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Endoscopic Proximal Median Nerve Decompression: An Alternative Treatment for Pronator Syndrome

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Proximal forearm median nerve compressive neuropathy, termed as pronator syndrome, is difficult to diagnose and often overlooked. Its symptoms include vague proximal volar forearm pain that may be associated with paresthesia and numbness in the median nerve distribution. Weakness is typically not present. The treatment of pronator syndrome is largely nonsurgical, consisting of activity modification, anti-inflammatory medication, corticosteroid injections, stretching, and periods of splinting. Surgery is indicated when conservative therapy fails; however, there is no consensus on the treatment approach or technique. Most decompressions are performed using an open technique through a variety of incisions. Recently, endoscopic approaches have drawn an interest. This article describes a technique for endoscopic proximal median nerve decompression that enables the complete decompression of the median nerve in the distal aspect of the arm and proximal aspect of the forearm through a small incision, potentially minimizing surgical morbidity and reducing healing time.

Initially described in 1951 by Seyffarth,[1] pronator syndrome (PS) refers to a proximal median nerve compression manifesting as pain in the proximal volar forearm and numbness or paresthesia in the median nerve distribution.[2] The sites of potential compression include the ligament of Struthers, supracondylar process of the humerus, bicipital aponeurosis (lacertus fibrosus), vascular leashes overlying the median nerve, fibrous band of the pronator teres (PT) muscle, fibrous arch of the flexor digitorum superficialis (FDS) muscle, or an accessory head of the flexor pollicis longus muscle.[3–6]

The diagnosis of PS is often overlooked because of a similar presentation of carpal tunnel syndrome (CTS). Generally, a decreased sensation in the palmar cutaneous branch of the median nerve and an absence of findings with Tinel and Phalen provocation maneuvers suggest PS as opposed to CTS.[3,7] The pronator compression test, performed by applying pressure proximally and laterally to the PT muscle belly on the volar forearm, often elicits pain or paresthesia in patients with PS.[8] Resisted pronation and supination may reproduce symptoms caused by median nerve compression by the lacertus fibrosus or PT.[9] In patients with median nerve compression occurring between the heads of the FDS muscle, resisted flexion of the proximal interphalangeal joint of the middle finger may cause pain or numbness. A lack of motor findings differentiates PS from anterior interosseous nerve (AIN) syndrome, which is pure motor palsy.[10] Electromyography and nerve conduction study results are often normal in patients with PS.[11] These studies may be helpful in evaluating other sites of compression. Radiographs of the elbow are typically obtained to assess for bony pathology.

The initial management of PS is nonsurgical, with a period of activity modification, anti-inflammatory medications, corticosteroid injections, and temporary splinting. The surgical management of failed conservative treatment is controversial. Various surgical approaches for proximal median nerve decompression have been described, including oblique, transverse, and lazy-S incisions.[12–14] Recently, an endoscopic approach for PT decompression was proposed in order to minimize surgical morbidity and improve recovery time.[15]

We describe a technique for endoscopic proximal median nerve decompression (EPMND) to surgically address PS in patients in whom nonsurgical management has failed. This technique allows complete nerve decompression through a small incision, which

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may reduce surgical morbidity and reduce recovery time compared with traditional open-incision techniques.

Preoperative Evaluation

Patients presenting with vague proximal forearm pain, subjective grip weakness, and paresthesia in the median nerve distribution are evaluated for CTS and PS. The initial examination includes the pronator compression test, resisted forearm pronation and supination, Phalen and Durkan provocation maneuvers at the wrist, and Tinel testing at both the proximal forearm and wrist. Routine radiographic imaging of the ipsilateral elbow is performed to identify a potential supracondylar process. Each patient exhibiting the symptoms of PS undergoes electrodiagnostic testing to assess for the presence of concomitant cervical radiculopathy and peripheral compression neuropathy. Ultrasound is not typically performed for the evaluation of these patients.

Patients diagnosed with PS are initially managed nonsurgically for a minimum of 6 months. This regimen includes avoiding aggravating activities requiring excessive forearm pronation and supination as well as repetitive wrist flexion. Patients are encouraged to use nonsteroidal anti-inflammatory drugs, as needed for pain and inflammation. Removable Velcro wrist splints are suggested for use at night and during strenuous activities to prevent PS symptoms. A corticosteroid injection at the point of maximal tenderness identified during a physical examination is also offered to alleviate the symptoms.

