all patients from the billing department and the physicians' office. Direct costs evaluated included both fees and actual reimbursements for the surgeon, the facility, and the anesthesiologist, as well as operating room time. The number of office visits and the need for hand therapy was determined through chart review. Indirect costs and patient satisfaction were assessed via a telephone questionnaire for patients who were available for follow-up. These costs included lost time from work, medication, need for assistance, transportation, and miscellaneous expenses. No significant time off work was found among caregivers for patients, and no direct assessment comparison could therefore be made regarding costs of caregivers in either group. Patients were questioned regarding complications and overall satisfaction, and whether or not they would have surgery performed in the same manner again, if given the choice. Our institutional review board approved the study protocol, and all contacted patients gave verbal consent to participate.

Statistical Methods

The Student *t* test was used to compare continuous data, and the Chi square test was used to compare categorical variables. Statistical analysis confirmed 80 % power or greater

Table 2 Concomitant procedures

Staged	Simultaneous
Trigger finger (4)	Ganglion
ECU decompression	
LRTI (2)	
Ganglion	
DeQuervain's	
Cubital tunnel release	
Synovectomy	
Excision skin tag	

for all results that were reported to be statistically significant, except medication usage which achieved a power of 77 %.

Results

The average amount billed in group A (staged) was significantly higher than group B (simultaneous) ($p \leq 0.01$). More importantly, the average reimbursement in group A was significantly higher than group B (\$2,897 vs. \$1,864, $p \leq 0.01$) (Fig. 1). Reimbursement was calculated as the sum of the actual reimbursement received by the physician, facility, and anesthesiologist. The facility fee did not differ based on the number of carpal tunnel releases performed for the bilateral versus the unilateral cases. The average total operative time in group A was significantly higher than in group B (66 vs. 40 min, $p \leq 0.01$). All amounts billed were significantly higher in group A than group B, except for the physician's fee, which was essentially equal between groups (Fig. 2). However, the physician's actual reimbursement was significantly higher for group A than group B (\$995 vs. \$667, $p \leq 0.01$), despite nearly identical charges. This was also true of the actual facility and anesthesia reimbursement ($p \leq 0.01$, Fig. 3).

Patients in group A (staged) missed more work than those in group B (simultaneous) (46 vs. 22 days, $p \leq 0.01$). Furthermore, group A patients had significantly more office visits than did group B patients (five vs. three, $p \leq 0.01$) and required more days of pain medication (11 vs. four, $p \leq 0.02$). There was, however, no difference in the cost of pain medication or the number of patients requiring hand therapy. No patients incurred additional miscellaneous or transportation related costs (Fig. 4).

Both groups included similar numbers of patients available for follow-up with 38 patients contacted in group A (staged), compared to 35 in group B (simultaneous) (52 % vs. 66 %, $p \leq 0.2$). There was no statistical difference in

Fig. 1 Comparison of the amount billed to the patient with the amount received in reimbursement for staged and simultaneous bilateral carpal tunnel release

Fig. 2 Comparison of the constituents of billing for staged vs simultaneous carpal tunnel release. Comparison includes surgeon, anesthesia, and facility fees

overall satisfaction (82 % vs. 91 %) or the willingness to undergo surgery in the same manner again (84 % vs. 71 %, Fig. 5). Group A patients had significantly less self-reported difficulty with personal hygiene than those in group B (47 % vs. 71 %, $p \leq 0.05$), but no patient required a home health aide. Minor complications such as superficial infection, persistent tingling, or scar tenderness occurred in 21 (8 %) of hands, with no statistical difference between groups (Table 3).

