

A Detailed Cost and Efficiency Analysis of Performing Carpal Tunnel Surgery in the Main Operating Room versus the Ambulatory Setting in Canada

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Abstract

Background Our goals were to analyze cost and efficiency of performing carpal tunnel release (CTR) in the main operating room (OR) versus the ambulatory setting, and to document the venue of carpal tunnel surgery practices by plastic surgeons in Canada.

Method A detailed analysis of the salaries of nonphysician personnel and materials involved in CTR performed in these settings was tabulated. Hospital statistical records were used to calculate our efficiency analysis. A survey of practicing plastic surgeons in Canada documented the venue of CTR performed by most.

Results In a 3-h surgical block, we are able to perform nine CTRs in the ambulatory setting versus four in the main OR. The cost of CTR in the ambulatory setting is \$36/case and \$137/case in the main OR in the same hospital. Only 18% of Canadian respondents use the main OR exclusively for CTR, whereas 63% use it for some of their cases. The ambulatory setting is used exclusively by 37%, whereas 69% use it for greater than 95% of their cases. The majority of CTR cases (>95%) are done without an anesthesia provider by 73% of surgeons. Forty-three percent use

epinephrine routinely with local anesthesia and 43% avoid the use of a tourniquet for at least some cases by using epinephrine for hemostasis.

Conclusion The use of the main OR for CTR is almost four times as expensive, and less than half as efficient as in an ambulatory setting. In spite of this, many surgeons in Canada continue to use the more expensive, less efficient venue of the main OR for CTR.

Keywords Carpal tunnel surgery · Epinephrine · Cost · Efficiency · Main operating room · Ambulatory

Introduction

Carpal tunnel surgery is one of the most commonly performed procedures in hand surgery [7], with over 400,000 procedures per year in the United States [9]. In the past, carpal tunnel release (CTR) was mostly performed in the main operating room. A survey of members of the American Society for Surgery of the Hand by Duncan [4] in 1987 demonstrated that 48.4% of respondents used general anesthesia for some of their CTRs, whereas only 2.4% used it exclusively. In the same survey, 76.1% performed CTR using regional anesthesia for some of their CTRs and 19.9% used regional anesthesia for all of their CTRs.

The preceding statistics attest to a significant number of CTRs being performed in the main operating room setting. However, with increasing cost and limited resources faced by many of our institutions, some surgeons have looked at alternative, less expensive, and more accessible venues such as minor procedure rooms for CTR. Few studies in the literature have looked at CTR performed using minor procedure rooms [3].

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The main objective of our study was to analyze the cost and efficiency associated with performing CTR in the main operating room versus the ambulatory setting.

We also developed and distributed a survey to members of the Canadian Society of Plastic Surgeons in an effort to identify and document the venues used for CTR, including type of anesthetic technique utilized. We wanted to know where and how Canadian hand surgeons were performing their carpal tunnel releases.

Materials and Methods

All of the carpal tunnel surgeries in all three of the venues of the office, clinic, and main operating room in the same hospital were performed using the wide awake approach [6] with pure local anesthesia (no sedation, no tourniquet, and no anesthesia provider). The office and the clinic both are located in the same hospital as the main operating room. Like the main operating room, the clinic is under financial management by the hospital (government), whereas the office is under private financial management by the surgeon except for the surgeon's fees, which are paid by the government. Both the office and the clinic have the same sterility setup of minor outpatient procedure rooms. The surgeons use field sterility with prepping of the hand with iodine solution, a single towel/drape with a hole in it, a sterile tray with a modest supply of basic instruments and two Senn retractors. Sterile gloves and masks are used, but the surgeons are not gowned. Patients receive their local anesthesia on a stretcher, and then sit in a waiting room 30–60 min to await their surgery while the epinephrine in the local anesthesia takes effect to avoid the use of tourniquet and sedation. The surgery usually takes less than 10 min from skin to skin with very little bleeding even without a tourniquet.

A detailed analysis of the cost of performing CTR was performed, including the non-physician salaries of each person directly or indirectly involved in CTR and the cost of materials used for CTR by the same surgeon in all three venues, which are located in the same hospital.

After appropriate consultation with each person involved in the management of patients undergoing CTR at our hospital, a unit of time directly proportional to their interaction with the patient was assigned to each. Using the provincial agreement of the Canadian Union of Public Employees, we were able to identify the average salaries of each individual and use the above calculated time units to calculate the cost of manpower for successful completion of CTR. A careful analysis of all materials, including any processing of such materials, was tabulated and a cost attached to such items used in CTR.

