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Original article

Comparison between single portal endoscopic and 1-cm open carpal tunnel release

Comparaison entre la libération du nerf médian au canal carpien endoscopique à une voie et la libération ouverte mini-invasive

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ABSTRACT

Given the controversy about the best surgical technique for carpal tunnel release, this study tested the hypothesis that no significant differences would be observed between single-portal endoscopic release and a short, 1-cm incision open release in a large sample of patients. Consecutive patients were assigned to one of the two techniques. Preoperative and postoperative measurements included grip and pinch strength, a visual analog scale for pain and a satisfaction questionnaire. Eighty-seven patients completed the study: 35 with an endoscopic release and 52 with an open release. Both techniques were effective and safe: grip and pinch strength decreased 1 month after surgery in both techniques but improved significantly at 6 and 12 months ($P < 0.05$) while the complication rate was low. Subjective results were judged to be "excellent or good" by more than 90% of patients in both groups. No significant between-technique differences in outcomes were observed thus, surgical decisions may be based on criteria other than effectiveness.
Level of evidence: Level IV; Case Series; Treatment Study.

RÉSUMÉ

Dans un contexte de controverse sur la meilleure technique chirurgicale, cette étude a vérifié dans un large échantillon l'hypothèse qu'aucune différence significative ne serait observée entre la libération du canal carpien endoscopique à une voie et la libération ouverte mini-invasive avec une incision réduite de 1 cm. Les patients consécutifs ont été distribués entre les deux techniques. Les mesures préopératoires et postopératoires ont inclus la force de poigne et de pince pouce-index, une échelle visuelle analogique sur la douleur et un questionnaire de satisfaction. Quatre-vingt-sept patients ont terminé l'étude, dont 35 endoscopiques et 52 à ciel ouvert. Les deux techniques étaient efficaces et sûres: la force de poigne et de pince avaient diminué un mois après la chirurgie, mais elles s'étaient nettement améliorées à 6 et 12 mois ($p < 0{,}05$) et le taux de complications était faible. Les résultats subjectifs ont été jugés « excellents ou bons » par plus de 90% des patients des deux groupes. Aucune différence significative des résultats entre les groups n'a été observée et, par conséquence, les décisions chirurgicales pourraient être basées sur des critères différents de l'efficacité de ces techniques.
Niveau de l'étude. – Niveau IV, étude de cas.

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1. Introduction

Carpal tunnel syndrome (CTS) is the most common compressive neuropathy of the upper extremity [1]. The conventional open release technique has proven to be effective and safe [2,3], but limited open techniques (LOCTR) have received increasing support in recent years [4,5]. Both two-incision [6,7] and single-incision LOCTR techniques [8,9] have been shown to result in favorable outcomes [10–13]. The endoscopic technique (ECTR) is a new approach; both two-portal and single-portal endoscopic release of the transverse carpal ligament (TCL) have been reported to be safe and effective [14,15].

Nonetheless, there is no generalized consensus as to which of ECTR and LOCTR techniques is superior, and controversies have emerged. LOCTR has been advocated by some surgeons because it is easier to perform and does not require special equipment [16]. Two different reviews suggest ECTR is superior in some respects, including early improvement during the early postoperative period, allowing earlier return to work [1,17]. In fact, given the methodological flaws detected in some of the studies assembled in these reviews, as well as the fact that both suggest the overall effectiveness was similar following either technique, it is difficult to draw firm conclusions applicable to clinical practice.

Moreover, with the exception of the article by Mackenzie et al. [14], we have not found reports specifically comparing the two techniques commonly used in our hospital: single-portal endoscopic carpal tunnel release and 1-cm limited open release. Mackenzie et al. suggested better outcomes with the endoscopic technique, but they recruited only a small number of patients, used a 2.5-cm incision in the open release technique and had a follow-up period of only 4 weeks.

In this context, before implementing evidence-based policy decisions, the aim of our study was to compare the results of single-portal ECTR versus short, 1-cm incision LOCTR in terms of strength, complications and patient satisfaction at 6 months and 12 months of follow-up. Based on our clinical experience, we hypothesized that no significant differences between the two procedures would be found.

