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Comparison of Open and Endoscopic Approach in Carpal Tunnel Release: A Systematic Review

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ABSTRACT

Carpal Tunnel Syndrome (CTS) is a musculoskeletal disorder caused by the compression of the median nerve, with an incidence of 1 to 3 cases per 1000 people annually and a prevalence of 50 per 1000 in the United States. The two main surgical treatments for CTS are open carpal tunnel release (OCTR) and endoscopic carpal tunnel release (ECTR). This study aims to compare the outcomes of ECTR and OCTR based on randomized controlled trials (RCTs). A systematic review was conducted following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines, focusing on RCTs published between 2013 and 2023. The outcomes analyzed included the Boston Carpal Tunnel Questionnaire Symptom Severity Scale (BCTQ-S), Boston Carpal Tunnel Questionnaire Functional Status Scale (BCTQ-F), VAS score, and postoperative complications. The Grading of Recommendations Assessment, Development, and Evaluation (GRADE) guidelines were used to assess the level of evidence. Seven studies, including 271 hands treated with ECTR and 285 hands treated with OCTR, were reviewed. The comparison results showed minimal differences in BCTQ-S (MD=0.06), BCTQ-F (MD=0.02), VAS (MD=0.03), and complications (ECTR vs OCTR = 5 vs 9). Both ECTR and OCTR produced similar results, with only slight differences observed. In conclusion, ECTR and OCTR offer comparable outcomes based on BCTQ-S, BCTQ-F, VAS score, and postoperative complications. Despite some differences, these findings should be interpreted cautiously and not considered conclusive.

Keywords: Carpal Tunnel Syndrome, ECTR, OCTR, systematic review, postoperative complications.

Introduction

Carpal Tunnel Syndrome (CTS) is a musculoskeletal disorder in which the median nerve is compressed and inflamed, causing most patients to experience radiating pain through the wrist. Repetitive and strenuous activity may exacerbate the pain and impact the patient's quality of life.[1] The incidence of CTS is approximately 1 to 3 persons per 1,000 per year, with a prevalence of 50 per 1,000 in the United States. This incidence and prevalence are almost the same in most developed countries.[2] The prevalence of CTS among garment workers in *Denpasar* was 79.2%. In *Prof. Ngoerah General Central Hospital*, there were only 8 cases per year, with 62.5% managed conservatively and 37.5% undergoing surgery.[3] [4]

There are two surgical approaches for CTS: open carpal tunnel release (*OCTR*) and endoscopic carpal tunnel release (*ECTR*). Each approach has its own advantages and

disadvantages.[1] Therefore, we conducted a study to compare the outcomes between *ECTR* and *OCTR* based on several randomized controlled trials (RCTs). [A1][A2]

Despite the widespread prevalence of CTS and the availability of different surgical options, there remains a lack of comprehensive comparison between the outcomes of these approaches, particularly regarding recovery time, post-operative complications, and long-term patient satisfaction. Previous studies, such as those by Li et al. (2017) and Chang et al. (2019), have compared *ECTR* and *OCTR*, but they often focus on limited outcome parameters or fail to provide direct comparisons using modern tools and updated methodologies. These studies typically emphasize surgical success rates but overlook long-term functional outcomes and complications, leaving gaps in understanding the most effective approach for diverse patient populations.

This study aims to bridge this gap by conducting a systematic comparison of *ECTR* and *OCTR* based on a variety of factors, including functional outcomes, complication rates, and patient satisfaction. Using recent randomized controlled trials (RCTs), this research evaluates both approaches comprehensively, considering a wider range of clinical outcomes.

The findings of this study will provide crucial insights into which surgical approach offers better outcomes for CTS patients, thereby guiding clinical decision-making. By addressing the gaps identified in previous research, this study will also contribute to the ongoing debate regarding the optimal surgical intervention for CTS, providing evidence that can help improve patient care. Furthermore, the research could lead to more informed policies in surgical practices, improving resource allocation in healthcare settings.

Research Method

This systematic review was conducted in accordance with the Preferred Reporting Items of Systematic Reviews (*PRISMA*) guidelines.[5] Studies were identified through an electronic systematic search of *PubMed*, *Embase* (Elsevier), *Cochrane Central* (Wiley), *Scopus* (Elsevier), and *ClinicalTrials.gov*. The search keywords used were related to “open surgery”, “endoscopic”, “carpal tunnel release”, and “carpal tunnel syndrome”, utilizing the Boolean operators AND OR. The searching strategy is detailed in Table 1.

We included only randomized controlled trials (*RCTs*) published from 2015 to 2025 to ensure the sources were updated and relevant to the current situation. The resulting *RCTs* were screened based on the relevance of their titles and abstracts. We excluded articles published in non-peer-reviewed journals, those lacking an abstract, and duplicates of already included papers. All studies that compared *ECTR* and *OCTR* with any technique in patients with carpal tunnel syndrome and published in the English language were included.

