Carpal Tunnel Release Surgery- A Systematic Review of Open and Endoscopic Approaches

Vwaire Orhurhu 1, Sebastian Orman 2, Jacquelin Peck 3, Ivan Urits 4,5, Mariam Salisu Orhurhu 6, Mark R. Jones 7, Laxmaiah Manchikanti 8, Alan D. Kaye 4, Charles Odonkor 9, Sameer Hiji 10, Elyse M. Cornett 11,12, Farnad Imani 13,14,15, Giustino Varrassi 12 and Omar Viswanath 12,13,14,15

1University Of Pittsburgh Medical Center, Williamsport, PA, USA
2Department of Orthopedics, Georgetown University School of Medicine, Washington, DC, USA
3Department of Anesthesiology, Mt. Sinai Medical Center of Florida, Miami Beach, Florida, USA
4Department of Anesthesiology, LSU Health Shreveport, Shreveport, IA, USA
5Southcoast Health, Southcoast Physicians Group Pain Medicine, Wareham, MA, USA
6Department of Anesthesiology and Critical Care Medicine, Johns Hopkins School of Medicine, Baltimore, Maryland, USA
7Weill Cornell Medicine, Weill Cornell Medicine Division of Pain Management, New York, NY, USA
8Pain Management Centers of America, Paducah, KY, USA
9Department of Anesthesia, Critical Care and Pain Medicine, Division of Pain, Massachusetts General Hospital, Harvard Medical School, Boston, Massachusetts, USA
10Departments of Surgery, Brigham and Women’s Hospital, Harvard Medical School, Boston, Massachusetts, USA
11Pain Research Center, Department of Anesthesiology and Pain Medicine, Iran University of Medical Sciences, Tehran, Iran
12Paolo Procacci Foundation, Roma, Italy
13Valley Anesthesiology and Pain Consultants Envision Physician Services, Phoenix, AZ, USA
14Department of Anesthesiology, University of Arizona College of Medicine-Phoenix, Phoenix, AZ, USA
15Department of Anesthesiology, Creighton University School of Medicine, Omaha, NE, USA

Corresponding author:* 15

Department of Anesthesiology, Creighton University School of Medicine, Omaha, NE, USA. Email: farnadimani@yahoo.com

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Abstract

Context: Carpal tunnel syndrome (CTS) is the most frequent peripheral compression-induced neuropathy observed in patients worldwide. Surgery is necessary when conservative treatments fail and severe symptoms persist. Traditional Open carpal tunnel release (OCTR) with visualization of carpal tunnel is considered the gold standard for decompression. However, Endoscopic carpal tunnel release (ECTR), a less invasive technique than OCTR is emerging as a standard of care in recent years.

Evidence Acquisition: Criteria for this systematic review were derived from Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA). Two review authors searched PubMed, MEDLINE, and the Cochrane Database in May 2018 using the following MeSH terms from 1993-2016: ‘carpal tunnel syndrome,’ ‘median nerve neuropathy,’ ‘endoscopic carpal tunnel release,’ ‘endoscopic surgery,’ ‘open carpal tunnel release,’ ‘open surgery,’ and ‘carpal tunnel surgery.’ Additional sources, including Google Scholar, were added. Also, based on bibliographies and consultation with experts, appropriate publications were identified. The primary outcome measure was pain relief.

Results: For this analysis, 27 studies met inclusion criteria. Results indicate that ECTR produced superior post-operative pain outcomes during short-term follow-up. Of the studies meeting inclusion criteria for this analysis, 17 studies evaluated pain as a primary outcome, and 15 studies evaluated pain, pillar tenderness, or incision tenderness at short-term follow-up. Most studies employed a VAS for assessment, and the majority reported superior short-term pain outcomes following ECTR at intervals ranging from one hour up to 12 weeks. Several additional studies reported equivalent pain outcomes at short-term follow-up as early as one week. No study reported inferior short-term pain outcomes following ECTR.

Conclusions: ECTR and OCTR produce satisfactory results in pain relief, symptom resolution, patient satisfaction, time to return to work, and adverse events. There is a growing body of evidence favoring the endoscopic technique for pain relief, functional outcomes, and satisfaction, at least in the early post-operative period, even if this difference disappears over time. Several studies have demonstrated a quicker return to work and activities of daily living with the endoscopic technique.

