



Common Peroneal Nerve Entrapment in the Differential Diagnosis of Chronic Exertional Compartment Syndrome of the Lateral Lower Leg

A Report of 5 Cases

Aniek P.M. van Zantvoort,^{*†} MD, MSc, Maikel J.M. Setz,[‡] MD, MSc, Adwin R. Hoogeveen,[§] MD, PhD, and Marc R.M. Scheltinga,^{*†||} MD, PhD

Investigation performed at Máxima Medical Center, Veldhoven, the Netherlands

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Young individuals engaged in sports activities who report lower leg discomfort may have various conditions, including medial tibial stress syndrome, stress fractures, neurovascular entrapments, or chronic exertional compartment syndrome (CECS).^{2,5} CECS is caused by elevated muscle pressure leading to locoregional pain and tightness following running or walking or even during rest. The gold standard diagnostic tool is a dynamic intracompartmental pressure (ICP) measurement.¹⁷ Three subtypes of CECS may be identified. CECS of the anterior tibialis muscle and CECS of the posterior flexor muscle are most frequently studied. However, CECS may occur exclusively in a lateral muscle compartment (lat-CECS). Elevated muscle pressures in lateral portions of the lower leg have been found

in the presence of normal tissue pressures in the anterior tibialis muscle and the posterior flexor muscle.²⁰

A number of patients with symptoms suggesting isolated lat-CECS who were evaluated at the Department of Sports Medicine of our clinic demonstrated a normal ICP. Some of these patients were eventually diagnosed with a common peroneal nerve entrapment syndrome (CPNE). Patients with CPNE may be seen by a range of specialists, including neurologists, neurosurgeons, orthopaedic surgeons, physical or sports medicine specialists, or rehabilitation doctors, or by reconstructive surgeons treating sensory deficits in patients with diabetes.^{4,6,8,9} CPNE is occasionally considered by sports physicians evaluating lower leg syndromes.^{2,14} The present study describes characteristics and surgical management of patients who were initially evaluated for CECS by sports physicians but were found to have CPNE. Our aim was to increase awareness in the domain of sports medicine and orthopaedic surgery regarding this syndrome.

CASE SERIES

Case 1

The lateral aspect of the right knee of a 34-year-old woman was hit by a wheelchair 5 years previously, leading to chronic, severe neuropathic pain in her lower leg. Radiographs, bone scans, common peroneal nerve (CPN) ultrasonography, and magnetic resonance imaging (MRI) revealed no abnormalities. A lower leg electromyograph (EMG) including nerve conducting velocity (NCV) analyses of the CPN and superficial peroneal nerve (SPN) was normal. The

^{||}Address correspondence to Marc R.M. Scheltinga, MD, PhD, Department of Sports Medicine, Máxima Medical Center, De Run 4600, PO Box 7777, 5504 MB, Veldhoven, the Netherlands (email: m.scheltinga@mmc.nl).

^{*}Department of Surgery, Máxima Medical Center, Veldhoven, the Netherlands.

[†]Caphri Research School, Maastricht University Medical Center, Maastricht, the Netherlands.

[‡]Department of Neurology, Máxima Medical Center, Veldhoven, the Netherlands.

[§]Department of Sports Medicine, Máxima Medical Center, Veldhoven, the Netherlands.

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patient received physical therapy and oral medication including neuroleptic agents for intractable pain of unknown cause, but with minimal effect. At our clinic, she reported that pain ruled her life. Activities such as walking and bicycling were almost impossible, and normal sleeping was hindered because of flashing pain and annoying lower leg skin sensations. On examination, she demonstrated an antalgic gait pattern. Skin sensation of the anterolateral aspect of the lower right leg after light touching with a cotton swab was reported as “uncomfortable” compared with the left leg. Pinching the skin was extremely painful (positive pinch test). Digitally applying pressure or finger tapping just distal to the fibular head was also painful, with pain radiating toward lateral portions of the foot (positive Tinel sign). Palpation of the popliteal fossa and the lateral compartment was painful.

CECS of the lateral compartment, possibly associated with CPN nerve compression, was hypothesized. However, both peroneus and anterior tibialis muscle pressures after dynamic ICP measurement were below the Pedowitz cutoff values, ruling out the diagnosis of CECS (ICP 15 mm Hg at rest or 30 mm Hg after 1 minute or 20 mm Hg after 5 minutes of a provocative test).¹⁷ The patient was informed of the possible diagnosis of CPNE following a traumatic event, and she consented to a surgical exploration. The CPN appeared edematous and was entrapped in scar tissue. Following a neurolysis over a 10-cm length between the popliteal fossa and peroneal muscle entrance, skin sensation and lower leg functioning normalized in the following months. Ten months postoperatively, the patient experienced no pain at rest and had normal sleep. She received physical therapy for enthesopathy of various knee tendons that was due to an acquired antalgic gait pattern.

