Endoscopic versus open in situ decompression for the management of cubital tunnel syndrome

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ABSTRACT

Objective: This study aimed to compare the results of endoscopic in situ decompression (EISD) versus open in situ decompression (OISD) in the management of cubital tunnel syndrome (CUTS).

Methods: In this retrospective study, 32 patients who underwent either OISD or EISD for the treatment of CUTS between 2012 and 2019 were identified and divided into one of the two groups: Group I consisted of 13 patients undergoing EISD and group II consisted of 19 patients receiving OISD. Patients were queried regarding the presence of preoperative and postoperative paresthesia. Electromyography (EMG) was performed on all patients preoperatively and at the final control. Preoperative and postoperative pain with palpation were evaluated over the cubital tunnel. The Dellon classification was used for preoperative evaluation of patient symptoms, and the Bishop classification was used for postoperative evaluation. Hand grip strength was measured with a dynamometer. At the preoperative and postoperative final follow-up, the palmar, key, and tip pinches were measured with a pinchmeter. The surgical incision length was measured with a ruler at the end of the operation in all patients. The operation duration was recorded as the time interval between the beginning of the incision and the end of the tourniquet.

Results: The overall mean age was 43.8 (range; 22 to 66) years. Nine patients were female, and 23 patients were male. No Dellon I patients were present in either group. Overall, 68.75% of the patients were Dellon II and 31.25% were Dellon III. According to the Bishop score, excellent and good results were obtained in 84.6% of the patients in Group I and 73.7% of the patients in Group II. The final follow-up examination found continued paresthesia in 6 (18.75%) patients. Comparison of the improvement in the postoperative NCV value showed a statistically significantly superior improvement in Group I compared to Group II. The postoperative palmar pinch and tip pinch tests results were statistically significantly better in group I than in group II.

Conclusion: Although EISD had better results clinically, no statistically significant difference was found between the two techniques in terms of Bishop scores and complications. Examination of the electrophysiological results suggested a better outcome in patients who underwent EISD.

Level of Evidence: Level III, Therapeutic Study

Introduction

Cubital tunnel syndrome (CUTS) is the second most common compression neuropathy, with a prevalence of 1.8%-5.9% and an incidence of 24.7 cases per 100,000 people per year.1-4 Conservative treatment methods are generally preferred,5 but in situ decompression (ISD) of the ulnar nerve or anterior transposition (AT) are commonly used in patients who do not respond to conservative treatment and require surgery.6 The purpose of surgical treatment is to decompress the ulnar nerve while preserving its normal anatomical position or to create an alternative anatomy by transposition by mobilizing the nerve.5 Studies comparing ISD with AT have shown that the ISD method has fewer associated complications, but the revision rates do not differ, routine transposition is not necessary for every case, and the clinical results are similar.5,6

In situ decompression can be applied endoscopically (EISD) or openly (OISD). The literature shows conflicting results regarding which technique is superior for ISD.8,9 Although some studies conclude that EISD is superior in terms of both complication rates and patient satisfaction, other studies indicate no difference between the two techniques in terms of clinical results and complications.8-10

We have previously published our results of endoscopically assisted cubital tunnel release without using any specific instrument.11 Our hypothesis is that the EISD technique has better results in terms of electrophysiological studies than the OISD technique, in which the nerve is openly dissected and manipulated.

The aim of the present study was to compare the EISD and OISD results in a CUTS surgical treatment.

Materials and Methods

Institutional review approval (20-KAEK-318) was obtained from the local ethics committee before starting the study. The patients in this study underwent surgery by OISD and EISD for CUTS between 2012 and 2019 and were evaluated retrospectively.
The inclusion criteria were minimum age of 18 years and having primary idiopathic ulnar nerve entrapment syndrome. Exclusion criteria were having traumatic or congenital elbow deformity, previous elbow surgery, mass lesion, advanced cervical disc neuropathy, concomitant other neurological deficits, preoperative ulnar nerve subluxation, the use of anticoagulant, and less than 6 months of follow-up. All patients were evaluated for additional systemic diseases (e.g., diabetes mellitus, rheumatic diseases, thyroid, or kidney disorders) and patients with systemic diseases were also excluded from the study.

