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Original Research

Symptom Recurrence After Endoscopic Cubital Tunnel Release

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Purpose: To evaluate the recurrence of symptoms after an endoscopic cubital tunnel release using the technique of Hoffmann and Siemionow.
Methods: We retrospectively reviewed 286 consecutive patients who underwent Hoffmann and Siemionow's technique of endoscopic cubital release by a single surgeon during an 8-year period. Inclusion criteria were adult patients without previous elbow surgery, pathology, or trauma, and patients with a minimum 3-months' postoperative follow-up. We evaluated symptom recurrence rate and assessed risk factors that would affect recurrence.
Results: A total of 223 patients met inclusion criteria, 204 of whom (91.5%) had improvement at 3 months after surgery. Eleven patients (4.9%) had persistent symptoms and 8 (3.6%) had recurrent symptoms at a mean of 16 months (range, 3–93 months) after the primary surgery. Intraoperative ulnar nerve subluxation had a statistically significant relationship with symptom recurrence.
Conclusions: Symptoms recurred at a rate of 3.6% after Hoffmann and Siemionow's endoscopic cubital tunnel release. This is comparable to other endoscopic or open techniques for cubital tunnel release. The procedure has the added advantage of less tissue dissection. Intraoperative ulnar nerve subluxation seems to be associated with symptom recurrence.
Type of study/level of evidence: Therapeutic IV.

Cubital tunnel syndrome (CuTS), entrapment of the ulnar nerve around the elbow, is the second most common compressive neuropathy in the upper extremity after carpal tunnel syndrome.[1,2] Clinical manifestations include numbness or tingling in the ulnar side of the hand, and wrist or medial elbow pain in some patients. Patients might also have fatigue, loss of dexterity, weakness of grip, and intrinsic muscle wasting.[2]

There are multiple surgical options for CuTS, but there is still a lack of consensus regarding the optimal surgical treatment.[3] In past decades, endoscopic cubital tunnel release (eCuTR) techniques have evolved. After it was originally proposed in 1995 by Tsai et al,[4] various eCuTR techniques were subsequently proposed and reviewed by several authors.[5–22] The theoretical advantage of this minimally invasive procedure is that of visualization using an endoscope through small skin incision with less soft tissue dissection compared with open release. Thus, it has the potential for shorter operative time and faster recovery with less scarring.[9,20] Comparable functional and symptomatic improvement has been demonstrated between endoscopic and open cubital tunnel release.[8,22–25] Of those options, the procedure described by Hoffmann and Siemionow[8] has many advantages. It requires no special instruments, has a relatively short learning curve, and allows for better visualization proximally and distally through a small incision, allowing complete exposure and visualization.[26]

Similar to the open technique, symptoms may recur after eCuTR. Lowe and Mackinnon[27] classified symptomology after failed primary cubital tunnel release into 3 general categories: patients with new, persistent, or recurrent symptoms. New symptoms are often reported as increased or new pain after ulnar nerve release. Patients with persistent symptoms, who experience either no or incomplete relief after a primary procedure, may have had

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incomplete decompression of the ulnar nerve, an inaccurate diagnosis, or irreversible intraneural pathology. In contrast, recurrence refers to when the patient had a symptom-free period after primary surgery with return of symptoms more than 3 months after surgery, according to Seradge and Owens.[16,28] Recurrent symptoms may result for various reasons including injuries to the medial antebrachial cutaneous nerve[16,27] or the ulnar nerve itself, longitudinal tension in the nerve,[30] new points of compression such as scarring near the nerve,[16,27] perineural fibrosis,[29,30] or ganglion cysts.

Few articles have clearly distinguished persistence and recurrence.[16,27,29–31] The 2 entities are different and may warrant distinctive surgical considerations.[31] In this study, we focused on symptom recurrence.[5,16,26] Hoffmann and Siemionow[8] described no recurrence of ulnar nerve symptoms in 76 patients who were observed for 11 months (range, 1–34 months) in 2006. To date, these findings have not been validated by other authors.

We hypothesized that the recurrence of CuTS symptoms after eCuTR using the procedure of Hoffmann and Siemionow[8] would be comparable to those of other techniques. We also investigated factors that might have affected symptom recurrence.