Extracted data included the authors’ names, publication year, region, sample size, surgical technique, and a summary of outcomes. Outcome parameters were the Boston Carpal Tunnel Questionnaire Symptom Severity Scale (*BCTQ-S*), Boston Carpal Tunnel Questionnaire Functional Status Scale (*BCTQ-F*), VAS score, and postoperative complications. The level of evidence was assessed according to the Grading of Recommendations Assessment, Development, and Evaluation (*GRADE*) guidelines.

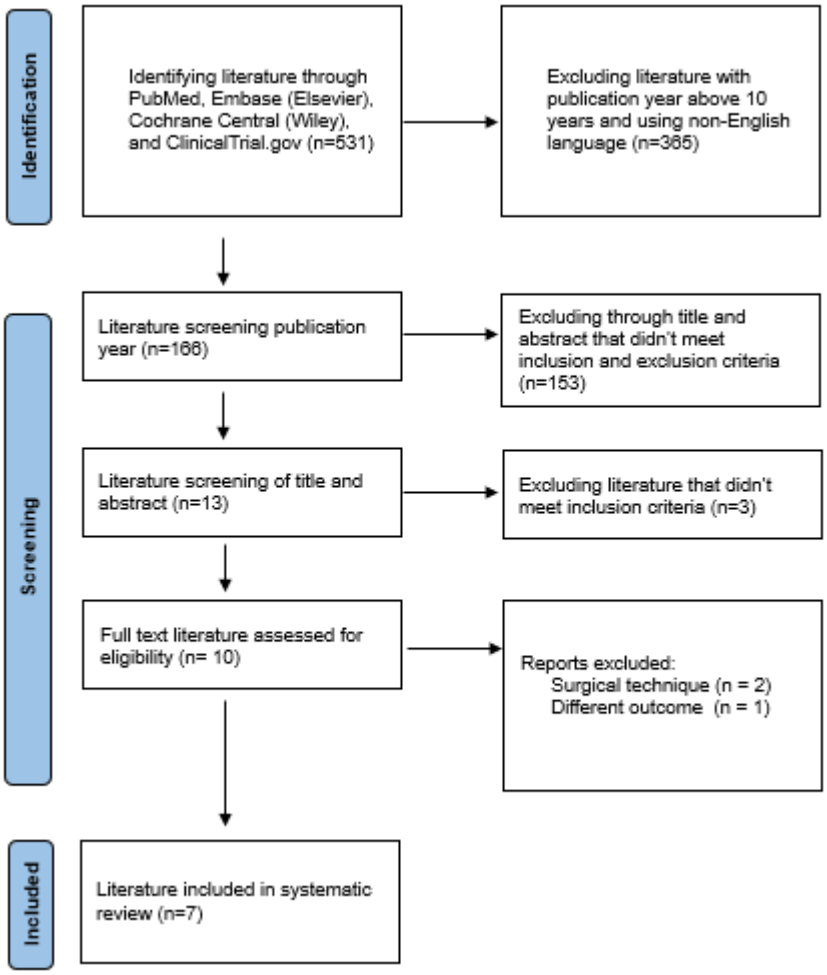

Figure 1. Research flow

Results and Discussion

Ten studies that has been quality assessed based on GRADE guideline in Table 2 were involved in this study. Nine studies were at low-risk selection bias of random sequence generation, while only one study had risk of blinding of outcome assessment for results. All RCTs were at a low risk of reporting bias The outcomes summary could be seen in Table 3. In total, there were 271 hands in ECTR approach and 285 hands in OCTR approach. There were three types of technique used in ECTR and four types of technique used in OCTR.

Five studies were involved in the analysis of Boston Carpal Tunnel Questionnaire Symptom Severity Scale (BCTQ-S) which showed slight differences (Mean Difference (MD) = 0.06). Five studies were involved in the analysis of Boston Carpal Tunnel Questionnaire Functional Status Scale (BCTQ-F) which showed slight differences (MD=0.02). Three studies were involved in the analysis of Visual Analog Scale (VAS) which showed slight differences (MD = 0.03). Six studies were involved in the analysis of complication rates which showed difference (ECTR vs OCTR = 5 vs 9). All studies showed ECTR and OCTR gave similar result, although the difference was slightly.

Table 1. Outcomes summary of the RCTs

Study (year)	Region	Follow up	Sample		Surgical Technique		Outcomes
			ECTR	OCTR	ECTR	OCTR	
Gumustas (2015)[7]	Turkey	6 months	21	20	Two portal (Chow)	NR (Taleisnik)	BCTQ-S, BCTQ-F, median nerve motor DL, CMAP, SCV, sensory nerve action potential, complications
Michelloti (2018)[8]	USA	2, 4, 8, 12, 24 weeks	30	30	One-portal (Agee) 1.5 to 2 cm	Palmar incision 3 cm	VAS pain score, 2PD test, SW monofilament test, thenar strength, grip strength, BCTQ-S, BCTQ-F, satisfaction rating, complications
Zhang (2016)[10]	China	3 years	65	72	Two portal (Chow)	Double small incision	BCTQ-S, BCTQ-F, patient satisfaction, VAS pain score, cylindrical strength, lateral strength, pinch strength, grip strength, time to RTW, 2PD test, SW monofilament test, hospital cost, complications
Atroshi (2015)[11]	Sweden	1, 11-16 year	63	61	Two portal (1 cm)	Classic incision 4 cm	BCTQ-S, BCTQ-F, pain score, numbness and tingling, satisfaction score, quick DASH, pain scale, complications
Schwarm (2022)[13]	German	3, 12 months	22	18	Retractor endoscopic	Palmar incision 3 cm	Operation time, McGowan score, Neurophysiologic examination, Bishop score, Duration of incapacity to work and postoperative pain, Subjective weakness

