

Endoscopic Fascia Release for Forearm Chronic Exertional Compartment Syndrome: Case Report and Surgical Technique

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Abstract

Background: Chronic exertional compartment syndrome (CECS) of the forearm is traditionally treated with open compartment release requiring large incisions that can result in less than optimal esthetic results. The purpose of this study is to describe a case report of 2 professional motocross patients with forearm CECS treated endoscopically using a minimally invasive technique. **Methods:** Two professional motocross racers presented with a history of chronic proximal volar forearm pain when motocross riding. Other symptoms included paresthesia and weakness, which, at times, led to an inability to continue riding. Both failed conservative management. Compartment pressure measurements were performed before and after provocative exercises to confirm diagnosis of CECS. Release of both the volar and dorsal compartments was performed endoscopically through a single incision. **Results:** Symptoms resolved after surgery. The first patient resumed riding at 1 week, competing at 3 weeks, and continues to ride competitively without symptoms at 3 years postoperative. The second patient began riding at 1 week and won second place in the National Supercross finals 5 weeks after simultaneous bilateral release. **Conclusions:** This technique is simple and effective. The cannula used protects the superficial nerves while allowing release through a small, cosmetically pleasing incision.

Keywords: chronic exertional compartment syndrome, compartment release, endoscopic, minimally invasive surgery, muscle injury, motocross arm pump, forearm, fasciotomy

Background and Purpose

Chronic exertional compartment syndrome (CECS) of the forearm is a well-known and feared condition within the professional motocross racing circuit. Among the motocross racing community, this condition is more commonly referred to as “arm pump.”² While the prevalence of CECS is unknown, Johnathan Edwards, MD reported the following, “Of the estimated 300 elite motocross racers in the United States, approximately 85% have symptoms of CECS. Of these individuals, an estimated 10 to 20% seek surgical treatment.” Dr. Edwards, a former professional motocross athlete, is a sports medicine physician who has worked with elite motocross athletes for 20 years and currently serves as Adjunct Faculty at Touro University, Las Vegas, NV. Chronic exertional compartment syndrome is a condition that typically occurs in athletes due to repetitive and/or sustained forceful muscle exertion that results in exercise-induced pain that is relieved by rest.¹² Intracompartmental pressures in CECS reach pathologic levels that cause significant pain similar to acute traumatic compartment syndrome. The latter is a progressive unrelenting problem, whereas CECS starts to resolve as soon as the inciting action is stopped. Many riders experience severe forearm pain,

cramping, and numbness while riding.¹³ The forearm symptoms are often associated with crashes as the rider’s performance is hindered by their inability to pull the clutch or brake levers, effectively grasp the grips, and shut off the throttle.⁸

Open compartment release for CECS is a well-established treatment often performed through multiple large incisions which may result in marginal esthetic outcomes. There have been some reports of endoscopic release through smaller, more cosmetically pleasing, incisions.^{3,5,6} The purpose of this study was to report 2 cases of forearm CECS and a minimally invasive endoscopic technique not previously described.

Case I

A 23-year-old right-hand-dominant professional motocross racer presented with a 6-week history of chronic right-sided proximal forearm pain exacerbated by repetitive wrist

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extension and sustained gripping while riding and throttling the motocross bike. The patient had a recent history of upper extremity traumas due to riding, including a triangular fibrocartilage complex tear and right distal radius intra-articular fracture with surgical repair for which wrist and elbow immobilization was required for a period of approximately 2 months. The patient returned to riding for 3 months before presenting for initial consultation with worsening right-sided forearm symptoms. The patient reported that he was unable to perform required training workouts and competitions due to the incapacitating nature of the right forearm pain.

Symptoms included volar forearm pain and paresthesias of the right hand that were causing decreased reaction time and inability to maintain throttle grip strength. The patient described the symptoms as the “arm pump was like having a dead arm” while riding. Initial onset of pain was originally within 20 minutes of motocross riding and progressed to an onset of pain within 5 to 10 minutes of riding. Numeric rating scale (0-10, 0 = no pain, 10 = worst imaginable pain) for pain of the right forearm was rated as 9 out of 10. Symptoms significantly decreased within 15 minutes of activity cessation and diminished completely after approximately 1 hour. Symptoms were not present when not riding the motocross bike.