Materials and Methods

The diagnosis of CuTS was made after a history and physical examination. Guyon canal syndrome or evidence of proximal compression such as cervical radiculopathy, which can mimic CuTS or cause double-crush injury, was ruled out.[30] If conservative treatment measures were unsuccessful, surgical decompression was offered mainly on the basis of clinical symptoms and physical examination. The nerve conduction study and EMG were obtained to support the indication for surgery. If the nerve conduction study showed decreased motor or sensory conduction velocity or amplitude across the elbow and/or increased distal latency, the patient was a potential surgical candidate depending on the severity of symptoms. If there was abnormal 2-point discrimination, muscular atrophy, and unrelieved pain despite conservative treatment, patients were considered severe. If the EMG result showed muscular denervation, severe compression neuropathy was suggested.

The senior author (T.O.) performed all consecutive 286 procedures between 2010 and 2017. All patients obtained nerve conduction study and EMG before surgery.

After the researchers obtained institutional review board approval, all patient charts were reviewed retrospectively. Patients were excluded if they were minor or had less than 3-month postoperative follow-up or associated pathology at the elbow to account for the nerve damage or compression.[28] Other exclusion criteria were a positive history of elbow trauma or previous ulnar nerve release. After exclusion criteria were applied, the study included 223 elbows (133 females and 90 males) in 210 patients. All arms that underwent surgery had the diagnosis confirmed with a positive nerve conduction study. Surgical release was performed on the right side in 111 elbows and on the left side in 112 elbows. Thirteen patients (8 females and 5 males) had bilateral procedures at different times. Mean age was 53 years (range, 24–88 years). In 89.7% of patients (200 patients), the right hand was dominant. Average follow-up after initial endoscopic release was 13.6 months (range, 3–93 months).

All patients had 2-point discrimination test for objective sensory disturbance. Standardized grip strength, Tinel sign, and/or elbow flexion test as well as cross-finger adduction test were used for each patient. These tests were performed by the fellowship-trained hand surgeon or a hand surgery fellow. Based on the data in chart, the authors retrospectively classified patients using Dellon's staging, which classifies the syndrome as mild, moderate, or severe.[32]

Pearson chi-square test was used to calculate statistical differences to compare categorical variables in the independent groups. $P < .05$ was considered statistically significant.

Surgical technique

All surgeries were performed using the Hoffmann Cubital Tunnel Set (Karl Storz, Tuttlingen, Germany). Patients were placed in the supine position. Under regional or general anesthesia, the procedure was performed based on the technique described in previous articles.[8,21,32] The ulnar nerve is marked in the proximal forearm and in the upper arm. A 3-cm longitudinal incision is made posteromedially proximal to the line connecting the medial epicondyle to the olecranon tip. The space between the superficial fascia and deep fascia is developed and tunneling is performed proximally and distally.[32] Through a small opening, the ulnar nerve is identified behind the medial epicondyle. After a speculum is introduced proximally, the ulnar nerve is visualized through an inserted endoscope; then, the upper-arm fascia, medial intermuscular septum, and bands within the triceps medial head over the nerve are released using long Metzenbaum scissors.[32] Later, a shorter speculum is introduced distally in the forearm and the ulnar nerve is visualized by the endoscope. The Osborne ligament, flexor carpi ulnaris aponeurosis, and deep fascia immediately over the ulnar nerve are released with the help of Metzenbaum scissors. The mesoneurium and epineurium are carefully preserved during decompression so as not to cause further instability in the ulnar nerve.

After complete release, dynamic intraoperative subluxation of the ulnar nerve over the medial epicondyle was evaluated under direct visualization through full range of motion. We defined ulnar nerve subluxation as anterior displacement of the nerve out of its groove and perching on the medial epicondyle while the elbow is flexed. No patient underwent transposition, even if ulnar nerve subluxation was observed during surgery. Patients were kept in a bulky Jones dressing after the operation. Elbow range of motion and nerve glides were initiated after the day of surgery. The postoperative routine was the same in all cases: Patients were brought to the clinic for wound check at 2 weeks. All patients underwent short-term physical therapy or home exercises for nerve glide exercises. They were observed at 3-month intervals afterward to assess symptom resolution until 1 year after surgery.

