



Predictive Factors for Converting Endoscopic to Open Carpal Tunnel Release

Les facteurs prédictifs de la conversion d'une libération endoscopique à une libération ouverte du canal carpien : une série de cas dans un hôpital universitaire

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Abstract

Introduction: Both open and endoscopic methods of carpal tunnel release are accepted treatments for carpal tunnel syndrome. The objective was to determine the endoscopic to open conversion rate of all carpal tunnel surgeries. We evaluated potential predictive factors for an increased rate of conversion. **Methods:** The IRB/IRBnet approved (#20210613/1639264) a retrospective chart review of all attempted endoscopic carpal tunnel surgeries performed from July 1, 2012 through June 30, 2021. Charts were reviewed for procedure, age, sex, body mass index (BMI), electromyograph (EMG) reading, wrist arthritis on x-ray, preoperative steroid injections, trainee as surgeon, diabetes, hand dominance, and operated side. Conversion rate was noted. A chi-square test using a P -value of <0.05 was used to determine the statistical significance of the patients' age, sex, BMI, EMG severity, the presence of wrist arthritis, preoperative steroid injections, resident as surgeon, diabetic status, and operated hand dominance as predictive factors for conversion. **Results:** The plastic surgery service attempted 1053 endoscopic carpal tunnel releases using the Chow dual port technique over a 9-year period. Forty-five cases converted to an open release. Median age ($P=0.54$), sex ($P=0.43$), median BMI ($P=0.76$), EMG severity ($P=0.20$), wrist arthritis ($P=1.0$), preoperative steroid injections ($P=0.65$), resident surgeon ($P=0.53$), diabetes ($P=0.50$), and operated hand dominance ($P=0.36$) were not statistically significant predictive risk factors. Nineteen of 45 converted cases had a future successful contralateral endoscopic release. **Conclusion:** Our study found a 4.27% endoscopic to open conversion rate. No identifiable risk factors could predict conversion. Prior conversion does not determine a future contralateral conversion.

Résumé

Historique: Les méthodes ouverte et endoscopique de libération du canal carpien sont toutes deux des traitements acceptés du syndrome du canal carpien. La présente étude visait à déterminer le taux de conversion de la méthode endoscopique à la méthode ouverte de toutes les chirurgies du canal carpien. Les chercheurs ont évalué les facteurs prédictifs potentiels d'une augmentation du taux de conversion. **Méthodologie:** La plateforme IRB/IRBnet a approuvé une analyse rétrospective des dossiers (no 20210613/1639264) de toutes les tentatives de chirurgie endoscopique du canal carpien exécutées entre le 1er juillet 2012 et le 30 juin 2021. Dans les dossiers, les chercheurs ont examiné l'intervention, l'âge, le sexe, l'indice de masse corporelle (IMC), la lecture de l'électromyographie (EMG), l'arthrite du poignet observée à la radiographie, les injections préopératoires de stéroïdes,

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la présence d'un résident en chirurgie, le diabète, la dominance de la main et le côté opéré. Ils ont consigné le taux de conversion et utilisé le test du chi carré au moyen d'une valeur p de moins de 0,05 pour déterminer l'importance statistique de l'âge, du sexe, de l'IMC, de la gravité de l'EMG, de la présence d'une arthrite du poignet, des injections préopératoires de stéroïdes, de l'état diabétique et de la dominance de la main opérée comme facteurs prédictifs de conversion. **Résultats:** Sur une période de neuf ans, le service de chirurgie plastique a tenté 1 053 libérations endoscopiques du canal carpien par la technique à deux voies d'abord de Chow. De ce nombre, 45 cas ont été convertis en libération ouverte. L'âge médian ($p=0,54$), le sexe ($p=0,43$), l'IMC médian ($p=0,76$), la gravité de l'EMG ($p=0,20$), l'arthrite du poignet ($p=1,0$), les injections préopératoires de stéroïdes ($p=0,65$), la présence d'un résident en chirurgie ($p=0,53$), le diabète ($p=0,50$) et la dominance de la main opérée ($p=0,36$) n'étaient pas des facteurs prédictifs statistiquement significatifs. Au total, 19 des 45 cas convertis ont subi une libération endoscopique controlatérale par la suite. **Conclusion:** L'étude a permis de constater un taux de conversion de la libération endoscopique à la libération ouverte de 4,27 %. Aucun facteur de risque discernable ne pouvait prédire la conversion. Une conversion antérieure ne détermine pas une future conversion controlatérale.