He had failed conservative treatment including rest, non-steroidal anti-inflammatory medications, and myofascial release treatments.

On initial evaluation, the patient reported to be asymptomatic. There was no evidence of swelling, erythema, or ecchymosis of the right forearm. Right forearm girth, appearance, grip strength, range of motion, and 2-point discrimination were all normal and bilaterally symmetric. The patient denied any discomfort during palpation of the volar and dorsal forearm. The patient had no motor deficits and a normal vascular exam. No acute bone or joint abnormality on anteroposterior and lateral radiographs was observed.

To provoke exercise-induced symptoms, the patient alternated between a 7-pound Digi-Flex finger exerciser (IMC Products Corp, Hicksville, New York) and a FlexBar (Hygenic Corp, Akron, Ohio) used to perform gripping and twisting. Exercises were alternated at 3-minute intervals for a total of 15 minutes of muscle activity to mimic repetitive gripping and wrist extension movements experienced while performing motocross activity. After 13 minutes of repetitive exercise, the patient reported symptom reproduction to be approximately 70% of what he typically experiences when he rides. Forearm compartment pressure measurements were performed using the Stryker intracompartmental pressure monitor system.^{1,7} Slit catheter technique was used to measure the volar and dorsal superficial and deep compartments before exercise and at intervals of 1 and 5 minutes post exercise (see Table 1).¹¹ Criteria used to confirm CECS included resting compartment pressures above 15 mm Hg combined with delayed return to normal and measured as

Table 1. Compartmental Pressures of Case 1 Before and After Exercise.

Compartment	Compartmental pressure (mm Hg)		
	Preexercise	1-min post	5-min post
Volar			
Superficial	7	31	31
Deep	12	45	45
Dorsal			
Superficial	17	26	14
Deep	10	19	15

pressures of 20 mm Hg or greater following 5 minutes of rest post exercise.^{4,9} Pressure measurements confirmed CECS (Table 1). He underwent endoscopic fasciotomy.

The patient's symptoms resolved following surgery. He resumed motocross riding 8 days postoperatively. At his 1-month postoperative follow-up visit, the patient stated that he could ride as hard as he ever could without any pain. Objective measurements included improvement in preoperative grip strength from 46 to 57 kg at the 1-month postoperative follow-up. Total arc of wrist range of motion was 324° and 364° at the preoperative and 1-month postoperative visits, respectively.

Case 2

A 26-year-old professional motocross rider presented with a 4-year history of severe bilateral arm pump affecting his ability to control his motorcycle and race effectively. He rated his pain with activity as 10/10 bilaterally. He had tried therapy without relief of symptoms. He described the pain as “it feels like the forearms are going to burst.” Symptoms typically occurred within 20 minutes of beginning to ride his motorcycle. Compartment pressures were measured before exercise and again at 1 minute and 5 minutes after performing forearm exercises. Abnormal measurements within the right forearm dorsal compartment were found before exercise (16 mm Hg), and after 5 minutes of exercise (21 mm Hg). Abnormal compartment measurements were found 5 minutes after exercise for the left forearm dorsal compartment (25 mm Hg). Both dorsal and flexor surfaces were painful by history and also by examination after exercise, although the volar compartments were most symptomatic.

The patient was taken to surgery and underwent bilateral simultaneous endoscopic forearm fasciotomies. The patient presented to the clinic the following day with the comment, “If I had known it was going to be this easy, I would have done this a long time ago.” He began riding at 1 week. Grip strength improved from an average of 31.75 to 56.7 kg 2 weeks after surgery. Range of motion was unchanged. He had a small seroma that resolved with an Ace wrap by the second postoperative week. He won

second place in the National Supercross Championships 5 weeks after surgery.