For all patients in whom nonsurgical management has failed, both EPMND and open proximal median nerve decompression are offered. Patients electing to undergo EPMND are counseled regarding the potential need for an additional or more extended incision to perform complete decompression of the median nerve in the proximal aspect of the forearm. Endoscopic proximal median nerve decompression is not offered in a revision setting.

Indications

Endoscopic proximal median nerve decompression may be considered for patients diagnosed with PS, based on a physical examination and electrodiagnostic studies, in whom a minimum of 6 months of nonsurgical treatment consisting of activity modification, nonsteroidal anti-inflammatory drugs, splinting, and corticosteroid injection has failed.

Contraindications

The contraindications to EPMND include concomitant cervical radiculopathy or other peripheral compression neuropathies and a history of penetrating trauma or previous forearm surgeries on the affected extremity.

Surgical Technique

The patient is placed in a supine position, with the affected arm outstretched on a hand table. A tourniquet is placed proximally on the arm (Fig. 1). The shoulder is abducted slightly past 90° in order to provide ample space for the surgeon and instruments during the procedure. A 3-cm longitudinal incision is made just medial to the bicep tendon, approximately 3–4 cm above the antecubital crease (Fig. 2). The incision is carried sharply through skin, and full-thickness flaps are elevated. The proximal aspect of the lacertus fibrosus is identified and sharply incised; release is performed in line with the skin incision both proximally and distally (Fig. 3). The underlying bicep muscle is freed bluntly and mobilized laterally. A blunt dissection is carefully performed to identify and expose the median nerve, which may be found medial and deep to the brachial artery (Fig. 4). Under direct visualization, the median nerve is dissected as distally and proximally as possible. Care is taken to maintain hemostasis with bipolar cautery in preparation for the endoscopic portion of the procedure.

Figure 1. Patient positioning for EPMND. The patient is placed in a supine position on a stretcher, with the arm outstretched on a hand table. A tourniquet is placed proximally on the arm.

Figure 2. The incision for EPMND is approximately 3 cm in length medial to the bicep tendon and approximately 3–4 cm above the antecubital crease, as shown by the 2 dots.

A long, nasal speculum is introduced distally in line with the course of the median nerve. The speculum is passed several times to bluntly separate the overlying soft tissues. The speculum is then opened, and an Endobrow 4-mm, 30° endoscopic camera inside an endoplastic sheath with a flat spatula (Hayden Medical) is introduced (Fig. 5). The median nerve is identified proximally using an endoscope through the endoplastic sheath. The flat spatula tip of the endoplastic sheath is first used to bluntly dissect between the muscle and fascial planes while elevating the overlying soft tissue. This improves the overall visualization of the median nerve and facilitates the identification of constrictive tissues. Dissecting scissors are then introduced through the surgical incision and visualized using the endoscope. The scissors are used to release the bicipital aponeurosis under endoscopic view (Fig. 6). The nerve is maintained within the field of vision to prevent iatrogenic injury. Overlying vascular leashes are carefully avoided from the scissors during dissection. A bayonet bipolar forceps (Ethicon) is used to coagulate and release constrictive vascular leashes compressing the median nerve as well as to maintain hemostasis throughout the procedure. This ensures adequate visualization and prevents postoperative hematoma formation. The proximal fibrous band of the PT is then identified. Dissection with the scissors through the

Figure 3. The lacertus fibrosus is identified following the elevation of full-thickness skin flaps.

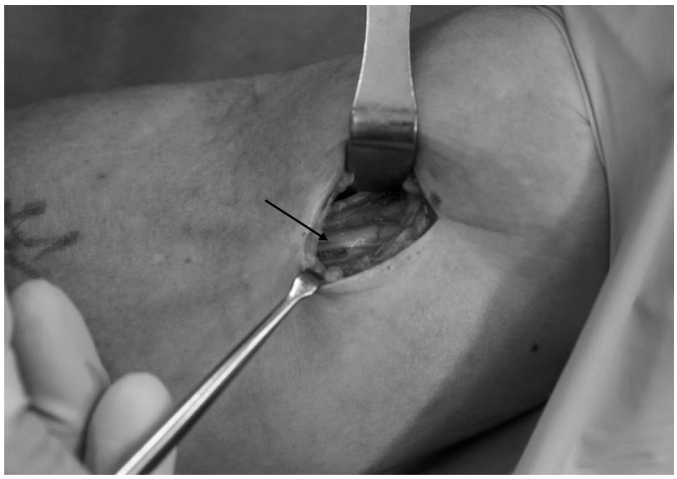

Figure 4. The median nerve (black arrow) is identified medial and deep to the brachial artery.

