A Cost, Profit, and Efficiency Analysis of Performing Carpal Tunnel Surgery in the Operating Room Versus the Clinic Setting in the United States

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Background: Carpal tunnel surgery (CTS) can be performed in the clinic or operating room with similar outcomes. Our goals were to perform a total cost comparison, profit analysis, and assess efficiency of CTS in each setting.

Methods: A detailed cost analysis for all CTSs at a tertiary care academic center was done for the year 2007. We calculated the net revenues and profit margins for single endoscopic port and open CTS performed in each setting in the year 2007. For efficiency analysis, we assumed that the time saved by performing a procedure in the more efficient setting could accumulate and permit additional CTSs. This would be the opportunity cost of performing CTS in the less efficient setting.

Results: In general, the operating room was a costlier setting than the clinic. The total cost per case when performing single-port endoscopic CTS was more than double ($2273 vs. $985) when performed in the operating room versus the clinic. For open CTS, the operating room was more than 4 times as expensive than the clinic ($3469 vs. $670). For single endoscopic port cases, profits gained were greater than double in the clinic versus the operating room ($2710 vs. $1139). For open CTS, clinic cases had a profit margin per case of $1186; however, procedures in the operating room incurred a loss of $650 per case. The block time allowed for CTS in the clinic was 30 and 60 minutes in the operating room. To value this efficiency, we used the profit margin of CTS performed in the clinic ($2710) and divided it by the 30 minutes it took to perform. This provided us with a multiplier of $90/min. We multiplied the 30 minutes saved when operating in the clinic by the $90/min to give us an opportunity cost of $2700.

Conclusion: Performing either single endoscopic port or open CTS in the operating room is more expensive and less efficient than in the clinic setting.

Key Words: carpal tunnel, cost comparison, cost analysis, profit analysis, efficiency analysis, outpatient setting, clinic setting, operating room setting

(*Ann Plast Surg* 2011;66: 245–248)

With health care costs rising in the United States, there has been a greater drive in all sectors of health care for improved efficiency. Not only is there a need to assess the cost and efficiency of competing surgical or medical technologies, but it is also important to compare the cost and efficiency of performing surgical procedures in different operating settings.

Carpal tunnel surgery (CTS) can be performed safely in multiple settings. Although it has traditionally been performed in the operating room, a significant number of hand surgeons are performing this operation in a outpatient clinic setting.[1] One of the key differences in each setting is that in the operating room, there is an anesthesiologist administering the anesthetic, whereas in the outpatient clinical setting, the surgeon administers the anesthetic. Given this variation of practice pattern, it is important to investigate the potential cost and profit difference in performing this operation in each setting.

Our goal was to investigate the cost and profit margin in performing CTS in the operating room and outpatient clinical setting. Additionally, we aimed to estimate the opportunity cost of performing CTS if one setting was less efficient than the other.

MATERIALS AND METHODS

To determine cost, revenue, and profit margin differences between the operating room and outpatient clinical setting, a detailed review was performed looking at all carpal tunnel procedures done in the year 2007 at our tertiary level health care center. Current procedural terminology (CPT) codes were used to identify all carpal tunnel procedures that were performed. Further charge code analysis was used to exclude any carpal tunnel procedure done with other surgical procedures. CPT codes were used to separate CTSs by the open and single-port technique, which were both performed at our institution. Additionally, we searched these CPT codes in both the hospital operating room database and the outpatient clinic database, which allowed us to compare CTS data in each setting with regards to cost, revenue, and profit margin.

To compare the costs, we separately looked at the total cost of performing single-port or open CTS in the operating room and the outpatient clinic setting. The outpatient clinic setting is an office setting at the tertiary care health center and is accredited as a section of the hospital. Equipment for the operation including local anesthesia and surgical tools are stored at the office. Total cost is defined as the summation of direct and indirect cost. Direct cost associated with CTS includes costs that directly impact the actual surgery such as physician fees, suture costs, and operating room time. Direct cost was adjusted to exclude resident physicians in either setting. Indirect costs are costs that are linked to the CTS but are also shared among other surgical procedures and specialties. Examples of indirect cost include transcriptionist fees, laundry fees, and other shared administrative costs.