Patients filing BWC claims demonstrated a significant increase in lost days from work compared with non-BWC patients in both group A (69 vs. 36 days, $p \leq 0.02$) and group B (70 vs. 20 days, $p \leq 0.05$, Fig. 6). In group A, BWC patients also had more office visits than non-BWC patients ($p \leq 0.01$). However, this difference was not seen in group B and was therefore not related to requirements on visits incurred by BWC regulations. In both groups, BWC patients had a higher rate of complications than non-BWC patients ($p \leq 0.02$), yet there was no difference in satisfaction, willingness to repeat surgery, or the number of patients requiring hand therapy. When all data was reevaluated with the BWC data excluded, all previous differences continued to be significant. BWC patients were returned to work using

Fig. 3 Comparison of reimbursement for staged vs simultaneous carpal tunnel release. Comparison includes surgeon, anesthesia, and facility fees with operating room time included to allow comparison

Fig. 4 Comparison of indirect costs for staged vs simultaneous carpal tunnel release

the same rational criteria used in the non-BWC population. The ability to perform a job at the job site was used as the prime determining factor for return to work.

Patients who underwent concomitant procedures billed significantly more for both groups A (staged) and B (simultaneous) than those who did not undergo additional procedures ($p \leq 0.01$). This difference was not significant for actual reimbursement, the number of office visits, or complications. There were not enough patients contacted to draw conclusions regarding differences in satisfaction measures or days missed from work when comparing patients within their own group.

Discussion

Carpal tunnel release has been shown to be the treatment of choice for carpal tunnel syndrome that fails to respond to conservative measures. The open technique is used by many surgeons and serves as an alternative to the now well-established endoscopic technique [7]. Due to the frequency of bilateral symptoms, simultaneous surgical intervention is an attractive alternative to staged procedures as long as there is no associated decrease in efficacy or increase in

Fig. 5 Patient satisfaction for staged vs simultaneous carpal tunnel release

Table 3 Complications

	Pain	Infection	Tingling	Swelling	Scarring	Recurrence	Delayed healing	Retained suture
Staged	4	2	2	2	1	0	1	1
Simultaneous	2	1	1	0	2	2	0	0

morbidity. Simultaneous bilateral open carpal tunnel release has been shown to be a safe and effective alternative to staged procedures in the setting of bilateral carpal tunnel syndrome [8, 12]. Concerns for self-care and the ability to deal with complications following surgery may play a role in the decision to avoid simultaneous bilateral carpal tunnel release. To the best of our knowledge, no previous study has compared the cost effectiveness of staged vs. simultaneous bilateral open carpal tunnel release. Our study demonstrates simultaneous surgery to be more cost effective when comparing direct costs. This is primarily due to the fact that simultaneous surgery generates only one facility and anesthesia fee and that physician reimbursement is decreased. This may be explained by the fact that third party payers decrease actual reimbursement for each additional procedure that is performed at the same operative setting. Total reimbursement was then decreased not only by a single facility and anesthesia fee but also by decreased actual physician reimbursement.

Indirect costs are less tangible; nevertheless, they are similarly reduced with simultaneous procedures as evidenced by decreased time lost from work, number of office visits, and requirement for pain medication. Furthermore, patients are only subjected to the stress of one trip to the operating room and a single recovery period. Although no patient required the assistance of a home health aide, almost all relied on a family member or spouse for activities of daily living and transportation. This is an additional societal cost that cannot be finitely quantified.

Previous studies have reported that patients filing BWC claims may have increased time lost from work compared to non-BWC patients [1, 10]. Our study confirmed this with

BWC patients missing 70 days on average in both groups, compared to 36 days in the staged non-BWC group and 20 days in the simultaneous non-BWC group (Fig. 6). We also found that BWC patients in the staged group had significantly more office visits, and BWC patients in both groups had higher complication rates than non-BWC patients. Despite this, there was no concomitant decrease in satisfaction in either BWC group compared to the non-BWC patients.

No formal outcome analysis was performed as numerous previous studies have documented the efficacy of open carpal tunnel release, and this was not the focus of our study. Katz et al. [9] proposed that self-administered symptom severity and functional status scores should serve as the primary outcome measures of therapy for carpal tunnel syndrome and that they are more responsive to clinical improvement than various measures of neuromuscular impairment. Our study relied on a simple “yes” or “no” response to questions regarding overall satisfaction and willingness to undergo the same type of procedure again.