Keywords

Carpal tunnel, endoscopic carpal tunnel, endoscopic conversion to open, case series

Mots-clés

canal carpien, libération endoscopique du canal carpien, conversion de la libération endoscopique à la libération

Introduction

Both endoscopic and open carpal tunnel release are within the accepted standard of care for surgical treatment of carpal tunnel surgery. The advantage of the endoscopic method is a more rapid recovery and fewer wound healing complications.¹⁻⁴ The port incisions tend to be shallower and heal more quickly than the transverse incision through flexor zone IV of the hand, which cuts through dermis, subcutaneous tissue, palmar fascia, occasional muscle belly, and finally, the transverse carpal ligament. Long-term results, however, are found to be comparable.^{1,5} The endoscopic method has not been universally adopted by hand surgeons, citing increased costs compared with the open technique⁶⁻⁸ as well as an elevated risk of reversible nerve injury.^{1-4,9}

The plastic surgery service at our facility has been offering the endoscopic method for over 20 years. Informed consent always includes the open method as a possibility in the event that the transverse carpal ligament cannot be visualized for safe endoscopic release. We tell the patient that we will not risk a nerve injury by deploying a blade if we cannot visualize the ligament well. We traditionally have told the patients that we cannot predict who will need an open release until we start the surgery and look for the transverse fibers of the transverse carpal ligament under the camera. This was based on our own experience as well as the lack of evidence in the literature for predicting poor visualization.

The objective of the study was to determine an overall endoscopic to open carpal tunnel conversion rate using the dual port Chow technique and to identify potential predictive factors that lead to poor visibility of the ligament under endoscopic vision. We chose nine potential factors that could be identified through a chart review: patient age, sex, body mass index (BMI), electromyograph (EMG) severity, the presence of wrist arthritis, prior steroid injections into the carpal tunnel, resident as operating

surgeon, diabetic status, and operated hand dominance. We also wanted to find out if prior conversion predicted a future conversion on the contralateral hand. This information would help with the informed consent process and allow us to give the patient better data-driven information and expectations.

Materials and Methods

The institution's IRB/IRBnet approved (#20210613/1639264) a retrospective chart review of all attempted dual port Chow technique endoscopic carpal tunnel surgeries performed over a 9-year period from July 1, 2012 through June 30, 2021 based on CPT codes 29848 (endoscopic carpal tunnel release) and 64721 (open carpal tunnel release). All endoscopic carpal tunnels in our institution are performed in the operating room. Patients routinely receive IV sedation and local anesthesia for this procedure. This is a single-center case series in a teaching hospital setting. Informed consent was determined not to be needed for this study. The consult, history and physical, and operative notes were reviewed for procedure performed (endoscopic or endoscopic converted to open carpal tunnel release), age, sex (male or female), BMI, EMG reading ("severe" or not), wrist arthritis on x-ray (yes or no involving the radiocarpal joint, mid-carpal joints, carpometacarpal joints, or distal radial ulnar joint), receipt of preoperative steroid injections (any time leading up to the surgery), resident as operating surgeon (yes or no), diabetic status (yes or no), and operated hand dominance (yes or no). The overall conversion rate was noted. A chi-square test using a P -value of <0.05 was used to determine the statistical significance of the patients' median age, sex, median BMI, EMG severity reading, the presence of wrist arthritis, preoperative carpal tunnel steroid injections, resident as surgeon, diabetes, and operated hand dominance as predictive factors for conversion. Statistical analysis was performed using Microsoft Excel version 2302.

Equipment failures requiring conversion were not included in the database. Endoscopic release is not offered for secondary carpal tunnel release.

For consistency, the same surgeon and the same endoscopic method was used for all the surgeries for this study. The surgeon was 5 years of out training and 2.5 years past successful oral board exam to minimize variance in technique and comfort level. This is an academic teaching institution where most surgeries are performed by residents under scrubbed faculty supervision. There is an off-site ambulatory center where the attending surgeon often works independently due to drive time and lack of redundancy in the trainee population.

This case series has been reported in line with the PROCESS Guideline.¹⁰

Results

The plastic surgery service performed 1053 endoscopic carpal tunnel releases using the Chow dual port endoscopic technique over a 9-year period from July 1, 2012 through June 30, 2021 (Table 1). There were 45 endoscopic to open conversions. This gave a 4.27% conversion rate. The reason for 43 of the conversions was soft tissue obstructing the field that could not be removed using endoscopic methods (cotton-tipped applicator, blunt hook, rasp, repositioning obturator). Two conversions were due to uncertainty of operator location. There were no endoscopic blade deployment injuries.

The median age of all 1053 surgeries was 61 years. The median age of completed endoscopic surgeries was 61 years. The median age of the converted surgeries was 59. This was not statistically significant, P -value = 0.54.

Table 1. Predictive Factors for Converted Carpal Tunnel Surgery.