Profit margin was calculated as the difference between revenue and expense (total costs). The profit margin for open and single-port CTS was compared in the hospital and outpatient clinical setting after revenues were analyzed.

Lastly, we reviewed the hospital operating room and clinic data base to find the time allotted for each carpal tunnel procedure. On the basis of the allotted time differences, we performed an efficiency analysis using opportunity cost to estimate which setting is more efficient. Opportunity cost was defined as the cost of time lost because of an inefficiency that could be used for other work.[2,3] The extra cost of time lost by performing the CTS in the less

Received December 7, 2009, and accepted for publication, after revision, February 28, 2010.
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Presented at the New England Society of Plastic and Reconstructive Surgery Annual Meeting, June 2009.
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ISSN: 0148-7043/11/6603-0245
DOI: 10.1097/SAP.0b013e3181db7784

TABLE 1. Cost and Profit Analysis of Procedure Type and Setting

	Single Port		Open	
Year 2007	**Clinic**	**OR**	**Clinic**	**OR**
# Cases (N)	76	11	25	113
Net revenue per case ($/N)	3695	3411	1855	2820
Direct cost per case ($/N)	808	1446	545	2387
Indirect cost per case ($/N)	177	827	124	1082
Total cost per case ($/N)	985	2273	670	3469
Profit margin/case ($/N)	2710	1139	1186	−650

TABLE 2. Opportunity Cost and True Cost

	Single Port		Open	
Year 2007	**Clinic**	**OR**	**Clinic**	**OR**
Operating time (min)	30	60	30	60
Operating time difference (min)		+30		+30
Opportunity cost multiplier ($/min)		90		90
Opportunity cost ($)		2700		2700
Total cost per case ($/N)	985	2273	670	3469
True cost per case ($)	985	4973	670	6169
True profit margin per case ($)	2710	−1562	1186	−3349

efficient setting was added to the total cost to create the true cost of performing this surgery in the less efficient setting.

RESULTS

Overall, the reported CTSs reflect the practice patterns of 5 hand surgeons at our tertiary care health center. A total of 225 carpal tunnel procedures were performed in 2007 of which 101 were performed in the clinic setting and 124 were performed in the operating room. Costs and revenues with calculated profit margins were determined per CTS and are reported in Table 1.

In general, CTS was costlier to perform in the operating room compared with the clinic setting. Both direct and indirect costs were substantially more in the operating room compared with the outpatient clinic setting. One of the main variables driving direct costs in the operating room was the use of an anesthesiologist to administer the anesthetic and/or monitor the patient. This added cost was not present when performing CTS in the clinic setting where the surgeon administered the anesthetic. Additionally, staffing, supplies, and administrative costs in the operating room are based on major surgery needs with standard staffing of 1 operating room technician and 1 circulating nurse versus less intensive staffing requirements in the outpatient clinic setting. Other direct and indirect expenses seen in the operating room setting included fringe benefits, supervision, linen, equipment depreciation, and general supplies. One of the highest indirect costs is facility costs, which are based on per square footage. The operating room demands a larger footprint than that of a clinic outpatient procedure room, thus leading to higher indirect costs as seen in Table 1.

Revenues per case were similar between settings when performing CTS. Given that CPT codes do not vary between settings and are connected only to the procedure being done, charges and subsequent reimbursement should not be affected whether a CTS is done in the operating room or whether it is done in the outpatient clinic setting.

The profit margin for performing either an open or a single-port CTS in the outpatient clinic setting was higher than if the same procedure was to be done in the operating room. When comparing the profit margin of performing a single-port carpal tunnel procedure done in the clinic setting versus the operating room, the clinic setting operation produced a profit margin ~$1571 greater than the operating room. Similarly, an open CTS done in the clinic had a profit margin $1836 greater than the same procedure done in the operating room. More significantly, an open CTS done in the operating room produced a net loss of $650 per case given that the total cost of doing the procedure in the operating room was more than the revenue earned.