Case 2

A 41-year-old woman reported pain in her lower left leg for 5 years that had started after childbirth. Normal functioning was not possible because of the pain. Rest, orthotics, surgery for varicose veins, and physical therapy did not result in relief. The pain was continuously experienced along the lateral aspect of her lower left leg. Sleeping on the left side of the body was impossible because of immediately occurring lower leg tingling. MRIs of the vertebral column, knee, and lower leg were judged normal. The letter from the referring neurologist stated that the outcomes of EMG and NCV analyses testing CPN functioning were entirely normal. CECS was excluded because peroneus and anterior tibialis muscle pressures were normal. The referring sports physician considered CPNE, but a local injection of lidocaine did not relieve the pain. The patient was referred to us for analysis and management of possible CPNE.

On inspection, the skin of the lower leg appeared shiny compared with the contralateral side, suggesting a sympathetic-parasympathetic imbalance, possibly due to nerve entrapment (Figure 1). Lower leg skin sensation following light touch with a swab was reportedly normal. In contrast, digital pressure just distal to the fibular head was very painful, with pain radiating toward the lateral aspect



Figure 1. Inspection of both lower legs of a patient with a left-sided common peroneal nerve entrapment. The skin on the left side appears shiny compared with the contralateral side, suggesting a sympathetic-parasympathetic imbalance associated with nerve entrapment.

of the foot. The patient consented to CPN neurolysis and made an uneventful recovery thereafter. She reported total relief and normal functioning 13 months postoperatively.

Case 3

A 61-year-old woman had experienced spontaneous pain of unknown cause in her lower left leg for 2 years. The pain was continuously experienced along the lateral aspect of her lower left leg. Bicycling was difficult, as the leg lacked power. She was bothered by tingling feelings during sleep. She received physical therapy and neuroleptic medication but with minimal effect. Orthopaedic and neurological consultations were not diagnostic. Radiographs, a lower leg MRI and EMG, ultrasonography of the CPN, and a vascular evaluation including ankle-brachial index revealed no abnormalities. The referring neurologist performed NCV tests of the SPN and sural nerve that were normal. The vascular surgeon suggested that the altered skin sensation was possibly associated with peroneal nerve dysfunction in the presence of CECS. However, the referring sports physician measured normal peroneus and anterior tibialis muscle pressures. The patient was referred to us for analysis and management of the possible diagnosis of CPNE.

On examination, skin sensation of the lateral aspect of the lower left leg following light touching with a swab was reported as different from the contralateral leg. The circumference of the lower leg was 1 cm less, suggesting a discrete muscle atrophy. The possible diagnosis of CPNE with sensory and motor deficit was discussed, and the patient chose to undergo surgery. At exploration, a small artery compressing the CPN at the level of the knee joint was ligated followed by neurolysis from the popliteal fossa to the peroneal muscle entrance. The patient reported total relief and normal functioning 8 months postoperatively.

Case 4

A 44-year-old woman reported pain in her lower right leg for 2 years, which had possibly started after a temporary antalgic gait pattern following a lower leg muscle tear. Rest, taping, physical therapy, and pain medication including nonsteroidal anti-inflammatory drugs and neuroleptic agents did not result in relief. She had noticed that touching the outside part of the lower leg was painful. The pain frequently bothered her during sleep. Walking and bicycling aggravated the pain. Evaluations by a neurologist, a vascular surgeon, and orthopaedic surgeons were not diagnostic. Normal results were found on radiographs; MRIs of the brain, vertebral column, knee, and lower leg; EMG; and arterial and venous ultrasonography. The neurologist had performed lower leg nerve conduction studies indicating normal function of tibial, peroneal, and sural nerves. The referring sports physician noticed that pressure on the fibular head intensified the pain, which radiated toward the foot. He considered the diagnosis of CPNE, but an injection of 15% of glucose (proliferation therapy, or "prolotherapy") did not attenuate the pain. CECS was excluded because deep flexor and anterior tibialis muscle pressures were normal.