overlying PT fascia as well as the fascia between the humeral and ulnar heads of the muscle is performed following the median nerve (Figs. 7, 8). The proximal fibrous arch of the FDS is identified and incised. The branch point to the AIN is typically seen at the distal fibrous arch of the FDS. Both the median nerve and AIN are carefully examined at this anatomic landmark to ensure complete decompression through the arch and remaining FDS muscle belly. The length of the decompression is also confirmed via transillumination of the overlying skin using the endoscope. At this point, dissection along the entire length of the endoscope is complete. The nerve is closely scrutinized for persistent sites of constriction as the endoscope is slowly withdrawn (Fig. 9 and Video 1). The tourniquet is deflated, and hemostasis is obtained using bipolar cautery. The proximal incision is irrigated with normal saline. A small drain is placed within the proximal incision if there is a concern for postoperative bleeding. The wounds are closed using a nylon suture, and a soft dressing is placed.

Postoperative management

If a drain is placed at the time of surgery, the patient is instructed to remove the drain 24 hours after surgery. The patient may remove the dressing 3 days after the surgery. Patients are

Figure 5. **A** Long nasal speculum. **B** Endobrow endoscopic sheath with a flat spatula tip. **C** A 4-mm, 30° endoscopic camera. **D** Bayonet bipolar forceps.

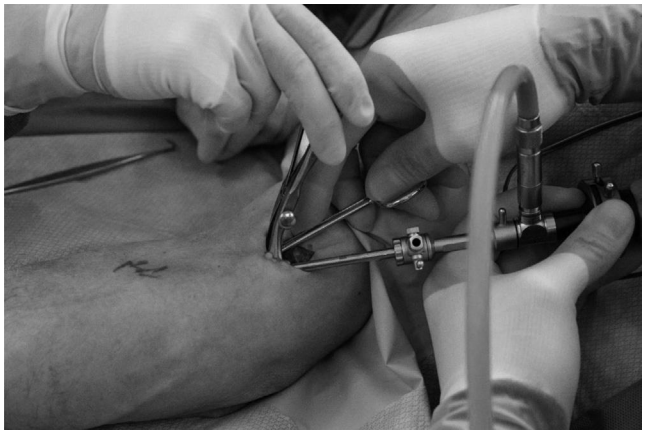

Figure 6. Instrument positioning during EPMND.

instructed to perform gentle elbow range-of-motion exercises in the first week following the surgery and refrain from heavy-lifting activities. Return to full activity occurs 2 weeks following the procedure, and the sutures are removed at this time.

Case Example 1

The patient was a 17-year-old female gymnast who presented with “shocking” pain in the anterior aspect of her elbow as well as the thumb, index, and middle finger. She had suffered bilateral elbow dislocations, treated with closed reduction, 18 months prior to this presentation. The symptoms had been present for approximately 6 weeks and were worsening in severity. On examination, the patient was found to have tenderness at the proximal volar aspect of the flexor pronator mass over the median nerve. The symptoms were reproduced with Tinel provocation testing at this site, manifesting as a shocking sensation in her thumb, index, and long fingers. Pain was elicited with the pronator compression test

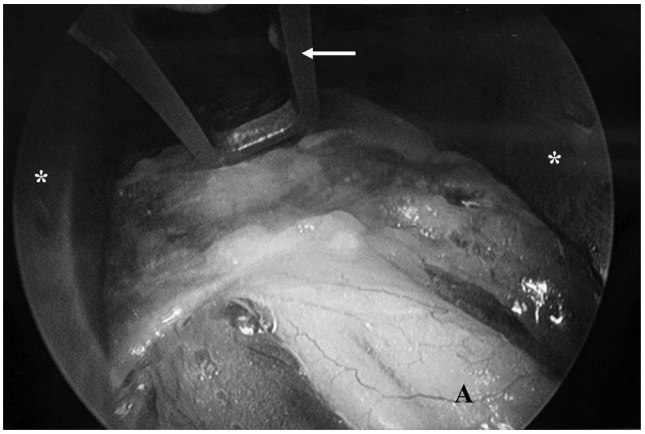

Figure 7. Endoscopic view of proximal median nerve decompression. Asterisks show the positioning of the speculum. **A** Arrow shows the Endobrow endoscopic sheath exposing the median nerve.