Keywords: Carpal Tunnel Syndrome, Chronic Pain, Open Carpal Tunnel Release, Endoscopic Carpal Tunnel Release, Endoscopic Surgery, Entrapment Neuropathy, Median Neuropathy, Disability

1. Context

Carpal tunnel syndrome (CTS) is caused when the median nerve is compressed within the carpal tunnel resulting in numbness, paresthesia, and pain within the median nerve distribution of the hand. A proportion of patients may also experience progressive atrophy and loss
of function of associated structures if CTS remains untreated (1). The incidence of CTS is higher in the U.S. compared to Sweden and the United Kingdom (U.K.). CTS is an important cause of work disability with profound and well-described implications for psychological and financial hardship among affected patients (2). CTS is frequently multifactorial or idiopathic, but may also be associated with trauma, diabetes, pregnancy, acromegaly, hypothyroidism, rheumatoid arthritis, vibration, and certain repetitive motions of the hands and wrists.

2. Evidence Acquisition

2.1. Data Sources and Search Strategy

Criteria for this systematic review were derived from Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) (3).

Two review authors searched PubMed, MEDLINE, and the Cochrane Database in May 2018 using the following MeSH terms: ‘carpal tunnel syndrome,’ ‘median nerve neuropathy,’ ‘endoscopic carpal tunnel release,’ ‘endoscopic surgery,’ ‘open carpal tunnel release,’ ‘open surgery,’ and ‘carpal tunnel surgery.’ Additional sources, including Google Scholar, were added. In addition, based on bibliographies and consultation with experts, appropriate publications were identified.

2.2. Eligibility Criteria

Inclusion Criteria: The present investigation included studies that met the following criteria: randomized controlled trials (RCTs) or quasi-RCTs, inclusion of an endoscopic carpal tunnel release (ECTR) treatment arm, and reporting of pain, function, or satisfaction outcomes. Studies with follow-up time greater than one month were included in our search. Exclusion Criteria: Excluded categories were non-English papers, studies available in abstract or poster form only, and retrospective studies and case reports.

2.3. Outcomes of the Studies

The primary outcome measure was pain relief. The most commonly reported pain scores were VAS for pain, Carpal Tunnel Syndrome Symptom Severity Score (CTSSS), Boston Carpal Tunnel Syndrome Questionnaire Symptom severity scale (BCTQ-S), Levine Symptom Severity Score, and subjective reporting of pain. The most commonly reported secondary outcomes included Carpal Tunnel Syndrome Functional Status Score (CTS-FSS), Boston Carpal Tunnel Syndrome Questionnaire Functional status scale (BCTQ-F), pinch/grip strength, sensation (two-point discrimination, monofilament), satisfaction, operating time, and time to return to work.

2.4. Data Extraction

The final evaluation included RCTs and quasi-RCTs and observational studies. The following data were extracted and compiled into a table: author’s last name, publication year, average age, percent of sample size that was female, study size, treatment arm, endoscopic technique, follow-up time, outcomes reported, pain relief outcomes, secondary outcomes, complications, and significant conclusions. When available, mean pain scores were extracted with the intent of doing meta-analysis if possible. Please see Table 1.

2.5. Assessment of Study Quality

Two authors (SO and VO) used the Cochrane Risk of Bias to measure the methodological quality of the RCTs. The Cochrane Risk of Bias has seven items included to assess the internal validity of each of the RCTs. Each of the studies are scored via the allocation of “+,” “−,” or “?” to each criterion that is met or unmet (29). Please see Table 2.

2.6. Analysis of Evidence

For this systematic review, evidence synthesis was performed utilizing a qualitative modified approach to the grading of evidence, modified and collated from multiple available criteria, including Cochrane review criteria and the United States Preventive Services Task Force (USPSTF) criteria (32).

2.7. Meta-Analysis

Meta-analysis was not performed in this systematic review because of the nature of active control trials showing no significant difference between the two groups, and both approaches have been shown to be effective in the past. Please see Table 1.