Lastly, a greater number of CTSs could be performed in the clinic setting compared with the operating room. The allotted surgical block time for CTS was 30 minutes when performed in the outpatient clinic and 60 minutes when performed in the operating room. This discrepancy was largely due to historical turnover times. Turnover time in the operating room included the cleaning of the operating room, transport of the patient, and preoperative preparation by the anesthesiologist. In the outpatient clinic, cleaning of the surgical suite was faster, the transport of the patient was easier given that the rooms were close by to each other, and no anesthesiologist was involved for the surgery. Given these time constraints and assuming a 10-hour surgery day, 20 carpal tunnel procedures could be performed in the outpatient clinic setting, whereas only 10 could be performed in the operating room. To attribute a cost to the opportunity lost of performing additional CTSs when choosing the operating room setting, we sought to calculate the opportunity cost. First, the opportunity cost multiplier was calculated, which was the profit margin of a carpal tunnel procedure ($2710, Table 1) divided by the number of minutes allowed for that procedure (30 minutes), which gave us $90/min. Multiplying this opportunity cost multiplier ($90/min) by the additional 30 minutes that it takes to complete a CTS in the operating room gives us the opportunity cost per carpal tunnel case done in the operating room ($2700) (Table 2).

The true cost of performing CTS in the less efficient setting is defined as the summation of opportunity cost and total cost. Thus, we calculated the true cost of performing a single-port carpal tunnel operation in the operating room to be $4973 per case, which when calculating the profit margin would lead to a net loss of $1562 per carpal tunnel case. For open CTS performed in the operating room, the true cost was calculated to be $6169 per case that would lead to a net loss of $3349 per carpal tunnel case (Table 2).

DISCUSSION

Our results show that CTS performed in the clinic setting incurs less cost and produces a greater profit margin than if done in the operating room.

To our knowledge, this is the first cost comparison analysis done in the United States comparing the cost, profit, and efficiency of performing CTS in the operating room versus the clinic setting. Leblanc et al[4] noted similar results when performing a cost and efficiency analysis comparing carpal tunnel procedures done in different settings in Canada. They noted both supply and labor costs to be significantly higher in the operating room when compared with the ambulatory (clinic or office) setting leading to an overall higher cost of performing CTS in the operating room. Additionally, they also noted that more CTSs could be done over a period of time in the clinic setting when compared with the ambulatory room. The opportunity cost or true cost to assess efficiency, however, was not calculated.

There are limitations to our study. First, this being a cost comparison study does not address the clinical efficacy of performing CTS in one setting versus the other. The assumption of

similar clinical efficacy is made based on empirical data supporting the safety of office-based CTS.[1,4] Our scope strictly focused on the economic assessment of performing this surgery in differing settings.

Second, our study does not compare the societal cost or benefit for either surgical approach in the treatment of carpal tunnel disease. Although there may be complications associated with each surgical approach and subsequent patient and societal costs because of associated complications, the scope of such complications goes beyond our cost comparison analysis between operating room versus outpatient clinic setting for either carpal tunnel surgical approach. To better analyze the societal impact of cost versus benefit when comparing the open versus endoscopic approaches to carpal tunnel treatment, a cost effectiveness study would be a good option. Such an analysis was performed by Vasen et al[5] who performed a decision analysis suggesting that the endoscopic approach becomes less cost effective compared with the open approach if a surgeon's complication rate (eg, hematoma or neuropraxia) exceeded 6.2% or if his career ending complication rate (eg, severe nerve injury) exceeded 1 in 1000.

Third, a limitation in the generalizability of our data may exist. Specifically, cost data, revenue data, and subsequent profit margins are calculated based on the data aggregated from 2007 specific to our tertiary care institution. Hospital facility fees such as operating room time and doctors' fees may differ region to region and between institutions making the actual cost and profit margin numbers different to the ones we report. Given that our opportunity cost multiplier was based on the profit margin and block times specific to our institution, the opportunity and true costs may also not be completely generalizable. However, one of our main intentions with this work was to introduce the concept of opportunity cost in measuring the efficiency of performing a surgical procedure in different settings. It is hoped that our introduction of this concept will encourage surgeons to estimate opportunity costs of performing CTS in their operating rooms versus clinic settings to come up with a surgeon- or institution-specific cost comparison. Although we do believe that there may be some cost comparison differences between institutions and regional settings in performing CTS, the clinic setting should typically be more cost efficient when it comes to performing CTS because of the decreased need for an anesthesiologist, decreased number of operating personnel typically in the clinic setting, and the faster turnover time that may be typically found in the clinic setting.