The efficiency analysis was calculated for a standard 3-h surgical block for CTR in the three different venues of the office, clinic, and main operating room. Our hospital's main operating room personnel keep statistics of the time it takes to perform every case. As a result of keeping these statistics, they have determined that we are not able to perform a CTR and turn a room over in less than 45 minutes, in spite of the fact that the surgery itself takes 10 minutes. The main operating room will therefore not let us book more than one CTR every 45 minutes, or no more than four CTRs in a 3-h block. In the ambulatory setting and in the office, the same boundaries permit us to book and to perform one CTR every 20 minutes, or nine CTRs in a 3-h block. These numbers were used to calculate our efficiency of performing CTR in the main operating room, clinic, and office settings.

A survey was also developed and e-mailed to practicing plastic surgeons in Canada through a database supplied by the Canadian Society of Plastic Surgeons. The survey documented the venue used for CTR, use of a tourniquet or not for hemostasis, type of anesthetic technique used, use of endoscopic release, and demographic data including years practicing plastic surgery, and approximate number of CTR performed per year.

Results

In a 3-h surgical block, we are able to perform nine CTRs in the ambulatory setting versus four operations in the main operating room. The calculated cost of performing CTR in the office setting is \$52.67 per case (\$474.03/9 cases), \$36.46 in our clinic (\$328.14/9 cases), and \$137.06 in the main operating room (\$1,233.54/9 cases; Table 1); all of these costs assume use of local anesthesia with no sedation and no tourniquet. The breakdown of our cost analysis includes: 1) supplies and 2) labor cost (Table 1). The calculated cost of supplies for CTR in the clinic and office was \$22.65 and \$41.42, respectively (Table 2). The supplies for the main operating room setting were more extensive and therefore also more expensive with a

Table 1 Cost analysis summary for total cost of performing carpal tunnel release (CTR) in the main operating room (OR), clinic, and office.

Cost Analysis	Main OR	Clinic	Office
Summary			
Supplies	61.42	22.65	41.42
Labor	75.64	13.81	11.25
Total	\$137.06	\$36.46	\$52.67

calculated cost of \$61.42 (Table 2). The surgeon's fee was the same in all three venues and therefore not included in the cost analysis. Labor cost increased with progression from the office, clinic, and finally the main operating room. The labor cost was \$11.25, \$13.81, and \$75.64 for the office, clinic, and main operating room, respectively (Table 3).

We received 104 completed surveys from the 250 members of the Canadian Society of Plastic Surgeons emailed (Table 4).

The main operating room was used exclusively for CTR by 18% of respondents, whereas 45% used this setting for some of their CTRs. The ambulatory setting was used exclusively for CTR cases by 37%, whereas 69% used this type of setting for greater than 95% of their cases. An ambulatory setting was used at least some of the time for CTR by 82% of respondents.

An anesthesiologist was present for some cases of CTR in 47% of respondents, 43% never used an anesthesia provider, and only 10% used an anesthesia provider for all

their CTRs. The majority of CTR cases (>95%) were done without an anesthesia provider by 73% of surgeons.

A tourniquet was used by 87% at least some of the time for CTR, but only 57% used it for all their cases of CTR. For at least some cases of CTR, 43% avoided the use of a tourniquet, whereas only 13% excluded the use of a tourniquet for all of their cases. If a tourniquet was used, 53% were brachial and 47% over the forearm.

The majority of surgeons used the same anesthetic exclusively for all their cases as follows: 24% used lidocaine with epinephrine, 19% used lidocaine and bupivacaine with epinephrine, 14% used lidocaine, 10% used lidocaine and bupivacaine, and 9% used bupivacaine. Two respondents reported adding sodium bicarbonate to their anesthetic.

Endoscopic CTR was used by 14% of surgeons at least some of the time; however, only 7% used it to any substantial amount (>10% of cases). Two surgeons used a double portal release, and 12 used a single portal release. The open CTR was used by 86% of respondents for all their CTRs.

Table 2 Cost analysis of supplies for performing carpal tunnel release (CTR) in the main operating room (OR), clinic, and office.