2. Methods

During the period from August 1, 2009 to December 31, 2010, a prospective study was conducted in consecutive patients admitted to our hospital who suffered from carpal tunnel syndrome (CTS). The CTS diagnosis was based on clinical examination (pain, paresthesia and numbness) and electroneurographic findings. To be included in the study, patients were required to fulfill the criteria for surgical treatment, namely digital sensory alteration according to the Semmes-Weinstein monofilament test, and refractory pain, associated with moderate, severe or very severe results in the electroneurographic test. The exclusion criteria were presence of recurrent CTS, previous corticosteroid injection and/or previous surgery in the affected hand and/or the patient stating they preferred one technique over the other.

In our sample size calculation, accepting an alpha risk of 0.05 and a beta risk of 0.2 in a two-sided test, 34 subjects were needed in each group to recognize a difference greater than or equal to 3.5 units as statistically significant. The common standard deviation was assumed to be 5. Since a drop-out rate of at least 5% was anticipated, the study sought to recruit the first 100 patients fulfilling the inclusion criteria. While randomized assignment of patients to each treatment group was planned, it also depended on the availability of the three participating surgeons and the decision to assign them different techniques: surgeon "A" was expected to perform the LOCTR technique and surgeon "C" the ECTR technique, both exclusively, while surgeon "B" was expected to perform both techniques.

In all cases, regional anesthesia was performed, and a tourniquet was inflated to 200 mmHg in the arm. LOCTR was performed as described by Bromley (3), with a longitudinal mini-incision that does not exceed 1 cm between both thenar and hypothenar eminences. To make it easier to identify the TCL, Senn-Miller type retractors were used to divide the ligament using a scalpel supported on a cannulated probe, first distally and then proximally (Fig. 1). ECTR was performed as described by Menon [15] by making a single endoscopic portal through a transverse incision on the volar side of the wrist, 1 cm proximal to the pisiform and the palmaris brevis tendon. By inserting a probe in a distal direction towards the 4th ray, just below the TCL, the ligament was divided by a scalpel supported on the probe and guided by the endoscope (Fig. 2).

In both the preoperative and postoperative phases, the clinical findings and pinch and grip strength in pounds-force per square inch (psi) were recorded at 1 week then at 1, 6 and 12 months after surgery using a hand dynamometer. A visual analog scale (VAS) was used to assess pain. At the final assessment, patient were asked to rate their satisfaction as "Excellent", "Good", "Fair", or "Poor".

The statistical analysis included mean values and standard deviations to describe quantitative variables, and frequencies for categorical variables. Two-tailed Chi^2 tests were used to compare categorical data, and two-tailed t-tests and Wilcoxon tests used for parametric and non-parametric data, respectively. Significance was set at $P \leq 0.05$. IBM SPSS Statistic Version 21 tool was used for data analysis.

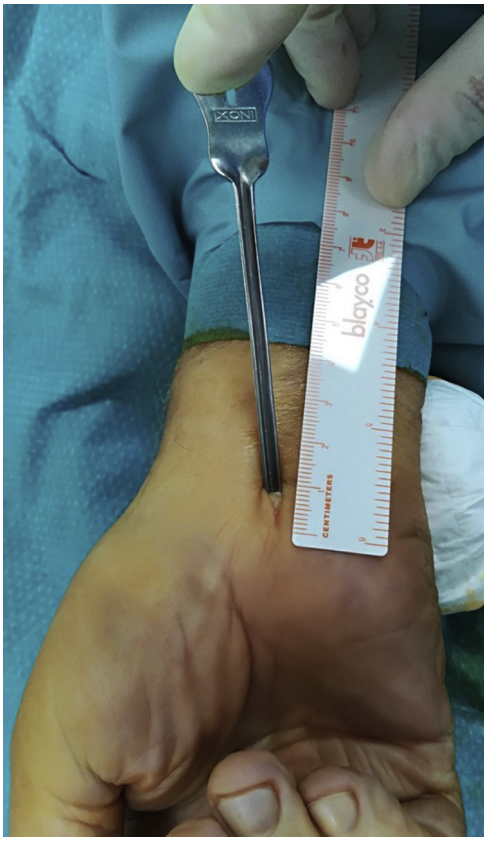

Fig. 1. The LOCTR technique is shown, with a longitudinal mini-incision that does not exceed 1 cm between the thenar and hypothenar eminences. The cannulated probe used to support the scalpel is also shown.