Results

Of 223 arms, 204 (91.5%) had partial or complete subjective improvement of weakness or abnormal sensation after eCuTR at an average of 3 months after surgery. Among the other 19 cases, according to the 3 general categories, 11 had persistent symptoms (4.9%) and 8 had recurrent symptoms (3.6%) (Tables 1, 2). No new symptom categories were observed. In the persistent cases, most symptoms resolved after 3 months and no patients required a

Table 1
Recurrence Rate (%) After Open CuTR and eCuTR

Open CuTR	eCuTR
Dellon[34]: 6–67	Tsai et al[4,5]: 3.5
Seradge et al[28]: 13	Cobb[16]: 0.02–5.24
Lankester et al[35]: 10	Sautier et al[26]: 1.6
Mowlavi et al[3]: 4.0	
Schnabl et al[36]: 10.3	Current study: 3.6

Table 2
Patient Characteristics (n [%])

Clinical Progress	Postoperative Symptoms	Subluxation Cases
Improved	204 (91.5)	70
Persistent	11 (4.9)	3
Recurrent	8 (3.6)	7
Total	223	80 (35.9)

repeat release. In these cases, nerve conduction studies and EMGs were repeated to ensure no worsening had occurred.

Eight cases had initial relief, but symptoms recurred at an average of 16.5 months (range, 3–86 months). The principal report was return of clinically evident CuTS such as sensory disturbance in the ulnar half of the ring and little fingers and/or the ulnar aspect of the hand. Positive electrodiagnostic studies were confirmed once again after surgery in the 8 patients for documentation. Based on these findings and after treating the patients conservatively at least for a year, we proceeded with revision surgery. None of the other 215 cases required revision surgery. No patients with recurrence had an associated medical condition such as diabetes. One patient had filed claims for workers' compensation. Another patient's case had been complicated with hematoma after eCuTR.

Surgical findings in all recurrent cases revealed ulnar nerve subluxation during surgery at the time of revision surgery. One patient had not shown subluxation at the time of initial eCuTR but was found to have subluxation at revision. The other 7 patients had subluxation noted initially. Anterior subcutaneous transposition was performed in all cases. All recurrent cases had scarring around the nerve, and 2 required minimal internal neurolysis to see normal fascicular architecture. One patient had scarring around both the ulnar nerve and medial antebrachial cutaneous nerve around the Arcade of Struthers, which was either not divided completely at the prior eCuTR or scarred back. All patients with symptom recurrence showed resolution of symptoms and required no further surgeries after the revision surgery.

We noted 80 ulnar nerve subluxations (48 female and 32 male) of 223 patients (133 female and 90 male) during the initial surgery (35.9%). The sex ratio of subluxation was compared using Pearson chi-square test. The female prevalence (60%) was not significantly greater than that for males (40%) ($P = .935$). Among 80 subluxation cases, 7 resulted in recurrence of symptoms (8.75%) (Table 2). Recurrence was significantly correlated with the presence of intraoperative subluxation using Pearson chi-square test ($P = .002$). Dellon's scores were severe in 51 limbs (23%), moderate in 172 (77%), and mild in none before surgery. Among the recurrent cases, 4 of 8 were severe. Using Pearson chi-square test, severe cases did not have a significantly higher recurrence rate ($P = .063$). Patients with more severe preoperative Dellon's staging did not predict symptom recurrence in this study.

Discussion

Symptom recurrence may occur after any surgical procedures[33] for nerve compression, even after many years. Published reports of recurrence rates after endoscopic or open operative decompression of the ulnar nerve at the elbow are variable (Table 1).[3,5,16,26,28,34–36] Because of the lack of recognition of differences between symptom recurrence and persistence, it has been challenging to determine the true rate of recurrent CuTS after surgery. Furthermore, techniques of primary cubital tunnel release and surgeons' skills vary. Our study computed the symptom recurrence rate from a large patient group treated in the same manner by a single surgeon. Although direct comparisons are difficult, our recurrence rate (3.6%) was comparable to that of other procedures for cubital tunnel release.