Cost Analysis	Main OR	Clinic	Office
Supplies			
Basic bundle	22.72	NA	NA
Major basin set	3.75	NA	NA
Surgeon gown	4.27	NA	NA
Masks	0.39 (3×0.13)	0.26 (2×0.13)	0.26 (2×0.13)
Surgeon hat	0.14	NA	NA
Nurses hat	0.58 (2×0.29)	NA	NA
Patient labels	0.09	0.09	NA
Pharmacy labels	0.09	NA	NA
Needle board	0.73	NA	NA
Sterile marking pen	0.85	NA	NA
Suction tubing	0.80	NA	NA
Elastocrepe	0.75	0.75	0.75
Kling	0.40	0.27	0.27
Nonadherent dressing	0.37	0.37	0.37
Scrub brush	1.08 (2×0.54)	NA	NA
Instrument tray	6.25	3.00	3.00
10-cc Syringe	0.09	0.09	0.28
18-g 1" Needle	0.24	0.24	0.11
25-g 11/2" Needle	0.24	0.24	0.11
1% Lidocaine/epinephrine (1:100,000)	2.08	2.08	3.43
Gloves	5.02 (2×2.51)	5.02 (2×2.51)	2.46 (2×1.23)
Split sheet	NA	NA	3.00
Blade	0.28	0.28	0.80
Suture×1	4.08	4.08	20.70
Splint	2.08	2.08	2.08
Fluff gauze	2.95	2.95	2.95
Bridine	0.10	0.10	0.10
Patient gown	0.25	NA	NA
Linen	0.75	0.75	0.75
Total	\$61.42	\$22.65	\$41.42

Table 3 Cost analysis of labor for performing carpal tunnel release (CTR) in the main operating room (OR), clinic, and office.

Cost Analysis	Main OR	Clinic	Office
Labor			
Registered nurse	56.25	10.00	10.00
Orderly	4.25	1.40	N/A
Housekeeping	5.00	1.25	1.25
Transcription/Dictation	2.50	N/A	N/A
Pre/Postoperative nurse	5.00	N/A	N/A
Registration clerk	2.64	0.66	N/A
Clinic secretary	N/A	0.50	N/A
Total	\$75.64	\$13.81	\$11.25

The distribution of surgical experience was balanced and included: $n=25$ for <10 years in practice; $n=23$ between 10–20 years; $n=37$ between 20–30 years; and $n=14$ greater than 30 years. Seventy-five percent of respondents performed greater than 50 CTR cases a year.

Discussion

In a 3-h surgical block, we are regularly able to perform nine carpal tunnel operations in the ambulatory setting versus four identical procedures in the main operating room in our hospital. The efficiency of the ambulatory setting is therefore more than twice that of the main operating room in the same hospital, as we can perform more than twice the number of operations in the clinic and office in the same time allotted in the main operating room. Our hospital's main operating room personnel keep statistics of the time it takes to perform every case. These statistics revealed that it took the main operating room 45 min to process one wide awake carpal tunnel case for the senior surgeon, although the surgery time was usually less than 10 min. As a consequence, he is not allowed to book carpal tunnels any faster than at 45-min intervals. This means he is only allowed to book and perform a maximum of four carpal tunnels in a 3-h block in the main operating room, regardless of whether the ancillary staff over-perform or under-perform to change turnover time on any given day.

In the ambulatory setting, either in the clinic or office of the same surgeon in the same hospital, the same statistical records of operative time used to calculate efficiency have allowed him to book and perform nine carpal tunnel procedures in the same 3-h block of time on a regular basis. The main reasons for the difference in times are the turnover times that are mostly related to room cleaning and the draping and instrumentation of full operating room sterility as opposed to field sterility preparation in the ambulatory setting.

We found that the cost of performing CTR in our in-hospital office setting was \$52.67 per case (\$474.03/9 cases), \$36.46 in our clinic (\$328.14/9 cases), and \$137.06 in the main operating room (\$1,233.54/9 cases). All procedures were performed by the same surgeon using the same techniques in the same hospital. The higher costs in the main operating room were related to the costs of full sterility versus field sterility, the requirement for more nurses, and the higher turnover time. The higher materials costs of the office versus clinic setting are caused by decreased material cost in the clinics secondary to better hospital contracts with suppliers in comparison to lower volume purchases of our office.

