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Original article

Minimally invasive endoscopic ulnar nerve assessment and surgery for cubital tunnel syndrome patients—Relation between endoscopic nerve findings and clinical symptoms

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Abstract

To minimize damage to healthy tissues, we have been performing endoscopically assisted cubital tunnel syndrome surgery based on endoscopic nerve findings since 1995. This is the first study to focus on endoscopic surgery for cubital tunnel syndrome based on endoscopic ulnar nerve findings and the subsequent postoperative clinical results. We analysed 82 upper extremities of 74 cubital tunnel syndrome patients who had undergone endoscopically assisted release surgery using the Universal Subcutaneous Endoscope system. Endoscopic observations of the ulnar nerve were made from a single 1- to 3-cm endoscopic portal incision at the cubital tunnel to 10 cm proximal and 10 cm distal. The abnormal nerve areas were identified and released based on nerve degeneration findings under endoscopic observation. The abnormal areas spread eccentrically from the entrapment point(s). In 82 diseased upper extremities, ulnar nerve entrapment occurred at the cubital tunnel. However, one extremity suffered from entrapment at the arcade of Struthers' in addition to the cubital tunnel. All patients showed improved clinical symptoms following surgery. There is no statistical relation between pre- and postoperative clinical scores of Dellon's Staging and abnormal nerve length findings. Cubital tunnel syndrome is usually caused by entrapment at the cubital tunnel; however, in some cases, there are other point entrapment(s). Our endoscopically assisted procedure avoids any damage to healthy tissues because the surgeon can observe the entrapment point(s) prior to release. Postoperative clinical recovery results clearly indicate that endoscopic nerve findings reveal entrapment points and ulnar nerve degeneration can spread maximally 10 cm distally and proximally from the entrapment point(s), even in clinically mild severity cases. All other possible entrapment points should, therefore, be observed and released using our procedure.

Keywords: cubital tunnel syndrome; endoscopic nerve findings; endoscopically assisted surgery; entrapment neuropathy; ulnar nerve entrapment

Introduction

Osborne[1] was the first to report on the treatment of cubital tunnel syndrome, and this operative procedure was the first established minimally invasive surgery for the treatment of this condition. However, considering the 7% reported postoperative persistent symptoms rate following *in situ* decompression[2] that consequently requires secondary anterior submuscular transposition, release only at the cubital tunnel is not always sufficient for all disorders clinically diagnosed as cubital tunnel syndrome.

We have been performing endoscopically assisted surgery using the Universal Subcutaneous Endoscope (USE) system[3,4] (TACT Med. Inc., Tokyo, Japan) since 1995.[5] This procedure allows the surgeon to dynamically observe and assess ulnar nerve conditions with enlarged monitor images. Endoscopic observations and assessments are made from the arcade of Struthers' (the most proximal potential entrapment point) to the deep flexor pronator aponeurosis (the most distal potential entrapment point) through a small endoscopic portal made at the cubital tunnel.

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Using this procedure, surgeons can identify and release entrapment points based on endoscopic nerve findings with minimal damage to healthy tissue and limited postoperative restriction of activity of daily living. We have achieved satisfactory results[6] equivalent to standard open procedures.

Considerations of unknown problems regarding clinical implementation of our endoscopically assisted surgical procedure include the following issues: (1) How do abnormal preoperative endoscopic nerve findings indicate preoperative entrapment points? (2) Does the correlation between these abnormal preoperative endoscopic nerve length findings and pre- and postoperative clinical severity of symptoms serve as a useful endoscopic staging?

In this study, we analysed the relation between pre- and postoperative staging that conform to Dellon's Staging,[7] as an indicator of clinical symptoms, and our endoscopically assessed abnormal nerve length findings. This analysis was carried out in order to evaluate the efficacy of our proposed endoscopic assessment procedure and to achieve a truly effective minimally invasive surgical procedure for the treatment of cubital tunnel syndrome.

Methods

We retrospectively analysed 82 upper extremities (44 male and 38 female) of 74 cubital tunnel syndrome patients who underwent endoscopically assisted surgery using the USE system from September 2003 to October 2010. All patients were followed up for more than 10 months, postoperatively. The mean age of patients at the time of operation (standard deviation, SD) was 61.6 (9.2) years (range, 36–81 years). The mean postoperative follow-up period (SD) was 31.5 (19.0) months (range, 10–90 months).