In total, 32 of 38 patients who met the inclusion criteria and attended the last follow-up were included in the study. Group I consisted of 13 patients with EISD and group II consisted of 19 patients with OISD. All patients were operated on by the same hand surgeon. Preoperative and postoperative evaluations and measurements of the patients were performed by an independent observer. The CUTS diagnosis was made based on paresthesia or numbness in the ulnar nerve trace, loss of strength in the small muscles of the hand, and a positive elbow flexion test. Electromyography (EMG) was performed preoperatively in all patients. The diagnosis was confirmed by a nerve conduction velocity (NCV) test showing NCV <50 m/s in the lower elbow segment.12 Patients with normal NCV tests were excluded from the study.

At the final follow-up, the patients were queried regarding the presence of preoperative and postoperative paresthesia (continuous, intermittent, or absent). Preoperative and postoperative pain (chronic scar pain) with palpation were evaluated over the cubital tunnel. Dellon’s classification13 was used for preoperative evaluation of patient symptoms, and Bishop classification14 was used for postoperative evaluation. Hand grip strength was measured with a dynamometer (Jamar, model SH 5001, Saehan Corp. Masan, South Korea). At the preoperative and postoperative final follow-up, the palmar, key, and tip pinches were measured with a pinchmeter (model SH 5005, Saehan Corp. Masan, South Korea). Measurements were made bilaterally and compared with the healthy, unaffacted extremity. The surgical incision length was measured with a ruler at the end of the operation in all patients. The operation duration was recorded as the time interval between the beginning of the incision and the end of the tourniquet. The setup time was determined as the time from the moment when the anesthesia team transferred the patient to the surgical team until the incision. During this period, the necessary arthroscopic devices and surgical sets for the operation were installed.

The endorelease cannulae and blade system described in Cobb’s technique7 with a standard 30° 4 mm endoscope were used for the patients in EISD (Integra LifeSciences Corporation, EndoRelease Endoscopic Cubital Tunnel Release System, New Jersey, USA) (Figure 1-3). After all potential structures were released in both techniques, the structural sources of nerve compression were tested by subluxation/dislocation of the ulnar nerve, flexion, and extension.

**Statistical analysis**

The data obtained were evaluated using International Business Machines Statistical Package for the Social Sciences software (software version 23.0, Armonk, NY, USA) program. The Shapiro–Wilk test was used to evaluate the distribution of the data. Normally distributed data were presented as mean ± standard deviation; non-normally distributed data were presented as median (interquartile range). Student’s t-test was used to compare normally distributed data, and the Mann–Whitney U test was used to compare non-normally distributed data. Normally distributed data were evaluated by a paired sample t-test for dependent groups, and data that were not normally distributed were evaluated with the Wilcoxon test. The Fisher’s exact test and the Fisher–Freeman–Halton test were used to evaluate categorical variables. A P-value of < 0.05 was considered statistically significant in all tests.

**Results**

The demographic data of the patients are given in Table 1. No statistically significant differences were noted between the demographic data of the patients. The duration of surgery was statistically
significantly longer in group I. The surgical incision length was statistically significantly shorter in group I (Table 1).

The relationship between the preoperative Bishop scores and Dellon’s classification is shown in Table 2. No Dellon I patients were present in either group. Overall, 68.75% of the patients were Dellon II and 31.25% were Dellon III. According to the Bishop score, excellent and good results were obtained by 84.6% of the patients in group I and by 73.7% of the patients in group II. There was no statistically significant difference between the groups in terms of Bishop score ($P=0.937$).