3. Results

3.1. Search Results

Thirty-four studies were identified for preliminary review. After applying inclusion and exclusion criteria, 27 studies with 1,920 patients were included for systematic review (Figure 1). The mean age was 49, with 78.1% of patients being female. The techniques used for ECTR, listed in descending order, were the Chow (33), Agee (19), and Okutsu (34). The studies were published between 1992 and 2018, and the follow-up time ranged from one week to 16 years. A summary of the studies included in this review is displayed in Table 1. Our search identified 15 RCTs and 12 observational studies (Figure 1).
Table 2. Risk of Bias Analysis. Risk of Bias was Ascertained by Two Separate Reviewers Using the Cochrane Risk-of-Bias Framework. Symbols Signify Low Risk of Bias (+), High Risk of Bias (-), and Uncertain Risk of Bias (?)

| Reference                   | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|-----------------------------|---|---|---|---|---|---|---|
| Aslani et al. (30) 2012     | ? | ? | - | - | + | ? | + |
| Atroshi et al. (4) 2006     | + | + | - | - | + | + | + |
| Atroshi et al. (31) 2009    | + | + | - | - | + | + | + |
| Atroshi et al. (28) 2015    | + | + | - | - | + | + | + |
| Brown et al. (5) 1993       | - | - | - | + | ? | - | + |
| Macdermid et al. (6) 2003   | ? | ? | - | + | ? | ? | ? |
| Eljiri et al. (7) 2012      | + | ? | - | + | + | + | + |
| Kang et al. (8) 2013        | + | ? | - | + | + | ? | + |
| Oh et al. (9) 2017          | + | ? | - | + | + | ? | + |
| Trumble et al. (10) 2002    | ? | - | - | + | ? | - | + |
| Michelotti et al. (11) 2014 | + | - | - | ? | + | ? | + |
| Mackenzie et al. (12) 2000  | ? | - | - | - | ? | ? | ? |
| Malhotra et al. (13) 2007   | ? | ? | - | - | ? | + | ? |
| Rab et al. (14) 2006        | ? | - | - | + | - | ? | ? |
| Saw et al. (15) 2003        | + | ? | - | + | + | ? | - |
| Chandra et al. (16) 2013    | + | + | - | + | + | ? | + |
| Gümüştaş et al. (17)        | + | ? | - | + | + | ? | + |
| Orak et al. (18) 2016       | + | ? | - | - | ? | ? | + |
| Agee et al. (19) 1992       | ? | - | - | - | ? | ? | - |
| Sennwald et al. (20) 1995  | + | ? | - | + | ? | ? | ? |
| Dumontier et al. (21) 1995  | ? | - | - | - | - | ? | ? |
| Jacobsen et al. (22) 1996   | ? | ? | - | + | + | ? | ? |
| Ferdinand et al. (23) 2002  | + | ? | - | + | ? | ? | ? |
| Wong et al. (24) 2003       | + | ? | - | - | ? | - | + |
| Larsen et al. (25) 2013     | + | + | - | - | + | + | ? |
| Erdmann (26) 1994           | ? | ? | - | - | ? | ? | - |
| Zhang et al. (27) 2016      | + | + | - | + | ? | + | ? |

a: 1: Random Sequence Generation, 2: Allocation Concealment, 3: Blinding of Participants and Personnel, 4: Blinding of Outcome Assessment, 5: Incomplete Outcome Data, 6: Selective Reporting, 7: Other Bias.

3.2. Pain Relief

In 24 studies, both open and endoscopic techniques resulted in significant pain relief postoperatively. Endoscopic surgery resulted in a significantly greater pain relief in 10/24 studies, usually in the early postoperative period. For example, Aslani et al. (30) showed that postoperative pain at the incision site was greater for the open surgery group at weeks 2 and 4, but the difference disappeared at four months post-surgery. MacDermid et al. (6) showed that open surgery resulted in significantly more pain at weeks 1 and 6, but this difference did not persist at 12 weeks post-surgery. Trumble et al. (10) demonstrated that CTS-SSS and CTS-FSS improved more for the endoscopic group at weeks 2, 4, 8, and 12 post-surgery. Other significant findings in favor of the endoscopic group were improvement of night-time hand and wrist pain at week 4 post-surgery (12), improvement of symptoms and function (13), improvement in VAS pain scores at hours 1, 2, 4, and 24 post-surgery (18), improvement of scar tenderness at weeks 1, 2, 3, and 9 post-surgery and radial pillar tenderness at weeks 3 and 9 (19), and improvement of VAS pain up to 1-month post-surgery (26).
3.3. Secondary Outcomes

