Median Nerve Injury After Removal of Subdermal Implantable Contraceptive

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Abstract

Background: Subdermal implantable contraceptives are highly effective, approved in over 60 countries, and used by millions of women. Due to simple insertion and removal protocols, these procedures are often performed in the outpatient clinic setting, and procedural complications are rare. However, given the location of the implant in the medial antebrachial interval, there is a risk of neurovascular injury, especially with malpositioned or deeply placed implants. **Methods:** We present a case of proximal median nerve injury leading to severe neuropathy after attempted removal of a subdermal implantable contraceptive requiring neurolysis and tendon transfers. **Results:** At 6 months post surgery, the patient regained flexion of the index interphalangeal joints and protective sensation in the thumb and index fingers. **Conclusions:** Subdermal implant retrieval can lead to nerve injury, despite the relative simplicity of the procedure. If difficulty is encountered, imaging or open retrieval should be considered. Improvement in function can be gained through operative interventions including neurolysis and tendon transfers in the setting of severe neuropathy.

Keywords: iatrogenic injury, implantable contraceptive, median nerve, tendon transfer, neuropathy

Introduction

Subdermal implantable contraceptive devices are frequently utilized as long-term reversible alternatives to oral contraceptives. They are effective and have lower rates of rejection and dysmenorrhea when compared with other implantable options.⁶ In addition, they have a low reported complication rate and are generally easy to implant and remove in the clinic setting. With an average of 1 minute for implantation and 2 minutes for removal,³ they are described as easy, efficient, and effective long-term reversible contraception.

However, as with all medical devices, patient risk exists. Reported complications are relatively uncommon and usually related to the insertion site. These include infection, bruising, bleeding, persistent pain, or wound healing delays.⁶ Very rare severe complications have also been reported. These involve implant migration or injury to vital brachial structures during attempted removal. Recent reports of median, ulnar, and cutaneous sensory nerve injury illustrate the potential risk of these devices encroaching on critical structures.^{2,7-9} To this point, we present a case of severe nerve injury during a failed removal procedure, resulting in dense median neuropathy severely affecting hand sensation and function, and requiring operative neurolysis and tendon transfers.

Methods

A 27-year-old female presented to the hand surgery clinic reporting paresthesias, pain, and loss of function in the left hand and wrist. Symptoms began 2 months prior, immediately following attempted removal of an implantable contraceptive device in the left upper arm by her gynecologist. Initial implant retrieval was unsuccessful despite an hour of ultrasound-guided attempts. She required a second operative procedure with a hand surgeon, where a counter incision was made posteriorly and the implant was successfully retrieved (Figure 1).

Following the initial attempt at device removal by her gynecologist, she noted paresthesias, pain, and loss of function, described as limited motion of the index finger and thumb, and loss of grip and wrist flexion strength (Figure 2). She started a course of gabapentin and meloxicam in the weeks following successful implant removal, without improvement. Nerve conduction studies obtained 6 weeks

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Figure 1. The patient had a small transverse scar near the left bicipital groove from initial attempt at removal and a longer posterior longitudinal incision from a second successful retrieval procedure.

Figure 2. The patient demonstrated an altered cascade on presentation with limited flexion of the index finger and thumb on attempted full-composite fist.

after symptom onset demonstrated left median response amplitude 0.1 compared with 11.4 mV of the right median and no sensory response. Electromyography (EMG) demonstrated inability to voluntarily activate motor units in the median and anterior interosseous nerve (AIN) distribution (flexor pollicis longus [FPL], pronator teres [PT]) and copious fibrillations indicating denervation. There was no evi-

dence of radial or ulnar nerve injury. On magnetic resonance imaging (MRI), there was no mass, fluid collection, or inflammation in the soft tissues.

After the above workup, the patient was referred to our clinic. Physical examination demonstrated a Tinel sign at the surgical scar. She had 0/5 strength in the flexor carpi radialis (FCR) and ulnar wrist deviation during flexion. In addition, the flexor digitorum superficialis (FDS) and FPL demonstrated 0/5 strength, and function of the flexor digitorum profundus (FDP) to the index finger was absent. Protective sensation in the median nerve distribution was absent with no response to 6.65 (300 g) monofilament.

Operative Details

Given the EMG and nerve conduction study (NCS) results, there was concern for possible neurotmesis. The patient was taken to the operating room for proximal exploration and distal tendon transfers to restore immediate index finger flexion. Following exposure of the median nerve in the brachial septum, there were 2 sites with a change in consistency along the length of the nerve, with epineurial constriction and fibrosis. In these areas, the epineurium was circumferentially removed and intrafascicular dissection over a span of 4 cm completed. No sites of fascicular discontinuity or neuroma-in-continuity were identified. However, consistent with preoperative studies, nerve stimulation demonstrated no conduction in any fascicles within the median system. The exposed segment of median nerve was wrapped with a porcine submucosa nerve wrap.

Given potential for recovery based on apparent fascicular continuity, tendon transfers to the thumb that would require sectioning of the FPL were deferred. However, side-to-side tenodesis of the FDP of the index finger to the FDP of the long finger was performed at the level of the distal forearm with the wrist, index finger, and long finger in a slight degree of flexion to recreate the appropriate cascade. Carpal tunnel release was performed to limit possible distal sites of nerve compression.