A significant improvement was noted in postoperative NCV values in both groups ($P<0.001$). Comparison of the improvement in the postoperative NCV value showed a statistically significantly superior improvement in group I compared to group II ($P=0.021$) (Table 3). According to Bishop’s score, all patients with poor and fair results were in the Dellon III group. Three patients with a poor result showed no improvement in postoperative NCV values but a regression when compared to the preoperative values.

Preoperative, continuous, or intermittent paresthesia was present in all patients. The final follow-up examination found a continued paresthesia in six (18.75%) patients. No significant difference was detected between the groups in terms of the presence of postoperative paresthesia. Preoperative pain was present in 30 patients over the cubital tunnel. At the last follow-up examination, the pain had continued in two patients (Table 4).

Significant improvement was observed in all parameters in terms of postoperative motor and sensory examinations in both groups (grip strength: $P<0.001$, palmar pinch: $P<0.001$, key pinch: $P<0.001$, type pinch: $P<0.001$, and discrimination: $P<0.001$). The postoperative palmar pinch and tip pinch tests results were statistically significantly better in group I than in group II (Table 5).

Hematoma developed in one patient in group I, but no additional complications were found. Revision surgery was performed on a total of five patients from both groups with progression in electrophysiological and clinical symptoms. In group I, OECD was applied to 1 patient and subcutaneous AT was applied to another patient. In group II, subcutaneous AT was applied to three patients.

Table 2. Relationship between Bishop Score and Dellon’s Classes for groups I and II

| Dellon’s Classes | Dellon I (n=9) | Dellon II (n=22) | Dellon III (n=10) |
|------------------|---------------|-----------------|------------------|
| Bishop score     | Group I | Group II | Group I | Group II | Group I | Group II |
| Excellent        | -      | -      | 9      | 11     | -      | 1      |
| Good             | -      | -      | 1      | 1      | 1      | 1      |
| Fair             | -      | -      | -      | -      | 1      | 3      |
| Poor             | -      | -      | -      | -      | 1      | 2      |

Table 3. Postoperative NCV changes between groups

| Postop NCV < 50 | Postop NCV > 50 | $P$ |
|-----------------|-----------------|-----|
| Group I (n=21)  | 5               | 8   | 0.021 |
| Group II (n=11)| 16              | 3   |      |

NCV: nerve conduction velocity

Discussion

Surgical treatment of CUTS includes techniques that differ according to the severity of the entrapment, the duration of the symptoms, elbow anatomy, and the surgeon’s preference.15,16 In situ decompression can be applied as an open procedure, using specific endoscopically assisted instruments or without specific instruments.15-22 Recently, the endoscopic technique has been the top trend because of its minimally invasive nature. Tsai et al22 were the first to use endoscopy for the treatment of CUTS and this popularized ISD and led to the presentation of different modifications in the literature. Compared to OISD, EISD has smaller skin incisions, less soft tissue dissection, faster recovery time, and smaller scar development in the surgical area.23-25 It also allows the loosening of multiple compression zones through a small endoscopically assisted incision without extensive dissection.10,20

No consensus is evident in the literature regarding which of the two techniques, OISD or EISD, is the superior method. The available studies show no significant difference in terms of clinical improvement results; however, the significant decrease in complication rates favors EISD.23,24 Some studies report a similar incidence of complications for both EISD and OISD.26-28 Similarly, some authors report no difference between the two techniques in terms of clinical or neurophysiological outcomes at both the early and late stages.24

In our study, the rate of excellent and good results was 84.6% for EISD and 73.7% for OISD. Although more instances of excellent and good results occurred in the EISD group, this difference was not statistically significant. In the literature, excellent and good results between 76.9% and 93% were reported for EISD and a wider range, between 65.3% and 96%, for OISD.24-26 In many of these studies, the preoperative EMG values were normal and the number of grade I patients was considerably higher than the Dellon and Mcgowen classifications.22-29 We think that the reason for the relatively low success rate in our study compared to other studies is the absence of Dellon I
patients in our study and the greater number of patients with Dellon III initially, especially in the OISD group.