The above findings may create a conflict of interest for the treating physician. Simultaneous surgery clearly offers socioeconomic advantages without a significant difference in satisfaction. This advantage comes at the expense of the physician, the facility, and the anesthesiologist, manifested by diminished reimbursement. This decrease in reimbursement, however, needs to be considered in the context of decreased total operative time, fewer office visits, and what is best for each individual patient. Despite decreased reimbursement per patient, simultaneous surgery may be more productive due to improved efficiency with regards to the physician’s time. Another distinct advantage of simultaneous surgery is the simplification of assigning work restrictions. It obviates the need to attempt to return a patient to work between procedures while one hand may be under different restrictions than the other.

Certain limitations in the study were expected from the start. Because a large number of variables contribute to the cost of carpal tunnel surgery, it is difficult to control for all of them. We attempted to minimize this by analyzing both direct and indirect costs and the actual reimbursement for each patient, not just generalized charges. The two groups were similar in demographics with the exception of the staged group having more BWC claims and more concomitant procedures than the simultaneous group. Each of these differences in group composition was evaluated separately,

Fig. 6 BWC return to work for staged vs simultaneous carpal tunnel release

and the remaining patients' data was reevaluated to confirm statistical significance.

The number of patients available for follow-up was also a limitation. Multiple exhaustive attempts to contact all patients were made with no emphasis placed on a particular group. Despite a relatively short interval between treatment and follow-up (3 years), many phone numbers had changed, or patients simply were not reachable. There were 38 patients contacted in the staged group (group A, 52 %), compared to 35 patients in the simultaneous group (group B, 66 %) ($p \leq 0.2$). The number of patients contacted was not statistically different between groups. It is impossible to know why patients were lost to follow-up, and certainly members of either group could be lost to follow-up for differing reasons. That is to say that those in the simultaneous group could have been difficult to contact because of systematic dissatisfaction and those in simultaneous group unreachable for the opposite reason, or vice versa. All we can know is that similar numbers of patients in each group of patients available for this study would undergo the same surgery procedure again in the same way.

As time has passed since the collection of the patients in this study, a limitation arises in the relevance of the measured costs and reimbursements. An independent analysis of more recent subsequent patients not included in the study group has revealed little change in the reimbursement for staged and simultaneous bilateral carpal tunnel release at the author's institutions.

Perhaps one limitation of the study is that the results are obvious to the casual observer. One would expect reimbursement to be lower for simultaneous carpal tunnel release performed in an outpatient surgical center. Nonetheless, it should be noted that the current economic climate may dictate that the conflict noted above may play a role in the decision to pursue one or another combination of procedures while attributing the choice to the fact that patients fare poorly with simultaneous bilateral carpal tunnel release—this would be, in our opinion, unfounded.

A key limitation is the significantly increased number of patients with concomitant procedures in group A, which contributes to an asymmetry in the two groups. However, group B patients undergoing simultaneous bilateral carpal tunnel release are more likely, by the same logic, to self-select to have the procedure in the absence of other additional procedures on the hands. It may therefore be true that the best comparison group to simultaneous patients are those who have staged surgery with other procedures at the same time on the same hand. This notwithstanding, we did not formally exclude patients from this study simply for undergoing other procedures at the same time as carpal tunnel release—a fact which has led to asymmetry in our groups. Another limitation exists in the fact that both the operative time and the time away from work are likely to

have been affected by the presence of other procedures. It is very difficult to account with any accuracy for the specific additional time off work associated with an additional procedure.

Other limitations include the number of surgeons participating in the study, although variability in technique was minimal, the fees were identical, and all procedures were performed in the same facility. Recall bias is another limitation that we could not control. Finally, natural selection bias is of concern because the patients participated in the decision to undergo staged vs. simultaneous surgery. One could speculate that highly motivated patients would choose to have simultaneous surgery and may go on to a quicker recovery than their less motivated counterparts.

Although a prospective, randomized, controlled trial would be preferable, our data support the conclusion that simultaneous bilateral open carpal tunnel release is more cost effective than a staged procedure, with fewer days missed from work and no difference in patient satisfaction. We recommend that patients undergo simultaneous bilateral open carpal tunnel release when symptoms are present in both hands.

Conflict of interest The authors declare that they have no conflict of interest.

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