Study (year)	Region	Follow up	Sample		Surgical Technique		Outcomes
			ECTR	OCTR	ECTR	OCTR	
							and subjective assessment of the operative result, Muscle atrophy and hypoesthesia, Complications
Oh (2017)[15]	South Korea	24 weeks	35	32	One-portal (Agee)	Mini-incision (1.5 cm)	BCTQ-S, BCTQ-F, DASH, CSA, CSA-I, CSA-M, CSA-O, flattening ratio, complications
Martinez (2019)[16]	Spain	1,4 weeks 6, 12 months	35	52	One-portal (Menon)	Mini-incision (1 cm)	Grip strength, pinch strength, VAS pain score, satisfaction questionnaire, complications

Table 2. Outcomes of Studies

	ECTR	OCTR
Boston Carpal Tunnel Questionnaire Symptom Severity Scale (BCTQ-S)		
Atroshi (2015)	1.4±0.6	1.4±0.5
Gumustas (2015)	1.26±0.48	1.41±0.46
Oh (2017)	1.2±0.2	1.3±0.3
Zhang (2016)	1.5±0.36	1.2±0.45
Boston Carpal Tunnel Questionnaire Functional Status Scale (BCTQ-F)		
Atroshi (2015)	1.3±0.5	1.2±0.4
Gumustas (2015)	1.2±0.35	1.56±0.48
Oh (2017)	1.5±0.37	1.7±0.37
Zhang (2016)	1.5±0.42	1.2±0.38
Visual Analog Scale (VAS)		
Atroshi (2015)	3.5±11	5.1±16
Martinez (2019)	0.52±1.5	0.17±0.81
Zhang (2016)	0.06±0.31	0.05±0.44
Complication rates		
Gumustas (2015)	2	1
Martinez (2019)	2	1
Michelloti (2018)	0	0

Oh (2017)	0	0
Schwarm (2022)	1	7

Discussion

This systematic review was made as an update from the previous study. We excluded several studies from the analysis because the data were incomplete and did not use the same method. Both ECTR and OCTR gave a promising result in several aspects, but the studies involved showed inconsistent data where sometimes the ECTR gave better result or vice versa. These were also strengthened with the statistic result which were not significant and the data was moderately heterogenic.

The most current approach of ECTR is two portal. This procedure put the wrist and fingers hyperextended, then the trochar inserted at the base of the hook of hamate as a guide. Then a hook knife is inserted, and the carpal ligament fibers are released by segments.17 While in open carpal tunnel release, the surgeon incised the subcutaneous tissue for about 1.5 cm and release the ligament under direct vision.18 This review showed that complication rates between OCTR and ECTR was similar because the proportion of complications for carpal tunnel release performed with both technique is very low.19 Other study also showed a very low power (<50%) although they have included 5000 patients. This study also suggested that the probability of finding significant result is very low and the conclusions are unlikely to differ.20 A review by Shin said that both approached are comparably safe and equal, besides more surgeon preferred mini incision rather than endoscopic.21 A recent meta-analysis showed that ECTR showed better outcomes in key pinch strengths, earlier return to work times, transient nerve injury rate, complications, and satisfactions.22 This study divided the variable based on follow up period which we did not do due to lack of studies and became our limitation. We also used different techniques of surgery which might influence the result. In contrast, other eight studies found that ECTR gave better result in terms of return to work for about 6 days earlier. But, there might be consequences, especially for patient with history of abnormal anatomy, anatomic anomalies, trauma, previous surgery on hand or wrist, infection, or inflammation. The reason was because in ECTR, the visualization is limited and it might damage the neuron or arterial. Transient neuropraxia was common in ECTR. In terms of cost, each intuitions might have different prices. But, a retrospective review in 2019 showed that ECTR was pricier for about $600 than OCTR.21

CONCLUSION

Both Endoscopic Carpal Tunnel Release (*ECTR*) and Open Carpal Tunnel Release (*OCTR*) demonstrated comparable outcomes when evaluated using the Boston Carpal Tunnel Questionnaire Symptom Severity Scale (*BCTQ-S*), the Functional Status Scale (*BCTQ-F*), Visual Analog Scale (*VAS*) scores for pain, and the incidence of postoperative complications. While some differences were observed between the two surgical techniques, these variations were not substantial enough to indicate a clear clinical superiority of one method over the other. Therefore, the findings should be interpreted with caution, considering potential limitations such as sample size, study design, and follow-up duration, and should not be regarded as a definitive conclusion regarding the efficacy or safety of either procedure.

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