Watts and Bain\textsuperscript{30} reported that paresthesia continued in 12 of 15 patients after OISD and in 10 of 19 patients after EISD.\textsuperscript{30} Another study reported that 23.7% of the patients who underwent OISD had numbness around the elbow due to a lesion of the medial ante-brachial cutaneous nerve.\textsuperscript{24} In our study, the presence of ongoing postoperative paresthesia was 15.4% in the EISD group and 21.1% in the OISD group, but this difference was not statistically significant. We attribute this to the better postoperative NCV values in the EISD group.

No statistically significant difference was evident in the literature between the two techniques in terms of reoperation.\textsuperscript{9,21,24,30} The reasons for reoperation were frequently identified as ulnar nerve subluxation.

Table 4. Evaluation of preoperative and postoperative paresthesia and pain

|                        | Group I (n = 13) | Group II (n = 19) | P   |
|------------------------|-----------------|-------------------|-----|
| Preoperative paresthesia | Continuous      | 7 (57.9%)         | 11 (53.2%) | 0.821 |
|                        | Intermittently  | 6 (47.1%)         | 8 (46.2%)  |     |
| Postoperative paresthesia | Yes            | 2 (15.4%)         | 4 (21.1%)  | > 0.999 |
|                        | No              | 11 (86.6%)        | 15 (78.9%) |     |
| Preoperative pain      | Yes             | 13 (100%)         | 17 (89.5%) | 0.502 |
|                        | No              | 0 (0%)            | 2 (10.5%)  |     |
| Postoperative pain     | Yes             | 1 (7.7%)          | 1 (5.3%)   | > 0.999 |
|                        | No              | 12 (92.3%)        | 18 (94.7%) |     |

*Data are presented as median (interquartile range). Qualitative variables are presented as percentages (%).

Table 5. Preoperative and postoperative results

|                        | Group I (n = 13) | Group II (n = 19) | P   |
|------------------------|-----------------|-------------------|-----|
| Preoperative hand grip |                | 73 (48.5-78)      | 70 (60-75) | 0.954 |
| Postoperative hand grip|                | 90 (73-92.5)      | 80 (78-85) | 0.131 |
| Preoperative palmar pinch |             | 65.4 ± 12.2       | 63.4 ± 13.1 | 0.740 |
| Postoperative palmar pinch |             | 95 (90.5-100)     | 80 (80-90)  | 0.005 |
| Preoperative key pinch |                | 60 (50-73.5)      | 68 (50-70)  | 0.847 |
| Postoperative key pinch |                | 90 (78-94.5)      | 84 (80-90)  | 0.430 |
| Preoperative tip pinch |                | 61.8 ± 16.8       | 61.1 ± 22.0 | 0.925 |
| Postoperative tip pinch |                | 90 (87.5-97)      | 87 (80-90)  | 0.026 |
| Preoperative discrimination |          | 8 (7-9)           | 9 (8-10)   | 0.257 |
| Postoperative discrimination |          | 5 (5-5)           | 6 (5-6)    | 0.103 |
| Preoperative NCV (m/sec) |                | 38.1 ± 6.2        | 35.1 ± 6.4 | 0.197 |
| Postoperative NCV (m/sec) |                | 46.3 ± 10.8       | 42.3 ± 8.3 | 0.223 |

Normally distributed data are presented as mean ± standard deviation, non-normally distributed data are presented as median (interquartile range).

NCV, nerve conduction velocity.

patients in our study and the greater number of patients with Dellon III initially, especially in the OISD group.

Watts and Bain\textsuperscript{30} reported that paresthesia continued in 12 of 15 patients after OISD and in 10 of 19 patients after EISD.\textsuperscript{30} Another study reported that 23.7% of the patients who underwent OISD had numbness around the elbow due to a lesion of the medial ante-brachial cutaneous nerve.\textsuperscript{24} In our study, the presence of ongoing postoperative paresthesia was 15.4% in the EISD group and 21.1% in the OISD group, but this difference was not statistically significant. We attribute this to the better postoperative NCV values in the EISD group.