Several studies showed that endoscopic release produced a greater improvement of grip and/or pinch strength in the early post-operative period (7, 12, 18, 20, 21, 25, 26). According to Orak et al. (18), there was less analgesic use in the endoscopic group in the first 24 hours postoperatively. According to two studies, satisfaction was significantly greater for the endoscopic group in the early post-operative period, but this difference disappeared at later time points (10, 30). Several other studies showed similar satisfaction between open and endoscopic groups (5). Overall, endoscopic surgery resulted in a faster return to work in most studies (5, 13, 15, 19, 20, 25-27). Two studies showed a longer operating time for endoscopic surgery versus open surgery.
3.4. Complications

Adverse events between endoscopic and open surgery were about equal (ECTR = 43, OCTR = 44). In the endoscopic group, the most commonly reported complications were post-operative numbness/tingling (n = 13), pillar pain (n = 6), and persistence or exacerbation of symptoms (n = 6). In the open group, the most commonly reported complications were pillar pain (n = 9), reflex sympathetic dystrophy (n = 7), and hypertrophic/painful scar (n = 5). There were four instances of re-operation in the endoscopic group and three instances of re-operation in the open group.

4. Conclusions

For this analysis, 27 studies met inclusion criteria. Results indicate that ECTR produced superior post-operative pain outcomes (decreased pain score) during short-term follow-up. Of the studies meeting inclusion criteria for this analysis, 17 studies evaluated pain as a primary or secondary outcome and 15 studies evaluated pain, pillar tenderness, or incision tenderness at short-term follow-up. Most studies employed a VAS for assessment and the majority reported superior short-term pain outcomes following ECTR at intervals ranging from 1 hour up to 12 weeks (6, 12, 18-20, 24, 30, 31). Several additional studies reported equivalent pain outcomes at short-term follow-up as early as one week (5, 14, 15, 21, 25). No study reported inferior short-term pain outcomes following ECTR.

Interestingly, pain scores following endoscopic and OCTR techniques were equivalent in long-term follow-up, even after superiority of post-operative pain scores in the early post-operative period. Several studies report equalization or narrowing of benefit at follow-up time points ranging from 12 weeks to one year (6, 10, 18, 19, 24, 26, 31). No study reports superior outcome at long-term follow-up exceeding one year for endoscopic, open, or mini-incision carpal tunnel release techniques.

Of the included studies, 24 studies reported outcomes pertaining to grip strength, pinch strength, and functional status. Most studies reported equivalent outcomes in grip or pinch strength at post-operative time points ranging from 1 week to one year (5, 9, 14, 15, 20, 23-25, 27). Several studies also reported equivalent functional status using BCTQ-F and CTS-FSS scales at time points as early as 6 weeks (11, 17, 18).

A subset of studies reported contradicting findings related to transient superiority or inferiority of functional status following endoscopic release. Of groups reporting favorable outcomes following endoscopic release, Aslani et al. (30) reported persistent weakness following OCTR relative to mini-incision or endoscopic release, MacDermid et al. (6) reported superior grip strength following endoscopic release at 1 and 6 weeks, Sennwald et al. (20) reported superior grip strength at 3 months, but equivalent pinch strength at all time points and Trumble et al. (10) reported superior functional status using the CTS-FSS scale at 2, 4, 8, and 12 weeks. Atroshi et al. (4, 28, 31) also reported a less severe post-operative loss of strength following endoscopic release, with a return of strength following both ECTR and OCTR at 3-month follow-up. Of studies reporting favorable outcomes following OCTR, Ejiri et al. (7) reported exacerbation of functional impairment in two hands, and Kang et al. (8) reported that transient worsening of symptoms was a commonly reported complaint among surveyed patients at three months follow-up after ECTR. Despite these potential transient discrepancies in strength and functional status, each study reported dissipation of any difference by three months (6, 20, 31).

Predictably, this early trend in pain and functional outcomes following ECTR was mirrored in patient-reported satisfaction scores. Studies either reported equivalent patient satisfaction (5, 27, 28, 31) or higher patient satisfaction following endoscopic release as late as 6 months post-operatively (4, 10, 11, 30). Superior short-term pain and functional status outcomes following endoscopic release did translate to improved short-term patient satisfaction scores in select studies. However, like pain and functional status assessments, patient satisfaction became equivalent at intermediate and long-term follow-up.