On inspection, the skin of the lateral aspect of the lower leg was painful following pinching. Skin sensation following light touching with a swab was abnormal. Digital pressure just distal to the fibular head was very painful, with severe pain radiating toward the lateral aspect of the foot. The possible diagnosis of CPNE was discussed with the patient, and she chose to undergo a neurolysis. During surgical exploration, the nerve was found to be covered by a very tight fascial layer, which was opened followed by CPN neurolysis. The patient reported total relief of pain and normal functioning 37 months postoperatively.

Case 5

A 63-year-old woman reported pain in her lower left leg for 6 months. She had noticed that touching the lateral aspect of her lower leg felt "uncomfortable." The pain increased during the first 10 m of walking and then decreased again. When standing, the patient had an urge to constantly move her leg in all directions. Her sleep was disturbed because of the pain. Pain medication and physical therapy did not result in relief. A neurologist found a minimal loss of power in the anterior tibialis muscle and skin hypesthesia on the lateral aspect of the lower leg. He noticed that pressure on the fibular head intensified the pain, which radiated toward the foot. An MRI of the vertebral column as well as SPN conduction studies were normal. The referring sports physician measured peroneus and anterior tibialis muscle pressures, which were also normal.

During physical examination, the skin of the lateral aspect of the lower leg was painful following pinching. Skin sensation following light touching with a swab was abnormal. Digital pressure just distal to the fibular head was very painful, with severe pain radiating toward the lateral aspect of the foot. The possible diagnosis of CPNE was discussed with the patient, and she chose to undergo a neurolysis. During surgical exploration, the nerve was found to

be covered by a very tight fascial layer, which was opened followed by neurolysis. Two days later, the patient reported that she had her "normal leg back." Three months postoperatively, she reported pain along the medial tibial bone, which was diagnosed as medial tibial stress syndrome, necessitating prolotherapy. However, the lateral portion of the leg demonstrated normal skin sensation without pain.

HOW TO PERFORM CPNE NEUROLYSIS

The patient is positioned on her back with a pillow underneath the ipsilateral buttock, resulting in a slightly endorotated knee. The skin covering the fibular head is obliquely opened over a 5- to 8-cm length (Figure 2A). A fascial layer partially covering the CPN is incised (Figure 2B). The CPN emerges from a fat pad (Figure 2C). The CPNE including its side branches is freed from its surroundings (Figure 2, D and E). The tendinous arch narrowing the nerve's entrance between both heads of the peroneus longus muscle is widened (fibular tunnel, Figure 2F). The nerve's exit from the popliteal fossa in a plane medial to the biceps tendon is also widened (Figure 2G). Neurolysis is complete (Figure 2H), and the skin is closed (Figure 2I). Crucial for success is opening of the fascia covering the CPN, whereby the nerve's entrance at the lower leg's peroneal muscle is sufficiently widened.^{6,8}

DISCUSSION

One in 3 young athletes with exercise-induced lower leg pain is found to have elevated muscle pressures due to CECS.³ However, if muscle tissue pressures are normal, other diagnoses must be considered. The present study reports on patients who tested negative for CECS at our clinic but who were subsequently found to have CPNE. A literature search for CPNE identified studies from the neurosurgery, plastic surgery, orthopaedics, and sports medicine domains.^{2,4-6,8-10,13,14,16} Interestingly, CPNE is not mentioned in a widely used book on sports medicine.¹ CPNE in athletes is thought to occur because of repetitive lower leg inversion and eversion in activities such as running and cycling.^{5,14} The relative unfamiliarity regarding CPNE is possibly reflected in the large number of consultants, noncontributing functional tests, and diagnostic delays as observed in the present case series. Our aim was therefore to create awareness regarding the diagnosis of CPNE, particularly in sports physicians and orthopaedic surgeons treating patients with lower leg pain. Interestingly, not imaging or functional tests including nerve conduction studies, but rather, specific clues found in patient history and physical examination were pivotal in the diagnostic process of CPNE. A correct diagnosis is crucial, as a CPNE neurolysis is often successful.

Awareness starts with a concise history. An orthopaedic study⁶ reporting on 60 patients with CPNE found that a small portion reported a history of their leg "falling asleep" with crossed legs or after working in a crouched position.