A fourth limitation is the assumption that every minute saved by the more cost-efficient setting (in this case the clinic setting) could be used toward performing another CTS. This concept assumes an abundance of CTS patients who could be added into the operating block so as to treat their disease and maximize the efficiency of the clinic setting. Although carpal tunnel syndrome is a prevalent disease in the US population[6] and CTS is a commonly performed operation,[7,8] the hand surgeon calculating the opportunity cost multiplier under the assumption of using the extra time saved in the clinic to do additional CTSs has to have a large enough demand for CTSs to fill this capacity. At our institution, this is the case but may not be for every hand surgeon around the country. Thus, our results may not be completely generalizable to every hand surgeon in the United States, but our intention again was to introduce opportunity cost as a concept that could then be used by the hand surgeon.

Also, a fifth limitation involves the lack of specific surgery time comparison between surgical approaches in each setting. The choice of the 30-minute block time in the outpatient clinic setting or the 60-minute block time in the operating room setting was based on historical surgical times needed in each setting to perform the procedure, set up, and turn over the room. Although the block time approach has advantages in including room turnover time and set up time for the case in addition to simplifying our opportunity cost analysis, it does neglect surgical time differences between the open versus endoscopic approach for the treatment of carpal tunnel disease and unrealistically assumes a 100% utilization of each block for surgery.

Sixth, a limitation to this study includes the fact that we do not have data from a surgicenter, which is a setting that hand surgeons can and do perform CTSs. Given that our tertiary care institution performs CTSs only in the operating room or the clinic, we did not have the numbers to calculate results and thus do not have objective data with which to assess an objective cost comparison. This would be an area for future cost comparison research to see which surgical setting, the surgicenter versus the outpatient clinic setting, provided for greater cost savings.

A seventh limitation includes the assumption that all 5 of the hand surgeons in our study had similar operating styles and preferences. Although we did accommodate single-port versus open carpal tunnel surgical preferences into our cost comparison, surgical equipment lists, operating efficiencies, and experience varied among our surgeons, thus creating potential confounding cost outcomes when cost comparing single-port or open CTS in the varying settings. Such variation in operating efficiency can be demonstrated in subtle cost differences such as the higher total cost for open CTS versus the endoscopic approach in the operating room setting. The surgeons who routinely performed the open approach in the operating room tended to request larger equipment sets that subtly increased the operation's direct cost (and subsequently total cost) compared with the surgeons who performed the laparoscopic approach in the same setting. Nevertheless, given that our data included a 1-year time period, we needed a sufficient sample size to provide meaningful results. Using just 1 surgeon's case log would not produce enough cases, and so all CTSs performed by hand surgeons were included in our analysis.

There are different ways by which one could use the findings presented here. From a hand surgeon's perspective, he or she would be able to self-assess his or her own practice style in different operative settings to determine the most efficient and profitable venue. Surely, the setting that provided the greatest efficiency, least cost, and ultimately the most profit would likely be favored as long as it has a proven safety record. From a hospital's point of view, more procedures performed would mean increased revenue for the hospital over a given operating day with decreased costs, thus translating to increased profits. Carpal tunnels could theoretically be performed in the outpatient clinic setting, thus freeing up the hospital operating rooms for other profitable surgeries. Lastly, from a societal standpoint, our analysis boasts greater efficiency in the outpatient clinic setting allowing for a greater number of surgeries that can be done in a given day. This should reduce the wait time for a procedure. Although certain regions and institutions do not have an extensive wait time for CTS, other types of surgeries may be able to get done in the operating room if CTSs were to be done in the outpatient clinic, thus freeing up the main operating room for surgeries that cannot be done in the clinic.

CONCLUSIONS

In our academic medical center, CTS performed in the clinic setting is less costly, more profitable, and more efficient than when done in the operating room. In addition, taking into consideration opportunity costs magnifies these findings. It is highly likely that similar findings would hold true in other institutions.

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