Based on 27 RCTs published from 1993-2016, ECTR and OCTR produce satisfactory results in pain relief, symptom resolution, patient satisfaction, time to return to work, and adverse events. There is a growing body of evidence favoring the endoscopic technique in pain relief, functional outcomes, and satisfaction, at least in the early postoperative period, even if this difference disappears over time. Several studies have demonstrated a quicker return to work and activities of daily living with the endoscopic technique.

Footnotes

Authors’ Contribution: Study concept and design: VO SO JP IU MSO MJ analysis and interpretation of data: LM ADK CO SH drafting of the manuscript: EMC FI GV OV critical revision of the manuscript for important intellectual content: VO SO JP IU MSO MJ LM statistical analysis: ADK CO SH EMC FI GV OV.

Conflict of Interests: Alan Kaye is on the Speakers Bureau for Merck Pharmaceuticals.

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Table 1. Characteristics of Studies Included in our Systematic Review

| Author          | Year | Average Age | Female (%) | Study Size | Endoscopic Technique                  | Follow-Up Times | Outcomes                                                                 |
|-----------------|------|--------------|------------|------------|--------------------------------------|-----------------|--------------------------------------------------------------------------|
| Atroshi et al.  | 2006 | 44           | 75         | 128 pts    | Endoscopic (60 pts), Open (65 pts)   | 3-4 weeks, 1-2 months | Scar and proximal pain and limitation of activity score, length of work absence, CTS-SSS, CTS-FSS, and physical health score change in hand sensation and strength, opening time |
|                 | 2009 | 44           | 75         | 128 pts    | Endoscopic (60 pts), Open (65 pts)   | 1-5 years       | CTS-SSS improved at 5 years compared to baseline, with no difference between groups. CTS-FSS and scar/palm pain improved at 5 years compared to baseline, but no difference between groups. |
|                 | 2015 | 44           | 75         | 128 pts    | Endoscopic (60 pts), Open (65 pts)   | 8-16 years      | CTS-SSS improved at 8-16 years compared to baseline, with no difference between groups. |
### Functional Outcomes

Injury to superficial palmar arch (n=1, endoscopic), persistent sensory disturbance (n=1, endoscopic), Hematoma (n=2, endoscopic). Functional outcomes were achieved more quickly when the endoscopic methods was used, however with a greater rate of complications.

| Study | Year | No. (4) | Follow-up | Method | Endoscopic | No. (4) | Open | Outcome |
|-------|------|---------|-----------|--------|------------|---------|------|----------|
| Brown et al. | 2020 | 125 | 12 months | Endoscopic (n=102), Open (n=23) | Yes | 77 | 49 | Return to work, operating time, pain, satisfaction, two-point discrimination, grip strength, pinch strength, function of hands, return to work, and sensory function |
| Ruefli et al. | 2012 | 59 | 6 weeks | Endoscopic (n=31), Open (n=28) | Yes | 23 | 36 | Improved postoperatively in endoscopic group, no difference between groups at 12 weeks |
| Kang et al. | 2013 | 55 | 12 months | Endoscopic (n=19), Open (n=36) | Yes | 20 | 35 | Significant improvement in endoscopic group, no difference between groups at 12 weeks |
| Oh et al. | 2015 | 52 | 24 weeks | Endoscopic (n=25), Open (n=27) | Yes | 15 | 37 | Significant improvement in endoscopic group, no difference between groups at 6 months |
| Troumbley et al. | 2015 | 56 | 8 weeks | Endoscopic (n=50), Open (n=6) | Yes | 25 | 31 | Significant improvement in endoscopic group, no difference between groups at 6 months |

### Additional Observations

- Pain and paresthesia rating: Improved in both endoscopic and open groups, no difference between groups.
- Symptom severity scale (n=1, endoscopic): Improved significantly at 2 weeks, no difference between groups at 6 weeks.
- grip strength, pinch strength, sensation improved significantly at 12 weeks in endoscopic group, no difference between groups at 6 months.
- The mean CSA-I decreased, and the mean CSA-M decreased in both groups. The mean CSA-O decreased in the endoscopic group, no difference between groups at 6 months.
- The endoscopic group had significantly better sensory scores at 2, 4, 8, and 12 weeks. CTSS improved throughout follow-up, but the endoscopic group had significantly better scores at 2, 4, 8, and 12 weeks. The endoscopic group had significantly better scores at 6 months, significantly less tenderness at 12 weeks.
- Endoscopic surgery produced similar outcomes at 12 weeks postoperatively. The majority of patients preferred the endoscopic technique.
In both groups, postoperative CTS-SSS and CTS-FSS improved significantly, with no difference between groups. Grip strength decreased equally in the early postoperative period then reached near preoperative levels by the end of the study. Satisfaction was significantly greater in the endoscopic group.