Diagnosis was based on clinical signs and electrophysiological test results (ulnar motor and/or sensory studies revealed a nerve conduction velocity of less than 50 m/second). Causes of the cubital tunnel syndrome were idiopathic (no apparent cause) in 21 extremities and hemodialysis-related in 61 extremities. This study excluded cases involving other factors such as a traumatic history of the same elbow joint, ulnar nerve subluxation at the same elbow joint, osteoarthritis of the same elbow joint, or systematic neuropathy.

Assessment of endoscopically assisted surgery and analysis of intraoperative endoscopic findings were discussed, and agreement was then reached by the authors of this study. The surgery was performed on an outpatient basis, under local anesthesia, and without a pneumatic tourniquet in order to dynamically observe and assess intraneural nerve blood circulation during surgery. A small 1- to 3-cm skin incision was made at the cubital tunnel to serve as a portal for the USE system. The USE system consists of a closed transparent sheath and a 4-mm standard 30° oblique viewing arthroscope. The Osborne ligament (fascial band bridging two heads of flexor carpi ulinaris muscle)[1] was exposed at the cubital tunnel and released under direct observation. The ulnar nerve was identified, and sufficient space for the insertion of the USE system was made between the nerve and the soft tissue. Under direct observation at the portal, hourglass narrowing and/or proximal pseudoneuroma formation of the ulnar nerve was judged as entrapment at the cubital tunnel. The USE system was inserted in contact with the ulnar nerve distally under endoscopic observation (Fig. 1). The USE system allowed us to make observations within a 10-cm range distally and proximally from the portal edge. The following endoscopic findings were judged as abnormal: areas where we could not observe the funiculi because of epineurial thickening (this finding was considered to indicate an entrapment point); and/or areas with winding and twisted funiculi; and/or areas with no intraneural adipose tissue (Fig. 2A–C). Conversely, areas were considered normal if there was no epineurial thickening, the funiculi were straight running, adipose tissue was present between the funiculi, and there was blood circulation between the funiculi (Fig. 2D).[6] Incidental elbow joint movement during insertion of the USE system does not affect proximal or distal observations, and our endoscopic findings also remain unaffected by any such movement. Even when the USE system is inserted between the nerve and surrounding soft tissue, intraneural blood circulation is maintained when the surrounding nerve pressure is less than 30 mmHg as Rydevik et al[8] concluded. Therefore, we use continued intraneural blood circulation as an indication of healthy noncompressed nerve areas.

The fascia and other soft tissue of the abnormal nerve area, at the opposite side of the USE sheath from the ulnar nerve, were released using a push knife under complete endoscopic observation (Fig. 3). After having identified the branch nerve, i.e., the medial cutaneous branch, we were careful not to damage it throughout the procedure. The released length of the soft tissue depended on the extent of the individual patient's abnormal nerve area. Following sufficient release of soft tissue compressing the ulnar nerve, we confirmed intraneural blood circulation throughout the observed areas, especially where intraneural blood circulation had not been observed prior to release (Fig. 4). Immediate confirmation of recovery from intraneural blood circulation disturbance could not be

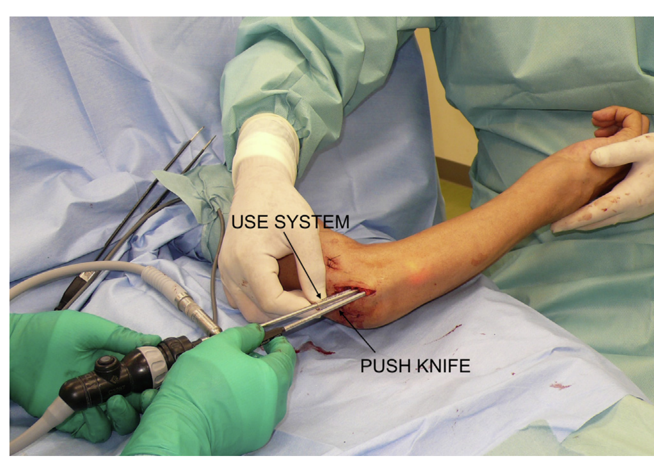

Fig. 1. Inserting the Universal Subcutaneous Endoscope (USE) system and push knife along the ulnar nerve. Releasing the contralateral side of the soft tissue of an abnormal ulnar nerve finding area using a push knife under complete endoscopic observation.