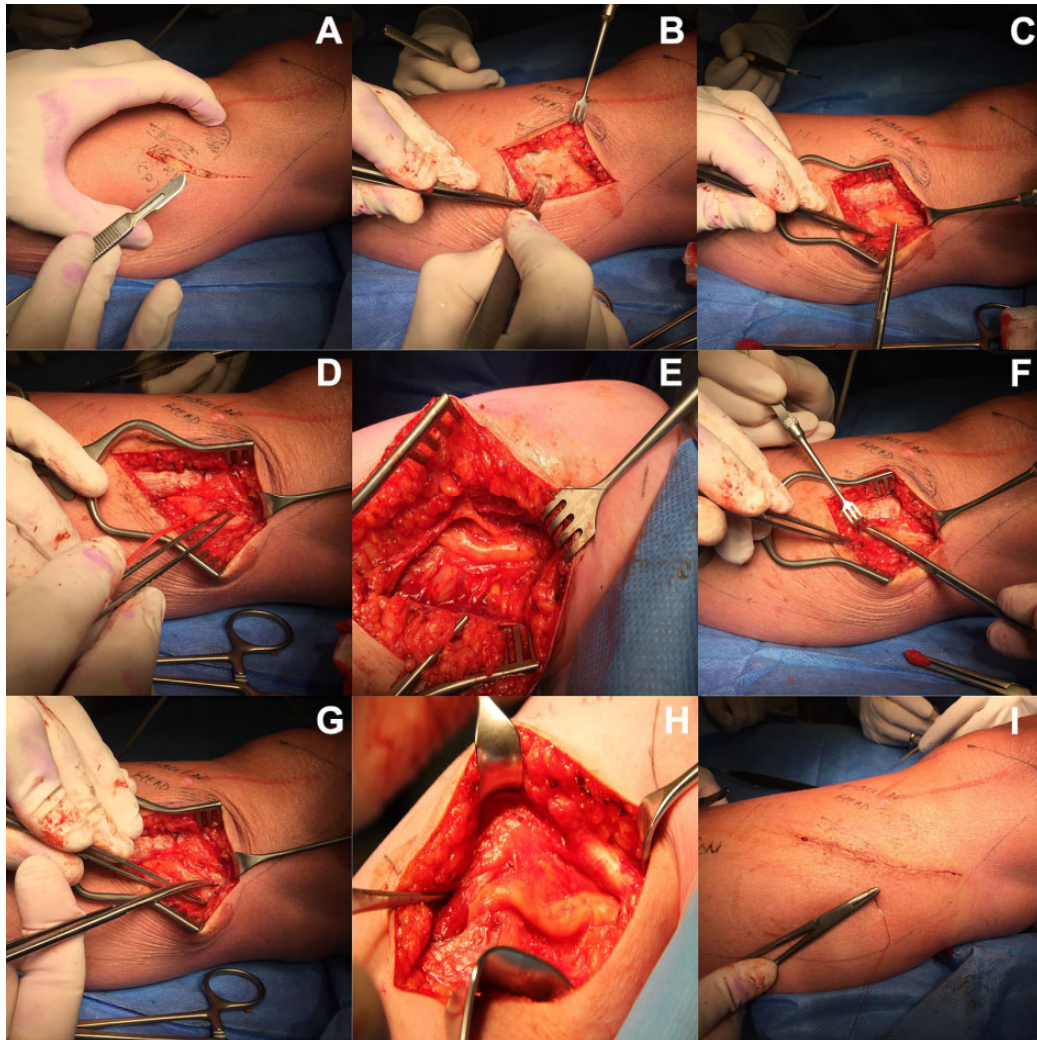


Figure 2. Surgery for common peroneal nerve entrapment neurolysis. (A) Making the skin incision. (B) Incising the fascial layer. (C) Identifying the nerve. (D) Freeing the nerve from its surroundings. (E) Freeing the side branches. (F) Widening the fibular tunnel. (G) Widening at the biceps tendon. (H) Neurolysis complete. (I) Closing the skin.

However, the vast majority of patients had a nonspecific history, leading to a commonly used diagnostic term, “idiopathic” CPNE.⁶ A study involving 48 patients treated by reconstructive surgeons reported that most cases were due to trauma.⁸ The present case studies confirmed that CPNE was either idiopathic ($n = 3$) or had developed after a previous trauma ($n = 2$). Another orthopaedic study proposing a diagnostic algorithm for lower leg pain in athletes suggested that pain at rest is never associated with CPNE.⁵ Pain in our patients was provoked by exertion or normal walking but was also present during rest. Moreover, pain often depended on body posture, as previously suggested.⁶ For instance, all 5 of our patients had consistently disturbed sleep, indicating that symptoms were induced by unfavorable leg positions compressing the CPN. This important clue in the patient’s history may be used to differentiate CPNE from other lower leg pain syndromes.^{2,5}