Studied factor	Endoscopic surgery (n = 1008)	Endo→Open Carpal Tunnel (n = 45)	P-value
Median age > 61	489	20	
Median age ≤ 61	519	25	0.54
Median BMI > 32	438	19	
Median BMI ≤ 32	570	26	0.76
Male	836	39	
Female	172	6	0.43
EMG “severe”	343	11	
EMG not “severe”	665	34	0.20
(+) wrist arthritis	549	24	
(-) wrist arthritis	414	18	1.0
(+) preop steroid injection	135	7	
(-) preop steroid injection	873	38	0.65
(+) resident as surgeon	601	25	
(-) resident as surgeon	407	20	0.53
(+) diabetes	295	11	
(-) diabetes	713	34	0.50
(+) dominant hand	544	28	
(-) dominant hand	459	17	0.36

BMI: body mass index; EMG: electromyograph.

There were 836 (83%) men and 172 (17%) women who completed endoscopic surgeries. There were 39 (87%) men and 6 (13%) women who converted surgeries. This was not statistically significant with a P -value = 0.43.

The median BMI of all 1053 surgeries was 32. Individually, the median BMI of both the completed endoscopic and open carpal tunnel releases was 32 and not statistically significant with a P -value = 0.76.

EMG studies were read as “severe” in 343 (34%) of the completed endoscopic cases and 11 (24%) of the converted cases. This was found to not be statistically significant with a P -value = 0.20.

Wrist arthritis was noted in 549 (57%) of the completed endoscopic cases where x-rays were available. Wrist arthritis was noted in 24 (57%) of the converted cases where x-rays were available. This was not significant with a P -value of 1.0.

One or more prior steroid injections were documented to have been administered for symptomatic relief in 135 (13%) of the completed endoscopic surgeries, compared with seven (16%) in the converted cases. This was not found to be statistically significant with a P -value = 0.65.

Resident as operating surgeon was found in 601 of the completed (60%) endoscopic surgeries and in 25 (56%) of the converted surgeries. This was not statistically significant with a P -value of 0.53.

Diabetic status was documented in 295 (29%) of the completed endoscopic surgeries and 11 (24%) of the converted surgeries. This was not statistically significant, with a P -value of 0.50.

The endoscopic surgery was completed in 544 (54%) dominant hands. There were five endoscopic cases where hand dominance was not recorded. Twenty-eight (62%) of dominant hands were converted to open release. Hand dominance was not statistically significant with a P -value of 0.36.

Nineteen of the converted cases had successful contralateral endoscopic carpal tunnel releases during the study period. There was no need for a contralateral converted endoscopic to open release during the 9-year study period.

Discussion

Carpal tunnel syndrome is the most common peripheral nerve compression in the United States¹¹ and results in nearly 500,000 surgical releases per year.¹² Both the open and endoscopic methods are appropriate methods of treatment, each with its advantages and disadvantage. The open release is the more traditional method, has a shorter learning curve, can be done in a clinic setting with few instruments, and has consistently good results.¹¹ The endoscopic method has the advantage of a faster return to work^{1-4,12,13} and fewer wound complications.^{1,2,4,6,14} The endoscopic technique requires a steeper learning curve,¹⁵ has a higher risk of neuropraxia,^{1-4,9} and higher costs due to the OR time, anesthesia, and equipment requirements.⁶⁻⁸ Return to work time can be difficult to interpret due to differences in patient activity and occupations.¹

The plastic surgery service at our facility has been providing both methods for decades. The endoscopic release, using the

two-port Chow technique, is the preferred method at our institution. Patients actively seek out the endoscopic approach for their surgery. This is a teaching institution with rotating residents, fellows, and students. Informed consent always allows for the possibility of converting an endoscopic to an open method. The patients have been traditionally been told, based on surgeon experience, that we cannot guarantee an endoscopic release until an attempt has been made to visualize the transverse carpal ligament under the camera. If there is too much synovial tissue obstructing the view, the motor branch of the median nerve is visualized in the field, or we identify any reason that would preclude a safe operation, we will convert to an open release rather than risk a median nerve injury. Patients seem to understand and accept the possibility that their surgery may not stay endoscopic. This study was performed to help us identify predictive factors, previously unrecognized, that could predict an increased risk of endoscopic to open conversion.