Surgical Technique

A well-padded sterile tourniquet was placed high on the brachium. The upper extremity was prepped and draped in the usual sterile fashion. A portal was placed over the subcutaneous border of the ulna midway between the olecranon and the ulnar styloid. The skin was mobilized in a volar and dorsal direction to allow release of both the volar and dorsal compartments through this single portal. The cannula of the EndoRelease (Integra LifeSciences Corporation, Plainsboro, New Jersey) system was placed under the fascia of the volar compartment and advanced distally. The retractor was allowed to slide over the fascia thereby elevating the superficial nerves out of harm's way. The scope was placed over the cannula and under the retractor to visualize the superficial surface of the fascia and to confirm that there were no superficial nerves in harm's way. The scope was placed into the cannula, and the fascia was released with a push knife. The scope and cannula were removed.

The cannula was then inserted under the fascia of the volar compartment in a proximal direction, and the release was completed in the same fashion (Figure 1). The cannula was removed and the skin was mobilized to allow exposure of the antebrachial fascia over the dorsal aspect of the forearm. The antebrachial fascia of the dorsal compartment was opened proximally and distally as described above. The incision was closed with interrupted subcuticular 4-0 Monocryl with Steri-Strips.

Discussion

This technique as described is simple and effective. The cannula used protects the superficial nerves while allowing release through a small cosmetically pleasing incision (Figure 2). Based on the outcomes of the patients in this study, we believe this endoscopic procedure provides further evidence to support Wittstein et al¹⁴ who suggested that the endoscopic approach may provide for improved cosmesis. The authors have also used a single incision over the subcutaneous border of the ulna for acute compartment syndromes of the forearm and prefer it to standard size incisions in most cases. The second patient in this report flew in unaccompanied from out of town, had bilateral release, returned home the day after surgery, and won second place in a national championship motocross race 5 weeks after surgery, illustrating the apparent ease of recovery following this minimally invasive surgery.

Although the patients in this case report had both the volar and dorsal compartments released, cadaveric studies have suggested that single compartment release may be adequate.¹⁰ The authors have no experience with single compartment release. However, the authors did note that the muscle protruded from release of the volar fascia, whereas

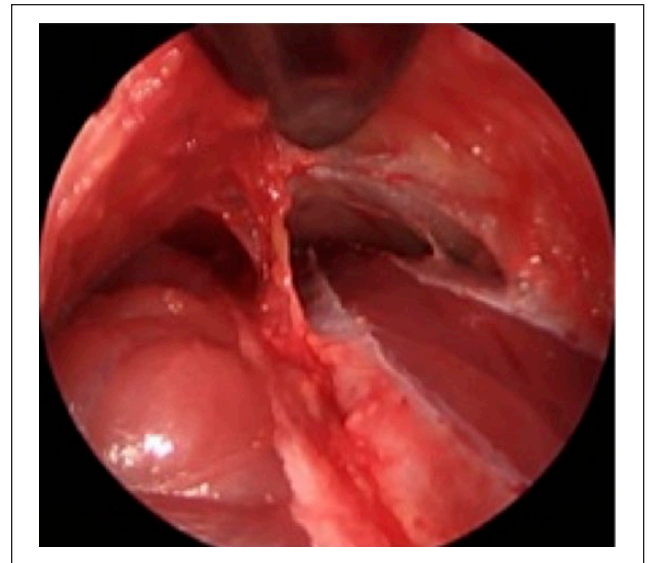


Figure 1. Intraoperative photo showing endoscopic release of the volar and dorsal compartments through a single incision.



Figure 2. Photo showing scar at the 1-month follow-up visit.

the dorsal musculature did not show obvious compartmental relief during surgery. Therefore, release of only the volar compartment could allow for a less invasive treatment option for CECS.

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. Prior approval by the Genesis Health System institutional review board (IRBNet ID: 506125-1) was obtained.

Statement of Informed Consent

Informed consent was obtained from all individual participants included in the study. Additional informed consent was obtained from all patients for whom identifying information is included in this article.

Declaration of Conflicting Interests

The author(s) declared the following potential conflicts of interest with respect to the research, authorship, and/or publication of this article: TKC declares that he has a financial relationship with Integra LifeSciences Corporation. ALC and EAM declare that they have no commercial associations (eg, consultancies, stock ownership, equity interest, patent/licensing arrangements, etc) that might pose a conflict of interest in connection with the submitted article. In addition, TKC has a patent for the EndoRelease Cannula with royalties paid by Integra Life Sciences.

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