Fig. 2. The ECTR technique is shown, with a single endoscopic portal through a transverse incision on the volar side of the wrist, located 1 cm proximal to the pisiform and the palmaris brevis tendon. An inserted probe towards the 4th ray is also shown.

Table 1
Demographic and preoperative characteristics of the sample (n = 87).

	1-cm LOCTR	One portal ECTR	P
Number of patients	52 (59.8%)	35 (40.2%)	
Age	57.75 ± 14.38	50.4 ± 15.62	0.46
Sex			
Women	39 (57.4%)	29 (42.6%)	
Men	13 (68.4%)	6 (31.6%)	0.384
Preoperative pain (VAS)	6.48 ± 2.47	5.39 ± 2.99	0.073
Electroneurography			
Moderate	17 (56.7%)	13 (43.3%)	
Severe	28 (59.6%)	19 (40.4%)	
Very severe	7 (70%)	3 (30%)	0.757
Preoperative strength (psi)			
Grip	8.37 ± 3.69	8.7 ± 3.45	0.594
Pinch	4.5 ± 1.83	4.31 ± 1.43	0.822

3. Results

One hundred CTS patients were recruited, 13 cases were lost and 87 patients (68 females and 19 males) completed the follow-up period. The mean age of those completing the study was 54.8 ± 15.2 years (range, 20–87 years) and mean duration of symptoms before the operation was 4.5 ± 6.9 months (range, 1.25 months to 3.5 years).

LOCTR was performed in 52 patients (23 left hand, 29 right hand) and ECTR in 35 patients (6 left hand, 29 hand right). The subjects operated by the open method had a mean age of 57.7 years, and 50.4 years for the endoscopic technique, without statistical differences between them (P = 0.46). The groups did not differ in terms of gender (P = 0.384), severity of preoperative pain (P = 0.073), severity of electroneurography findings (P = 0.757) or preoperative pinch and grip strength (P = 0.59 and P = 0.822, respectively) (Table 1).

Average grip and pinch strength compared to preoperative values are shown in Tables 2 and 3. LOCTR patients had a significant decrease in grip strength 1 month after surgery (P = 0.001), improving at 6 months (P = 0.003) and 12 months (P = 0.001). Pinch strength on this group did not decrease the first month after surgery and improved significantly at 6 and 12 months ($P < 0.05$) (Table 2). ECTR patients had a significant decrease in grip strength the first month after surgery ($P < 0.05$), although the decrease in pinch strength did not reach statistical significance (P = 0.39). Subsequent measurements at 6 months and 12 months found significant increases in both pinch and grip strength compared to preoperative values ($P < 0.05$) (Table 3).

Comparison of LOCTR and ECTR outcomes at follow-up are shown in Table 4. Both measurements of strength, and particularly grip strength 1 month after the procedure decreased noticeably with both techniques, but no between-technique significant differences were observed (P = 0.86 and P = 0.67, respectively). At 6 months, the improvement was higher in the LOCTR group, but the differences with the ECTR group were non-significant (P = 0.836 and P = 0.232, respectively). At 12 months, the pinch strength improved more in the LOCTR group, while the grip strength improved more in the ECTR group but, again, the differences did not reach statistical significance.

The pain scores (VAS) reported by patients at last follow-up visit were quite low, indicating an absence of significant pain (0.17 ± 0.81 in the LOCTR group and 0.52 ± 1.59 in the ECTR group) but no between-group significant differences were observed (P = 0.27). In the final subjective assessment, 94.3% of patients in the LOCTR group had a rating of "excellent" or "good" and 91.5% in the ECTER group, with the differences being non-significant (P = 0.58) (Table 5).

Surgeon "A" operated 32 patients with LOCTR. Surgeon "B" operated 20 patients with LOCTR and 13 with ECTR. Surgeon "C" operated 22 patients with ECTR technique. No between-surgeon differences in the outcomes were observed. For example, at the 12-month follow-up, differences between post-operative measures and the preoperative measures were as follows: for grip strength, they were 2.31 ± 3.1 (surgeon A), 1.9 ± 2.2 (surgeon B) and 2.75 ± 2.7 (surgeon C) (P = 0.69); for pinch strength they were 1.83 ± 1.8 (surgeon A), 2.1 ± 1.8 (surgeon B) and 1.25 ± 1.5 (surgeon C) P = 0.35; satisfaction was good/excellent in 90.7% (surgeon A), 91% (surgeon B) and 100% (surgeon C), P = 0.88; VAS for pain was 0.28 ± 1.02 (surgeon A), 0.36 ± 1.5 (surgeon B) and 0.2 ± 0.7 (surgeon C), P = 0.91.