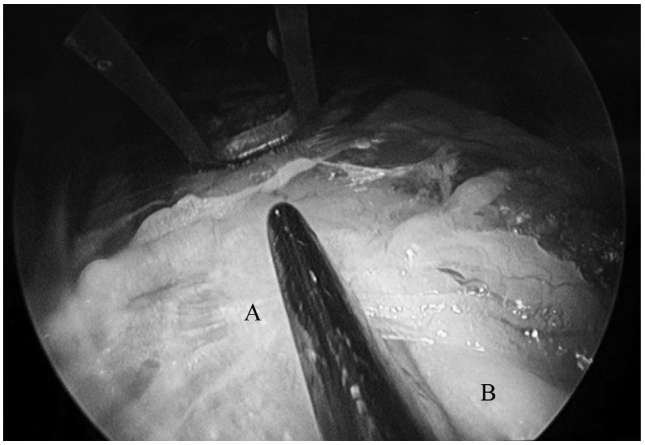

Figure 8. Endoscopic view of proximal median nerve decompression with tenotomy scissors. **A** The fascia of the PT overlying the **B** median nerve is carefully released under direct visualization.

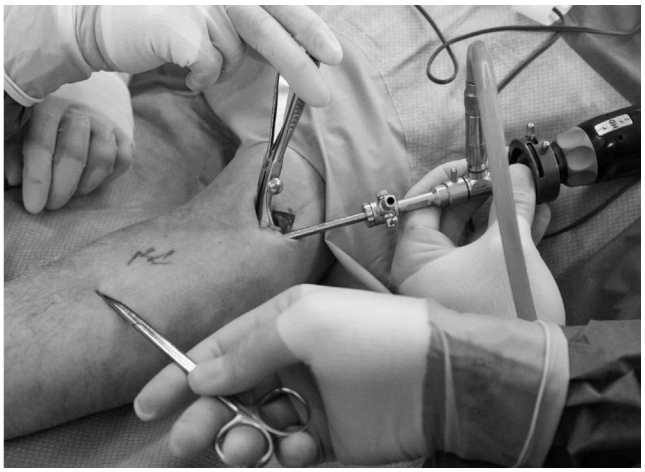

Figure 9. Tenotomy scissors indicating the distal extent of the endoscopic decompression.

as well as with resisted pronation of the forearm. Her radiographs did not demonstrate a supracondylar humerus process. Electrodiagnostic study results were negative for cervical radiculopathy and CTS. Initially, the patient was instructed to refrain from gymnastics for an additional 4 months. Nonsteroidal anti-inflammatory drugs provided her with minimal relief from the pain during activities consisting of light stretching and resistance bands. The patient received 1 corticosteroid injection at a clinic appointment, which provided 2 weeks of moderate relief. Given her worsening symptoms and failed conservative therapy, she decided to proceed with EPMND. There were no complications during the surgery, and the total operative time was 22 minutes. Following endoscopic decompression, the patient had immediate improvement in the symptoms and returned to gymnastic activities 2 weeks after the surgery.

Case Example 2

The patient was a 20-year-old man with a 6-month history of vague pain in the medial aspect of his right distal brachium. There was no traumatic event that triggered his symptoms. His symptoms progressed in severity during this time despite avoiding exacerbating activities, performing forearm stretching, and taking anti-inflammatory medication. On examination, the patient was found to have tenderness to palpation along the proximal edge of his PT. The pain was reproduced with resisted pronation. The patient denied numbness or changes in sensation along the forearm and in the hand. No nerve pain was elicited with Tinel maneuver along the proximal forearm. Radiograph results were negative for a supracondylar humeral process. Electrodiagnostic study results were normal, without evidence of cervical radiculopathy or concomitant peripheral compressive neuropathy. The patient received 1 corticosteroid injection at the clinic, which provided 3 weeks of symptomatic relief; however, the symptoms returned with the same severity. Given the prolonged period of the symptoms and the lack of substantial relief, the patient decided to undergo a surgical intervention. He underwent EPMND (the surgical time was 26 minutes), with resolution of the symptoms 1 day following the procedure. He returned to full activity 2 weeks after the surgery and has not experienced recurrence of the symptoms.