One of the limitations of this paper is that we have reported an underrepresentation of true total costs. The surgeons' fees and the costs associated with the processing the surgical fee in the surgeon's office are not included because surgeons' fees are the same regardless of the venue in Canada's public health care system. In addition, we did not include the costs of the hospital building, its expenses, taxes, surgical equipment, or other fixed assets. These costs would be incredibly difficult to estimate, as Canadian hospitals and their fixed assets are government-owned and tax-exempt. These costs would also have been very similar in the different venues we

Table 4 Summary of CTR practices among surveyed ($n=104$) Canadian plastic surgeons.

Category for CTR Practices	Percentage (%)
Setting	
Main OR exclusively	18
Main OR occasionally	45
Ambulatory OR exclusively	37
Ambulatory >95% time	69
Anesthesia provider	
Exclusively	10
Never	43
Occasionally	47
Tourniquet use	
Exclusively	57
Never	13
Occasionally	30
Anesthetic	
Lidocaine + epinephrine	24
Lidocaine + Bupivacaine + epinephrine	19
Lidocaine	14
Lidocaine + Bupivacaine	10
Bupivacaine	9
Other	24
Technique	
Open CTR exclusively	86
Endoscopic CTR exclusively	0
Endoscopic CTR occasionally	14

studied, as all of the venues were all in the same hospital. If anything, these costs would be slightly more expensive for the main operating room venue than for the minor outpatient clinic operating room venue as surgery takes twice as long per case in the main operating room, and more equipment is used there than in the outpatient minor operating room. It is, therefore, likely that the true cost of minor procedure room surgery is even more significantly cheaper than main operating room surgery. We preferred to err on the conservative side and focus on concrete numbers such as salaries of all of the involved employees, and disposable supplies.

All of our costs were estimated with the same type of surgery with pure local anesthesia using the wide awake approach [6]. This approach uses only lidocaine and epinephrine local anesthesia with no sedation and no tourniquet. Another reason that the costs appear low in this study is that all patients in all three venues were performed with the wide awake approach, which means epinephrine hemostasis with no tourniquet. Because of this, all of the considerable costs associated with an anesthesia provider are eliminated.

The literature on outpatient carpal tunnel release is sparse. Derkash reported on office carpal tunnel release using wrist block anesthesia at 80% of the hospital cost in 1996 [3]. Lichtman [8] showed satisfactory results after carpal tunnel release under local anesthetic as an outpatient procedure using an outpatient ambulatory care operating room as early as 1979. The present paper was not meant to address the outcome of carpal tunnel release performed in the outpatient minor procedure rooms versus the main operating rooms. However, in the senior author's experience (D.L.) of more than 2,000 cases in more than 25 years, he has not observed any changes in the outcomes of the results of the surgery or its complications other than to witness an increase in patient satisfaction as a result of the deletion of the tourniquet, and the deletion of the nausea and vomiting of sedation with opiates suffered by one-third of patients who undergo this route as well as other problems such as urinary retention etc. [2]. The one factor that has diminished the incidence of stitch abscesses in the author's experience has been the deletion of nonabsorbable nylon suture closure and the introduction of Monocryl® buried 5-0 simple dermal sutures.

The need for general or regional anesthesia and sedation has often precluded the use of alternative venues other than the main operating room for CTR. A survey of members of the American Society for Surgery of the Hand by Duncan in 1987 [4] demonstrated that 48.4% of respondents used general anesthesia for some of their CTRs, whereas only 2.4% used it exclusively. In the same survey, 76.1% performed CTR using regional anesthesia for some of their CTRs and 19.9% used regional anesthesia for all of their

CTRs [4]. The cost of general anesthesia or regional anesthesia with an anesthesia provider would have increased our costs greatly.

The senior author's (D.L.) own experience since starting practice in 1984 is likely a reflection of the practice changes of many Canadian hand surgeons over the same period of time. During his residency, all CTR surgery was performed with inpatient general anesthesia. From 1984 to 1989, it moved to day surgery with general or regional anesthesia with an anesthesia provider. From 1989 to 1995, pure local anesthesia without epinephrine minus the anesthesia provider but with a tourniquet was mostly performed in the main operating room as day surgery. In 1995, CTR began to move out into the ambulatory clinic with a hole in a sterile towel and an iodine scrub for field sterility, but the tourniquet was maintained. In 1997, epinephrine was added to the lidocaine and the tourniquet was deleted. Two Senn retractors under tension and a minimum of 30 min between epinephrine (1:1,000,000) injection and surgery provides hemostasis almost as good as a tourniquet in most patients, with far less discomfort (see film in on-line version on the web). The senior author (D.L.) has had his own CTR performed with the wide awake approach and can attest to its minimal discomfort without the tourniquet.