Two ECTR patients and one LOCTR patient had a localized hematoma that did not require any additional intervention and resolved without major complications at subsequent visits. One patient operated by LOCTR reported pillar pain at the first follow-up, which resolved completely after 6 months. Subjective assessment at the end of the follow-up was "excellent" in all three cases. No other type of complication was observed during the follow-up period in any patient.

4. Discussion

This study confirms that nerve release by a single portal endoscopic procedure (ECTR) and the limited open approach (LOCTR) are safe and effective techniques in refractory cases of carpal tunnel syndrome (CTS): the grip and pinch strength improved in all patients following the surgery, pain decreased in most patients, and the complication rate was low. Moreover, the great majority of patients rated their satisfaction as "good" or "excellent" (LOCTR = 94.2% and ECTR = 91.5%). In support of our initial hypothesis, no significant between-technique differences were observed in the short and medium term in this prospective study when it comes to strength, pain or patient satisfaction.

Table 2
Average grip and pinch strength compared to preoperative values in the 1-cm LOCTR technique.

Grip strength (psi)						
Preoperative	1 month	P	6 months	P	12 months	P
8.37 ± 3.69	7.00 ± 3.06	0.001	10.08 ± 3.52	0.003	10.50 ± 3.65	0.001
Pinch strength (psi)						
Preoperative	1 month	P	6 months	P	12 months	P
4.50 ± 1.83	4.42 ± 1.51	0.68	6.40 ± 2.06	< 0.05	6.31 ± 2.33	< 0.05

Table 3
Average grip and pinch strength compared to preoperative values in the one-portal ECTR technique.

Grip strength (psi)						
Preoperative	1 month	*P*	6 months	*P*	12 months	*P*
8.70 ± 3.45	7.23 ± 3.71	< 0.05	9.84 ± 3.12	0.018	10.74 ± 3.49	< 0.05
Pinch strength (psi)						
Preoperative	1 month	*P*	6 months	*P*	12 months	*P*
4.31 ± 1.43	4.09 ± 1.66	0.39	5.84 ± 1.73	< 0.05	5.96 ± 2.30	< 0.05

Moreover, the results of our study reinforce its design: contrary to some studies with a short, 4-week follow-up period [14], grip and pinch strength had worsened at the 1-month follow-up, but a positive outcome was observed at the 6-month follow-up, with further improvement at the 12-month measurement.

Previous studies have shown that carpal tunnel release is successful, regardless of whether ECTR [14,15] or LOCTR [18] is used. However, controversies about the advantages and disadvantages of both techniques have made it impossible to reach a generalized consensus. ECTR is considered by some surgeons to be superior. Among the relevant studies in this area, Sayegh and Strauch [1] reported in their meta-analysis of randomized controlled trials that ECTR, when compared to LOCTR, resulted in better outcomes due to lower risk of scar tenderness and improved strength during the early postoperative period, allowing earlier return to work. A Cochrane review supported the findings related to early improvement in grip strength and earlier return to work, and also found a lower risk of minor complications [17]. On the other hand, LOCTR is advocated by some surgeons because it is easier to perform and does not require special equipment [16,19], but also because it may prevent complications typical of endoscopic procedures [13].

Inferences with implications for clinical practice are difficult to make in light of this controversy. In fact, in the Sayegh and Strauch study [1], patients operated with the ECTR technique had an elevated incidence of transient nerve injury, and no between-technique differences were observed in the reoperation rate or in the general outcome at 6 months or later. Likewise, in support of previous studies [10,11,13], Vasiliadis et al. [17] also suggested that ECTR and LOCTR are both effective overall. Unfortunately, several previous studies are hampered by methodological shortcomings. For example, Vasiliadis et al. [17] concluded the results of their review "are limited by the high risk of bias, statistical imprecision and inconsistency in the included studies". Most studies in the Sayegh et al. review [1] had small patient samples, 8 out of the 21 studies reviewed had a follow-up of 4 months or less, and some had only a 4-week follow-up. In the absence of a generalized consensus about the best surgical technique, Sayegh et al. admit that some patients who require an early return to work might prefer the ECTR technique, but also warn surgeons about transient complications amid its similar overall efficacy to LOCTR.