One portal

2, 4, 8, 12, 24 weeks

Pain, sensation -Endoscopic

53 84 25 pts, 25 hands

Mackenzie et al. (31) 2000

None

Open and endoscopic treatments are well-tolerated and with no difference in functional outcomes, symptom severity, functional status, and complications.

Both groups reported very little pain at 2 weeks and were pain free by the end of the study.

One portal (Agee)

56.2 58.3 60 pts, 25 hands

Mackenzie et al. (31) 2000

Endoscopic (25 pts, 25 hands), Open (25 pts, 25 hands)

M.2; 4 weeks

Grip strength, pinch strength

Nightingale hand/elbow pain was improved significantly in the endoscopic group over the open group at week 4.

One portal (Agee)

4, 24 weeks

Symptom amelioration, operation time to resume normal life frequency of revision surgery

In the early postoperative period, the endoscopic group did better symptomatically and functionally, and this group had less carpal tunnel syndrome and scar.

One portal (Agee)

2, 4, 8 weeks, 6,12 months

Wrist pain, Lyndsey Symptom Severity Score, Lyndsey Functional Status Score, two-point discrimination, grip strength, pinch strength, key grip strength.

Both groups had significant postoperative improvements in SSSpain score, Leinent score, and sensory testing, with no difference between groups.

Two portal (Chow)

Grip strength, pinch strength, and key grip strength (bend) on improvement or worsening, with no difference between groups.

Grip strength was significantly better in the endoscopic group at weeks 2 and 4. Pinch strength improved over same period at level in endoscopic group by week 4 but only small change. There was no difference between the open group by week 4.

Endoscopic group had less scar and grip strength showed no difference.

Endoscopic group returned more quickly to normal activity. There was no significant difference in regards to symptom amelioration, EMG testing, and complications.

Hematoma (n=1, open), - Reflex sympathetic dystrophy (n=2, open)

Endoscopic release resulted in better short-term results with no scar formation. Results at 6 months were comparable between groups.

Endoscopic release should be considered uncomplicated patients a cost-effective procedure. Pain may not be true in the general population as a whole.

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None

Early endoscopic surgery should be preferred over late surgery in patients with moderately severe CTS.

Excessive acute carpal pain, grip strength, return to work, operating time

There was no significant difference between groups in regards to symptoms severity scores, functional status scores, median carpal pain and grip strength.

Wrist pain, Lyndsey Symptom Severity Score, Lyndsey Functional Status, Gripp strength, pinch strength, return to work, operating time.

There was no significant difference between groups in regards to symptoms severity scores, functional status scores, median carpal pain, and grip strength.

If follow-up, everyone in the early group had returned to work, which was significantly higher than the delayed group.

There was significant improvement in clinical symptoms and most symptoms in the early group. The early group had significant early improvement than the delayed group.

There was significant improvement in clinical symptoms and most symptoms in the early group. The early group had significant early improvement than the delayed group.

If follow-up, everyone in the early group had returned to work, which was significantly higher than the delayed group. The early group had complete return to normal activity and had partial return. There was significant postoperative improvement in all measurements in both groups, but improvement was significantly better for the early group.

The mean MRC measurements generally improved from baseline with no difference between groups.

Endoscopic release should be considered uncomplicated patients a cost-effective procedure. Pain may not be true in the general population as a whole.

MRC 5, MRC 4, MRC 3, MRC 2, MRC 1, MRC 0, EMG improvement

The RCDS-Sand RCDS-Q scores improved significantly from baseline, with no difference between groups.

One portal (Agee)

4, 24 weeks

Grip strength, pinch strength

Satisfaction was significantly better in the endoscopic group at weeks 2 and 4. Pinch strength improved over same period at level in endoscopic group by week 4 but only small change. There was no difference between the open group by week 4.

Hematoma (n=1, open), - Superficial wound infection (n=1, open), - Transient index finger symptoms (n=1, endoscopic), - Hematoma (n=1, open)

Endoscopic release result in better short-term results with no scar formation. Results at 6 months were comparable between groups.