Our survey of Canadian Plastic Surgeons who do most of the CTR work in Canada revealed that the main operating room is still used exclusively for CTR by only 18% of respondents, whereas 45% use this setting for some of their CTRs. The ambulatory setting is used exclusively for CTR cases by 37%, whereas 69% of respondents use this type of setting for greater than 95% of their cases.

In Canada, almost every hand surgeon has a choice of performing carpal tunnel release in the main operating room or in outpatient minor procedure rooms (ambulatory clinics) in virtually every hospital because of the publicly funded system. They get the same fee for performing the surgery regardless of the venue. Although we did not ask them why they choose the venue they do, we know that the reasons for their choice revolve around local tradition, the way they were taught, their attitudes toward local anesthesia and patient interaction, and patient preference.

There may be several factors at play in Canada that are not present in other countries. As carpal tunnel and trigger finger release are such common operations, a large percentage of Canadian patients already understand that the pain of the local anesthetic with carpal tunnel or trigger finger release is minimal. Most of the patients in the community of the senior author come into the consultation already preferring to avoid the tourniquet or general anesthesia to have their surgery because of this widespread knowledge. However, even in communities where this knowledge is not widespread, surgeons can still relatively easily sway their patients to the choice of venue by

explaining to their patients that the pain of the local anesthesia is very similar to that which they have almost all experienced at the dentist. The disadvantages of sedation are understood by many. In Canada, surgery with an anesthesiologist in the main operating room has a longer waiting time and is more subject to cancellation than outpatient surgery under pure local anesthesia in a minor procedure room. Hand surgery with sedation is almost exclusively performed in the main operating rooms in Canada, even without the presence of an anesthesiologist. Surgery in outpatient minor procedure rooms is generally only available for pure local anesthesia cases.

As the wide awake approach only uses lidocaine with epinephrine and no tourniquet (the same as is used in dental offices around the world), coexisting illness is seldom a concern except in patients with severe liver disease [5].

Our Canadian survey revealed that an anesthesiologist was present for some cases of CTR in 47% of respondents, 43% never used an anesthesia provider, and only 10% used an anesthesia provider for all their CTRs. The majority of CTR cases (>95%) were done without an anesthesia provider by 73% of surgeons.

The majority of Canadian surgeons surveyed used the same anesthetic exclusively for all their cases of CTR as follows: 24% used lidocaine with epinephrine, 19% used lidocaine and bupivacaine with epinephrine, 14% used lidocaine, 10% lidocaine and bupivacaine, and 9% used bupivacaine. Two respondents reported adding sodium bicarbonate to their anesthetic. It is interesting that at least 43% of Canadian respondents now routinely inject epinephrine in their carpal tunnel surgery. This increase in the routine use of epinephrine in CTR is a reflection of the end of the myth that epinephrine should not be used in hand surgery [10].

Of the Canadian plastic surgeons surveyed, 87% use a tourniquet at least some of the time for CTR, but only 57% used it for all their cases. For at least some cases, 43% avoid the use of a tourniquet, whereas only 13% exclude the use of a tourniquet for all of their cases. If a tourniquet is used, 53% are brachial and 47% over the forearm. In the 1987 survey of members of the American Society for Surgery of the Hand, 97.9% always used a tourniquet for CTR, 1.7% occasionally, and 0.4% never used a tourniquet for CTR [4].

In a randomized controlled comparison study of tourniquet and local adrenaline infiltration for hemostasis in patients undergoing bilateral CTR, Braithwaite showed that intraoperative pain was substantially greater with tourniquet

use, at least twice as painful, compared with the use of adrenaline infiltration [1]. They used a visual analog scale to measure intraoperative pain with scores of 4.7 with tourniquet use and 2.2 without tourniquet use but with adrenaline infiltration hemostasis ($p < 0.01$) [1].

Our Canadian survey revealed that endoscopic CTR is used by 14% of surgeons at least some of the time; however, only 7% use it to any substantial amount (>10% of cases). Two surgeons use a double portal release, and 12 use a single portal release. The open CTR is used by 86% of respondents for all their CTRs.

We conclude that the use of the main operating room for CTR is almost four times as expensive, and less than half as efficient as CTR in an ambulatory setting. In spite of this, many surgeons in Canada continue to use the more expensive, less efficient venue of the main operating room for CTR.

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