The role of a detailed physical examination is controversial. One study found that a combined sensory and motor deficit was demonstrated in two-thirds of patients with CPNE, whereas a sensory deficit alone was demonstrated in the remaining one-third.⁶ We have observed interesting features in our patients. For instance, the lower leg skin may look shiny, as also observed in complex regional pain syndrome or deep venous thrombosis (patient 2). As well, the examiner may observe limb atrophy, suggesting CPN motor involvement, that can be quantified using a tape measure (patient 3). All of our patients demonstrated sensory involvement that was reflected by altered lateral lower leg skin sensation, which can be detected simply with a swab or alcohol-soaked gauze. Skin hyperesthesia or hypoesthesia may be accompanied by an inappropriate pain sensation following skin pinching. Tapping (Tinel sign) or palpating the nerve at the fibular head was very painful in 4 of our 5 patients, whereby a radiating pain may be

TABLE 1
Characteristics of 5 Patients With Common Peroneal Nerve Entrapment^a

Patient No.	Sex	Age	Delay, mo	Trauma	Leg	Sleep	Skin Lateral Lower Leg (Swab Test)	Painful Pressure at Fibular Head (Tinel Sign)	Painful Skin Pinching	Scan Results ^b	Subjective Outcome After Surgery (mo of follow-up)
1	F	34	60	Yes	R	Disturbed	Hypoesthetic	Yes	Yes	Normal	Good (10)
2	F	41	60	No	L	Disturbed	Normal	Yes	Yes	Normal	Excellent (13)
3	F	61	24	No	L	Disturbed	Dystrophic	No	No	Normal	Good (8)
4	F	44	24	Yes	R	Disturbed	Hyperesthetic	Yes	Yes	Normal	Excellent (37)
5	F	63	6	No	L	Disturbed	Hypoesthetic	Yes	Yes	Normal	Excellent (3)
Mean		49 ± 5	35 ± 6								(14 ± 6)

^aF, female; L, left; R, right.

^bScans included electromyography, magnetic resonance imaging, ultrasonography, radiography, and bone scans.

provoked following this maneuver. Two studies also reported a positive Tinel sign in most of their patients.^{6,8} A recent study of 24 patients with CPNE showed 0.77 sensitivity for the “scratch collapse test” compared with 0.65 sensitivity for the Tinel sign.⁷ The superior diagnostic characteristics of this novel test require confirmation in future CPNE studies. We have provided a Video Supplement demonstrating a positive scratch collapse test in a patient with CPNE. It is clear that the combined results of a swab test, a pinch test, a Tinel test, a tape measure, and possibly a positive scratch collapse test strongly contribute to the diagnosis of CPNE.

Is there a role for EMG, including nerve conduction studies, in CPNE?⁵ Sensory deficits are reflected by markedly decreased amplitudes of sensory potentials, whereas motor deficits are suggested by decreased nerve conduction velocities.⁶ A second EMG study also found motor weakness in most of the patients.⁸ Interestingly, however, sensory or motor deficits with EMG, including nerve conduction studies, were not present in any of our 5 patients. In general, these tests and imaging methods are useful for exclusion of other lower leg pain syndromes. In contrast, we claim that the diagnosis of CPNE is an old-fashioned “clinical diagnosis” that is predominantly established by a physician’s ears, eyes, and hands. However, we are currently unaware of tests that are able to discriminate between CPN and SPN entrapment.

Once the diagnosis of possible CPNE is made, several conservative treatments are available, such as modification of the offending activities, physical therapy, stretching, and massage.² Some authors suggest iontophoresis or nerve blocks, but an incomplete nerve recovery is common.^{2,5,12,19} If minimally invasive strategies are to no avail during a short period of observation, surgery is indicated. Results in most patients are generally beneficial, particularly if motor deficits are present and the wait-and-see approach is short.^{6,8,12,18} All of our 5 patients were again interviewed in December 2016 (mean follow-up, 14 ± 6 months) and rated their outcome as excellent (n = 3) or good (n = 2) (Table 1). The literature regarding athletes undergoing surgery for CPNE is limited to a handful of case reports and 2 case series, encompassing a total of 8 runners and 12 competitive athletes.^{6,11,15,19}

CONCLUSION

Sports physicians treating patients with lower leg pain should consider the diagnosis of CPNE in patients reporting pain, disturbed sleeping, and an uncomfortable feeling in lateral portions of the lower leg. Pain following tapping at the fibular head and altered skin sensation determined with a swab or pinching are key to the diagnosis. Imaging, EMG including nerve conduction studies, and muscle compartment pressure measurements are useful for exclusion of other lower leg syndromes. A CPN neurolysis is often beneficial.

A Video Supplement for this article is available at <http://journals.sagepub.com/doi/suppl/10.1177/2325967118787761>.

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