Case Example 3

The patient was a 67-year-old man experiencing volar forearm pain during activities of daily living for several months. His pain was associated with numbness and tingling, most pronounced in the radial 3 digits of the hand. During this time, his symptoms worsened, and he recently began to exhibit weakness in the affected hand. On examination, the patient was found to have exquisite tenderness to palpation along the proximal border of the PT. He had a positive Tinel sign along the volar forearm, causing a shocking sensation in the thumb, index, and long fingers. The patient was also noted to have weakness during thumb interphalangeal joint flexion (flexor pollicis longus) and index distal interphalangeal joint flexion (flexor digitorum profundus). Resisted pronation caused substantial discomfort. Electromyography was performed, which demonstrated PS with an associated AIN compressive neuropathy. Given the concern regarding the electromyography findings and progressive symptomatology, the patient declined a corticosteroid injection and elected to undergo EPMND. There were no complications during the procedure, and the total operative time was 28 minutes. Following the procedure, the patient's proximal forearm pain improved within a few days following the procedure. His weakness resolved approximately 1 month after the surgery. He currently participates in activities without experiencing his previous symptoms.

Discussion

Pronator syndrome is characterized by a median nerve compressive neuropathy at the proximal forearm. Multiple structures serve as potential sites of constriction, including the ligament of Struthers, lacertus fibrosus, 2 heads of the PT, vascular leashes, proximal fascial edge of the FDS, and an accessory head of the flexor pollicis longus muscle. The diverse constellation of symptoms makes the diagnosis of PS difficult, and it is often overlooked. Although nonsurgical management typically results in a symptomatic improvement, a surgical intervention is warranted when the symptoms worsen or fail to improve. Previously, the decompression of the proximal median nerve was accomplished through a variety of open procedures. Recently, a trend of endoscopic-assisted decompression of the proximal median nerve has emerged. Lee et al[15] previously performed endoscopic-assisted proximal median nerve decompressions in 14 cases, with positive results. All patients in the study had improved disabilities of the arm, shoulder, and hand outcome measure scores (average difference of 51 points). Complications were minimal, with 3 patients experiencing some mild forearm discomfort due to strenuous activity and 1 patient developing scar tenderness. Despite these promising results, EPMND remains underused, and there continues to be a lack of consensus regarding the preferred method and technique.

This article outlines our surgical technique for the endoscopic decompression of the median nerve that has been successful in treating PS in patients with varying presentations. Complete decompression can be achieved through a small incision with the use of an endoscope. The nerve is decompressed in only a proximal-to-distal fashion, thus decreasing the chance of an iatrogenic nerve injury at the branch points of the median nerve. The more proximal incision avoids the need to decompress the median nerve in a distal-to-proximal direction. When dissecting in a distal-to-proximal fashion, nerve branch points are encountered at an axilla, increasing the risk of iatrogenic transection. The total length of decompression is confined to the length of the endoscope and scissors but is adequate to reach the branch of the AIN and relieve pressure on it. The median nerve is easily identified in the sulcus medial to the myotendinous junction of the bicep, and the endoscope enables excellent visualization of the median nerve along its entire course. One limitation of this technique is that of addressing a supracondylar process of the humerus through the small endoscopic incision. Patients with concomitant peripheral compressive neuropathy require either multiple incisions or an extended incision for the complete decompression of affected nerves; therefore, the endoscopic release of the proximal median nerve in this setting may not be advantageous. Additionally, like endoscopic cubital tunnel release, there is a learning curve to develop proficiency with this technique. Like other nerve decompression techniques, there is a risk of inadequate decompression and persistent symptoms. The smaller incision, minimized soft-tissue trauma, and decreased operative time may decrease surgical morbidity, improve cosmesis, reduce scar tissue formation, and facilitate shorter recovery times.

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