Other surgical disciplines have identified predictive factors for converting from minimally invasive to open techniques. Laparoscopic cholecystectomies have a higher risk of conversion to open in patients with advanced age, male gender, constrictive or restrictive lung disease, anemia, and prior laparotomies.¹⁶ Thoroscopic surgeries have a higher risk of conversion in males age older than 70 years and node-positive disease.¹⁷ Obesity and underweight, age > 50 years, ASA class 3 or 4, smoking, and ascites were found significant for conversion from laparoscopic to open colectomy.¹⁸ Upper endoscopic gastrointestinal procedures have an elevated risk of conversion for foreign body removal in patients older than 70, impaction time > 40 h, foreign body > 3.0 cm, and upper esophagus location.¹⁹ Appendectomies have a higher risk of being converted from laparoscopic to open in the setting of intraoperative perforation, necrosis, gangrene, abscess, and peritonitis.²⁰ Higher BMI, previous laparotomy, asthma, single-port technique, and lower surgeon case volume are indicators of a higher risk of converting robotic gynecologic procedures.²¹

A retrospective review of 892 endoscopic carpal tunnel surgeries using the single-port Agee technique performed by two fellowship trained hand surgeons in an academic practice found a 1.02% conversion rate due to poor visualization from hypertrophic tenosynovium (44%) and aberrant nerve anatomy (33%).²² The same authors found a 0.62% incidence of conversion in their systemic review of studies from 2000 to 2021.²² Other published studies quoted a rate of 3–4.4% conversion.^{15,23–26}

A Pubmed search failed to find literature suggesting risk factors for endoscopic to open carpal tunnel release other than surgeon and anesthesia provider learning curve.¹⁵ This study attempted to minimize this variable by starting the review 5 years after fellowship training in both plastic and hand surgery and after completion of plastic surgery and hand surgery board exams.

Potential indicators of difficult visualization were chosen by the authors because these data (age, sex, handedness, EMG findings, x-ray reports, prior injections, BMI, diabetic status)

were routinely documented during the consult and again during the history and physical or in the operative note (resident as surgeon). The attending surgeon was present and scrubbed throughout all surgeries.

Experience has shown the first author that under proper supervision and guidance, the most dangerous part of this case can be the initial transverse incision into the distal forearm. Trainees who are more familiar with the thick palmar tissue when doing the open method or cutting into the abdomen, back, or scalp, which requires a heavier hand, may initiate too much force on the distal volar forearm skin. The trainees are regularly told to cut “just dermis” when approaching this surgery. This is to avoid an inadvertent cut into the palmaris longus tendon or median nerve.

This study reports a rate of higher rate of endoscopic to open release than some published studies; however, in our training program, the plastic residents and fellows are taught that conversion to an open case when visualization, anatomy, or operator location is uncertain, is not a failure on the operators’ part, but safe surgical practice.

Limitations

This was a retrospective chart review and the data is collected from information documented before the study began. Attending surgeons, different level of residents and fellows (post-graduate years 1 to 8), and a nurse practitioner were all involved in documentation. Data is also dependent on accurate disclosure and recollection by the patients. Some may not have reported a prior steroid injection used as treatment before presenting to our service. Fortunately, the electronic medical record is part of a large, enclosed healthcare system and information is easily shared among providers in different cities as long as the patient seeks treatment within the system.

Many of the nerve conduction and EMG studies were performed outside our system due to the clinical backlog and scanned into the chart. We strongly prefer to keep studies in-house as a basis of comparison in the event the patient has a poor or incomplete response. Often, the outsourced studies give little information other than a conclusion. Labs may also have different cut-off values for what is considered “borderline,” “mild,” and “severe.” The service typically requires EMGs to be within 2 years of the surgery; however, there may have been rescheduling of surgery that fell out of the routine time frame due to patient or system factors, including the pandemic.

The study was not designed to not evaluate the outcome of converted surgery, relative to the minimally invasive approach; however, Beck et al found no difference in symptom relief, pain relief, or complications in converted surgeries.¹⁵

Conclusions

A low conversion rate from endoscopic to open carpal tunnel release can be safely obtained in experienced hands. The authors could not identify predictive risk factors when age,

sex, BMI, EMG severity, wrist arthritis, receipt of preoperative steroid injections, resident as surgeon, diabetic status, and operated hand dominance were evaluated as independent risk factors. This is consistent with what the clinicians in our practice have been telling patients during the informed consent process. There is no reason to believe that a prior conversion on one side predicts a future contralateral conversion.

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Presentations and Publications

This study was accepted and scheduled to be presented as an e-poster at the AAHS Annual Meeting 1/9 to 1/13/24 in Nassau, Bahamas.

Author Contributions

Coady-Fariborzian submitted the IRB and collected and analyzed data and wrote the manuscript. Anstead organized the data and edited the manuscript.

IRB Approval

This retrospective chart review was approved by University of Florida IRB#202101613 and North Florida South Georgia VA IRBNetID#: 1639264

All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008. Informed consent was not needed for this study due to the nature of this study (retrospective chart review).


Declaration of Conflicting Interests

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