Despite the considerable number of studies comparing ECTR and LOCTR, we have not found reports matching specifically the two techniques commonly used in our hospital: single-portal ECTR and 1-cm, short incision LOCTR. The only exception is the study by Mackenzie et al. [14] who observed that early grip and pinch strength with the endoscopic technique were improved significantly over short-incision open release. However, since they studied only 36 patients and followed them for only 4 weeks, it is difficult to compare their results with ours. While our patients had lower grip and pinch strengths at 4 weeks than in the pre-surgery assessment, both measures improved significantly at the 6-month and 12-month post-surgery assessments. In addition, our open release technique has the advantage using a 1-cm incision vs. the 2.5-cm incision in the Mackenzie et al. study [14].

We did not encounter the technical difficulties described in some studies [20] and, specifically, conversion to the open technique when performing ECTR was not necessary. Furthermore, contrary to Sayegh et al. [1], who reported shorter operative time with ECTR in comparison with LOCTR technique, our clinical experience coincides with the position of Ferdinand and MacLean [21], who suggest that ECTR is a slightly slower technique to perform; we did not record this information in our study. No patient had both hands operated on during the study period.

In terms of complications, and contrary to some previous reports [17], no re-operations were required in our study. A localized hematoma developed during the postoperative period in two ECTR patients and one LOCTR patient, but none required an additional intervention and the hematoma resolved spontaneously. Similarly, the reported pillar pain in one LOCTR patient resolved completely after 6 months. While the great majority of patients judged the results to be "excellent" or "good", the satisfaction level in 4 patients was only fair (3 patients operated by LOCTR and 1 by ECTR), and 1 patient undergoing ECTR reported persistent pain at the scar, rating his satisfaction as "poor" in the last assessment. Since ECTR requires a learning curve and the technique was carried out by trained surgeons, we cannot extend our conclusions to other surgeons.

Among the strengths of our study are its prospective design, the inclusion of one of the largest samples (n = 87) reported in the literature, the long follow-up period with three consecutive assessments and the comparison of outcomes between three different surgeons. The relevance of studying the influence of surgeons has been highlighted previously [1]. The primary limitation of our study was the lack of strict patient randomization. In addition, return to work and the DASH Score were not determined.

Table 4
Difference in strength relative to the preoperative measurement between 1-cm LOCTR and one-portal ECTR techniques (psi).

	1-cm LOCTR	One-portal ECTR	*P*
Grip preop. – 1st month	−1.366 ± 2.76	−1.469 ± 2.14	0.860
Grip preop. – 6th month	1.542 ± 2.88	1.375 ± 2.07	0.836
Grip preop. – 12th month	2.052 ± 2.85	2.674 ± 2.52	0.415
Pinch preop. – 1st month	−0.083 ± 1.43	−0.218 ± 1.42	0.678
Pinch preop. – 6th month	1.828 ± 1.63	1.281 ± 1.15	0.232
Pinch preop. - 12th month	1.879 ± 1.79	1.565 ± 1.67	0.520

Table 5
Pain and satisfaction reported by patients at 12-month follow-up visit after 1-cm LOCTR and one-portal ECTR.

	1-cm LOCTR	One-portal ECTR	*P*
Postoperative pain (VAS)	0.17 ± 0.81	0.52 ± 1.59	0.27
Satisfaction			
Excellent	37 (62.7%)	22 (37.3%)	
Good	12 (54.5%)	10 (45.5%)	
Fair	3 (60%)	2 (40%)	
Poor	0	1 (100%)	0.58

5. Conclusion

This study shows that both the ECTR and the 1-cm LOCTR technique are effective and safe in reducing the symptoms of CTS: while no strength improvement was observed 1 month after surgery, it was apparent at 6 months in both techniques and was maintained at 12 months. Moreover, pain decreased in most individuals, the complication rate was low, and most patients reported high levels of satisfaction. In support of our working hypothesis, no significant between-technique differences were observed in the outcome. Consequently, given that we found no evidence that one technique is superior to the other, factors other than effectiveness such as the technical ability and experience of individual surgeons may influence the choice of CTR technique.

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Informed consent

All patients gave their informed consent for this study.

Disclosure of interest

The authors declare that they have no competing interest.

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