Results

The patient began occupational therapy for range of motion, edema control, and strengthening on postoperative day 10. Therapy was modeled after a modified Duran protocol for her index finger, including passive range of motion and tenodesis exercises both to protect and rehabilitate the tendon transfers and promote improved range of motion of the interphalangeal (IP) joints, given the patient's inability to actively flex the fingers. Place-and-hold exercises and sensory stimulation were started at postoperative week 2. Active-assisted flexion began at 1 month, and active flexion started at 6 weeks.

Figure 3. The patient was able to make a full-composite fist at 10-month follow-up.

Three months postoperatively, the patient had 30 degrees of active thumb IP joint flexion, compared with 0 degrees at 2 months. By the fourth postoperative month, she regained thumb opposition to the tip of the small finger, 4/5 FCR strength, and increased sensation over the thenar eminence and distal median distribution. At 6 months postoperatively, she demonstrated flexion of the index proximal and distal IP joints to the distal palmar crease, and protective sensation in her thumb and index finger (4.31 monofilament, 2.0 g). By the 10th postoperative month, she could make a full-composite fist (Figure 3), sensation intact to 2.83 monofilament (0.07 g) in all distributions, and Quick Disabilities of the Arm, Shoulder and Hand score (QuickDASH) was 57%.

Discussion

Placement and removal of subdermal implanted contraceptives generally are quick office procedures performed under local anesthesia. The implant is a 4-cm long rod. Current instructions for insertion use a subdermal site 8 to 10 cm above the humerus medial epicondyle of the nondominant arm.⁴ The implant remains in place for up to 3 years prior to removal with a “pop-out” technique, which requires direct palpation and a 2-mm incision.³ In a multicenter cohort study involving 635 patients receiving implantable contraceptive devices, 97% had fast and uncomplicated implant removal.³ The 3% with difficulty were usually attributed to deep insertion. Complications include swelling, redness, pain, hematoma, and significant fibrosis at the insertion site.

Although these larger studies did not note nerve injury, isolated reports of contraceptive implant-associated neu-

ropathy have been published. Smit et al reported an ulnar nerve injury after removal of a 6-rod implant, despite the implants being clearly visible and easily palpable.⁸ Wechselberger et al and Brown and Britton reported medial antebrachial cutaneous nerve injuries after removal of or insertion of a single-rod contraceptive implant.^{2,9} Most recently, Restrepo and Spinner reported a 5-cm neuroma in continuity of the median nerve and mild scarring of the medial antebrachial cutaneous and ulnar nerves after attempted removal of a contraceptive implant.⁷

In this case, the patient’s clinical presentation indicated a severe injury, with absent sensation in the median nerve distribution and inability to flex the index finger or thumb. Preoperative EMG and NCS results led to concern that a large portion of the nerve could have been in discontinuity, with low probability of recovery without surgical intervention. In addition, the patient sought improved function in the short term, while awaiting neural recovery. For these reasons, we proceeded with exploration and tenodesis. Although controversy exists regarding the safety and utility of intrafascicular dissection,⁵ we proceeded in a stepwise approach, releasing the epineurium only in areas of constriction and scarring, and carried out intrafascicular dissection only to the extent necessary to identify any fascicular pathology to minimize any future scarring.

Physical examination was notable for no active opposition of her left thumb and ulnar deviation with wrist flexion. Her lack of function in the median nerve distribution, including those muscles innervated by the AIN, led to the diagnosis of a high median nerve injury. High median nerve injury is defined as a lesion to the median nerve proximal to the branch point of the AIN. Given the deficits, surgical treatment is aimed at restoring thumb IP joint flexion and index finger flexion. Long finger flexion can be preserved, as up to 80% of long finger deep flexors have innervation from the ulnar nerve.¹ Thumb flexion is restored with transfer of the brachioradialis to the FPL. Index finger flexion is provided via transfer of extensor carpi radialis longus (ECRL) to the index FDP, or side-to-side tenodesis of the long finger FDP to the index FDP, should long finger FDP function be spared. In this case, a side-to-side tenodesis of the index finger FDP to the long finger FDP was performed to give the patient immediate active motion at the index finger, with the caveat that this can be reversed if the innervation of the index finger FDP returns. We chose not to perform a transfer to the FPL, as no intrafascicular disruption was identified on exploration, making a lower grade axonotmesis, and therefore potential eventual recovery more likely. This is despite no voluntary activation of median or AIN motor units on initial EMG, and minimal and no sensory conduction through the median nerve on initial conduction studies.

Conclusions

This case highlights the potential for injury following retrieval of implantable devices in the upper extremity. We emphasize

that percutaneous retrieval should only be attempted for readily palpable implants in an immediately subcutaneous position. Any doubt as to the location of the device, or difficulties with immediate retrieval, should warrant consideration of cross-sectional imaging and open exposure for safe removal.

Ethical Approval

This study was approved by our institutional review board.

Statement of Human and Animal Rights

All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008.

Statement of Informed Consent

Informed consent was obtained from all patients included in the study.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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