Hematoma (n=1, open), - Superficial wound infection (n=1, endoscopic)

Endoscopic release should be preferred over late surgery in patients with moderately severe CTS.

Hematoma (n=1, open)

Endoscopic release should be considered uncomplicated patients a cost-effective procedure. Pain may not be true in the general population as a whole.
Endoscopic release is an effective treatment for CTS especially overgrowth to postoperative pain relief.

Endoscopic release offers the benefit of reducing only the transverse carpal ligament, without changing the underlying wrist, tendon, and palmar tissues. Endoscopic release results in some improved outcomes over open surgery and translates to quicker return to work and ADLs.

The endoscopic group had significantly lower analgesic use in the first 24 hours.

Endoscopic release was associated with a significantly longer operating time compared to open release. There was no difference between groups in terms of recovery of grip strength, hand function tests, grip strength, sensation, and satisfaction. Endoscopic release has no specific advantage over open release systems of inside-out, hand function, grip strength, manual dexterity or sensation. Endoscopic release is a slightly longer surgery.

Patients were divided into two groups based on postoperative numbness and time to return to work. The endoscopic group had faster grip strength recovery at 1 month.

The BCTQ-S and BCTQ-F scores were similar at one year follow-up. However, the limited-grip exercises shown were tenosynovitis and palmar pain in the early postoperative period. Limited open surgery is simple and avoids the potential complications of endoscopic release.
Larson et al. (25) 2013 SI 55.1 90 pts -Endoscopic (30 pts), Open (30 pts), Short incision open (30 pts) One portal (Menon technique) 1, 2, 3, 6, 12, 24 weeks VAS pain, VAS paresthesia, grip strength, range of movement, pillar pain, duration of sick leave There was no difference in terms of postoperative pain and paresthesia between the groups. The endoscopic group tended to have earlier return of grip strength, range of movement, and return to work. The odds ratio for return to work within 3 weeks was 5 and 1.2 times longer for the endoscopic and short incision group compared to the classic incision group. The endoscopic and classic incision groups had significantly larger improvement in grip strength at 6 and 2 weeks, compared to the short incision group.

Erdmann (26) 1994 SI 53.4 61.5 71 pts, 105 hands -Endoscopic (47 pts, 78 hands), -Open (47 pts, 77 hands) Two portal (Chow) 1, 2 weeks, 1, 3, 6, 12 months VAS pain, return to work, return to preoperative grip strength, return to preoperative pinch strength The endoscopic group had significantly lower VAS up to 1 month, but the difference disappeared at later time points. The endoscopic group had significantly faster return to work, return to preoperative grip strength, and return to preoperative pinch strength. There was no difference between groups in terms of time to relief of symptoms.

Zhang et al. (27) 2016 46.4 66.2 207 pts -Endoscopic (69 pts), -Open (65 pts), -Double small incision open (73 pts) Two portal (Chow) 2 years Sensation (two-point discrimination, monofilament), severity of symptoms and functional status (Levine-Katz Questionnaire), pinch strength, return to work, VAS scar pain, satisfaction There was no difference between groups in regards to postoperative scar pain or symptom severity. Endoscopic release and double small incision were associated with a significantly shorter return to work compared to standard open release. There was no difference between groups on enabling functional status, or hand strength. Patients were significantly more satisfied with endoscopic release compared to further treatments and other treatments.

Abbreviations: EMG: Electromyography; NCV: Nerve Conduction Velocity; CTS: Carpal Tunnel Syndrome; DASH: Disabilities of Arm, Shoulder, and Hand; VAS: Visual Analogue Scale; ADL: Activities of Daily Living; EP: Electrophysiology; N/A = Not available.

Endoscopic release is safe and allows for faster recovery and return to work.

Endoscopic release has advantages over open surgery, specifically faster recovery of hand strength and return to work as well as decreased postoperative pain and reduction in scar tendency.

Endoscopic release and double small incision were associated with a significantly shorter return to work compared to standard open release. There was no difference between groups in terms of time to relief of symptoms. There was no difference between groups in regards to postoperative scar pain or symptom severity. Endoscopic release and double small incision were associated with a significantly shorter return to work compared to standard open release. There was no difference between groups on enabling functional status, or hand strength. Patients were significantly more satisfied with endoscopic release compared to further treatments and other treatments.