In 1999, Tsai and coworkers[4] reported recurrence in 3 elbows (2 patients) of 85 elbows (76 patients) undergoing cubital tunnel release with endoscopic assistance. They were treated with anterior submuscular transposition of the ulnar nerve. Cobb et al[16] evaluated the recurrence rate of eCuTR in 2009 and reported a recurrence rate of 0.02% to 5.24%. They also concluded that the recurrence rate was similar to open cubital tunnel release based on literature controls. In 2017, Sautier and colleagues[26] performed Hoffmann and Siemionow's[8] eCuTR on 60 patients (62 cubital tunnel operations) and reported that one patient described a recurrence of symptoms after initial improvement.

Ulnar nerve hypermobility occurs in over one-third of the adult population (37%), according to Calfee et al.[37] Interestingly, this number was similar to our intraoperative subluxation rate of 35.9%. In that study, the authors suggested that ulnar nerve hypermobility was not associated with increased symptomatology attributable to the ulnar nerve. This is compatible with the predominantly asymptomatic nature of the hypermobile nerve as reported by Childress.[38] However, provocative physical examination testing (Tinel sign) showed consistent trends toward heightened irritability in hypermobile nerves.[37] In 2010, Cobb et al[16] reported one recurrence after eCuTR, yet subluxation of the nerve upon physical examination occurred in 8 of 104 patients (7.7%), which was not associated with the recurrence. In 2014, Cobb et al[22] also reported that preoperative ulnar nerve subluxation did not affect outcomes. These findings suggest that ulnar nerve instability in the absence of ulnar neuritis does not mandate an anterior or submuscular transposition. Furthermore, Cobb et al[20] reported that ulnar nerve subluxation was not significantly correlated with preoperative Dellon's classification ($P = .26$), postoperative resolution rates of pain ($P = .69$), numbness and tingling ($Pp = .53$), or satisfaction ($P = .26$).

In contrast, Lankester and Giddins[34] reported one patient out of 20 patients with symptom recurrence that was thought to result from subluxation of the nerve over the epicondyle. The current study also revealed that symptom recurrence was affected by the presence of intraoperative subluxation ($P = .002$). However, the remaining 72 of 80 intraoperative subluxation cases (90%) did not show recurrent symptoms after surgery. Intraoperative subluxation thus may have some impact on symptom recurrence, but it is unlikely to cause symptom recurrence alone. This may also be related to the activity level of the patients in the current study. A sedentary patient with subluxation who avoids repetitive flexion may not show recurrent symptoms, whereas a similar patient with subluxation working on an assembly line may.

Bartels et al[39] performed a randomized trial comparing simple decompression versus anterior subcutaneous transposition for idiopathic neuropathy of the ulnar nerve. Ulnar nerve (sub)luxation was reported to be present in 42 of 152 participants (26.7%). They found no difference in outcome between simple decompression and anterior subcutaneous transposition in cases of ulnar nerve instability. Therefore, their study concluded ulnar nerve instability is not an indication for transposition. Considering that simple *in situ* decompression has the advantage of preserving neural blood supply,[40] these reasons are why we did not routinely perform anterior transposition for patients in whom intraoperative subluxation occurred. However, upon the findings of this review, there may be patients with CuTS with intraoperative ulnar nerve instability who may benefit from open surgery with anterior transposition to avoid symptom recurrence. As a result, we currently perform open transpositions in patients in whom the nerve completely dislocates over the medial epicondyle during elbow flexion. We prefer anterior subcutaneous transposition with creation of a septum between

the medial epicondyle and the skin. Likewise, in revision surgery, we recommend anterior transposition in patients with intraoperative subluxation.

This study had several limitations. Although this procedure has a low rate of recurrence with a mean follow-up of 14 months, it is possible that the recurrence rate could be higher with longer follow-up. The intraoperative assessment of ulnar nerve subluxation was confirmed if the nerve was perched or displaced out of the groove, but subclassification into a perchable, perched, or dislocating nerve, as advocated by Calfee and coworkers,[37] was not performed. Finally, our study was retrospective without a control group and was based on the experience of a single surgeon. Our study defined a low rate of recurrence among a large cohort of adults managed with a similar operative eCuTR technique and postoperative protocol. Multicenter, well-designed, prospective, randomized controlled studies that compare different cubital tunnel release techniques in a uniform patient population are needed to define recurrence rates better.

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