No statistically significant difference was evident in the literature between the two techniques in terms of reoperation.\textsuperscript{9,21,24,30} The reasons for reoperation were frequently identified as ulnar nerve subluxation.
following recurrence, insufficient release, or decompression.\(^8\) In our study, a total of five patients in both groups underwent reoperations. The complaints and symptoms of the patients regressed after revision surgery. All patients who underwent reoperation were in the Dellon III group and showed a worsening of NCV values rather than postoperative improvement.

Evaluation of the improvement in postoperative NCV values revealed a significant improvement in both groups. However, the rate of occurrence of patients with NCV >50 m/s was 61.5% in the EIDS group and 15.8% in the OIDS group. We believe that the better recovery of NCV in the EIDS group than in the OISD group is that the endoscopic technique is minimally invasive, allowing release without disturbing the vascular supply of the nerve. A statistically significant relationship was found between the increase in postoperative NCV values and excellent and good Bishop scores. Yoshida et al\(^{18}\) also found an 81.3% “detecting sensory improvement” and Hoffmann et al\(^{20}\) reported a 100% increase compared to preoperative values. Ahsan et al\(^{11}\) reported that 64% of the neurophysiological tests returned to normal completely.

As in the literature, a significant postoperative improvement occurred in both groups in terms of the grip strength, pinch, and sensory test results.\(^{15,16}\) A statistically significant improvement was noted in the EISD group, especially in the palmar and tip pinch evaluations. We think this is associated with a significant return to the normal NCV values in the EISD group.

Schmidt et al\(^{11}\) reported a surgical time of 70.45 minutes in EISD and 44.63 minutes in OISD, whereas Bolster et al\(^{11}\) reported a surgical time of 41.5 minutes for EISD and 32.4 minutes for OISD. The average duration of surgery in our study was 30 minutes for OIDS and 46 minutes for EIDS, in agreement with the literature. In the present study, the incision length was significantly shorter in EIDS, and it was compatible with the literature values.\(^{12,18}\)

The most common complication after CUTS surgical treatment is a hematoma.\(^{11,12}\) Schmidt et al\(^{11}\) reported a significantly higher postoperative hematoma rate (24.14%) with EISD and detected more patients (10.34%) with wound healing disorders with EISD. However, other studies that have compared an EISD group with an OISD group have reported a similar overall postoperative hematoma rate.\(^{3,6}\) In our study, unlike other studies in the literature, the hematoma was detected in only one patient. We think that this is due to appropriate patient selection by an experienced surgeon (exclusion of patients with the use of anticoagulant and exclusion of systemic diseases), good bleeding control, and the application of a compressive bandage, especially on the postoperative dressing.

The main limitation of our study is that it was primarily retrospective and the follow-up period was short. The small number of patients is related to the broad exclusion criteria aimed at excluding factors that would directly affect the outcome, such as chronic and comorbid diseases. Although the sample size was too small to detect a significant difference between the two treatments, it was sufficient to show that both methods had positive effects with a similar improvement in patient symptoms.

Although EISD had better results clinically, no statistically significant difference was found between the two techniques in terms of Bishop scores and complications. Examination of the electrophysiological results suggested a better outcome in patients who underwent EISD.

Although EISD and OISD appear to give comparably good results, more extensive randomized controlled trials are needed to demonstrate this reliably.

**Ethics Committee Approval:** Institutional review approval [20-KAEK-318] was obtained from the local ethics committee before starting the study.

**Informed Consent:** Informed consent was obtained from all individual participants included in the study.

**Author Contributions:** Concept - E.C.Z.; Supervision - M.Ş.; Data Collection and/or Processing - E.C.Z., T.Ö.; Analysis and/or Interpretation - U.Ş.; Literature Review - M.Ş.; Writing - T.Ö., EÇ.Z.; Critical Review - U.Ş.

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