

**Commentary****Clinical Practice****Cell Phone Induced Femoral Nerve Neuropathy**

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In considering this report, the following adage from medical school days comes to mind. “You cannot make the right diagnosis if you first do not think of it.” This is a quote that Dr. Mahlon Delp impressed on me and all of my medical school classmates. Dr. Delp was a long-time renowned teacher, internist, and chairman of the Department of Medicine at the University of Kansas School of Medicine in Kansas City. “Clinical Diagnosis” taught by Dr. Delp to the first semester, third year medical students was the foundation of our clinical years and Dr. Delp made sure we did not take it lightly.

The patient was a 77-year-old white male, 5’8”, 140 pounds, actively engaged in farming and ranching. His chief complaint was pain in the left posterior hip and left groin. The patient described aching pain at times in the left leg below the knee in the area of an old compound spiral tibial fracture sustained thirty years before. The pain had been bothersome intermittently over the past five years. The pain generally was “toothache like”, but over the previous four months it had become “ice pick like” at times, to the point the patient had to lie down or “go home” and get off his feet to obtain relief. He had used acetaminophen intermittently when “the ache” persisted at night and he could not get rest although usually the pain subsided in the evening spontaneously and by morning he was pain free. During the very hot summer days of 2012, the patient reported that the pain was daily and increasingly severe, usually beginning before or by noon and becoming progressively worse during the afternoon. When the pain was most intense, he also noted a feeling of weakness in his left leg.

His past medical history revealed a 20-year history of glaucoma with pressures controlled by timolol and latanoprost eye drops. PreserVision® vitamins were taken daily for early dry macular degeneration.

On examination, the patient demonstrated no increase in pain on movement of the left leg and hip. There was no limitation of flexion, extension, or rotation of the hip or leg. He was increasingly convinced there must be severe degenerative arthritis in the left hip and by phone consulted a friend, a retired orthopedic surgeon, who suggested obtaining x-rays of the left leg, pelvis, and both hips. These were obtained at the patient’s local rural hospital. The radiologist reported only minimal degenerative arthritis in the hip joints bilaterally.

The “right diagnosis” came by accident a week later. While involved in farm work about noon on this particular day, the pain became severe enough the patient decided to lie down for a while in the seat of the pickup. Before lying down, he removed his cell phone from the left front pocket of his jeans and laid it on the pickup dash. After a short nap, he went back to work for the rest of the afternoon. As the afternoon passed, he was aware that the left hip pain was much less severe than usual even though the work was strenuous. That evening, he discovered he had left his cell phone in the pickup. The next day, he intentionally did not carry his cell phone on his person and the pain did not recur. Since that time, the patient has not carried his cell phone on his person and the pain has not recurred to any degree. He reported 90% plus relief from his hip pain with only “occasional” dull aching and some feeling of slight weakness in the left leg.

No similar case reports of cell phone neuropathy could be identified in the literature. In considering this case, several factors may be important:

1. The patient verified that for “years” (10+) he had carried his cell phone in his left front pocket on a nearly daily basis, the phone “turned on” at all times. The prior 20 years he frequently carried a pager, mobile phone, or portable radio in a previous occupation.
2. As a farmer/rancher, he regularly had the phone in his pocket 12-14 hours a day during the busy spring/summer farming season.
3. The worsening of the patient’s symptoms occurred during the very hot summer. This may be significant.
4. The pain always went away in the evening and at night (coincidentally with removing the phone from his pocket and placing it in the charger).
5. The pain intensity in retrospect increased incrementally the longer he carried the phone in his pocket on any given day.
6. The immediate relief of the pain syndrome occurred “like flipping a switch” when he ceased carrying the cell phone. He changed no other activity.
7. A cell phone carried in a front jean pocket places it directly over the femoral nerve, artery, and vein as they pass under the inguinal ligament. Depending upon the patient’s habitus, particularly in thin individuals, this can be very close to the skin and the underlying femoral nerve.
8. Advancing age and some degree of degenerative osteoarthritis in the hip joints may increase susceptibility to the syndrome of cell phone neuropathy.
9. Following a two-week, pain-free interval (after ceasing to carry cell phone on his person), the patient began carrying a deactivated cell phone (battery removed) of similar size and shape and carried as before in the left front pocket. To date there has not been a recurrence of the pain previously experienced. This effectively rules out “mechanical pressure” as the cause of the neuropathy.
10. Possible adverse effects of electromagnetic non-ionizing radiations (NIR) are known.<sup>1</sup> Some people are more susceptible to exposure to electromagnetic fields than others.

## Discussion

The cell phone and related electronic devices have become a part of life. They are amazing tools that have made information and communication available literally at your fingertips. Cell phones and related devices operate by electromagnetic wave energy. Their wave length is in the radiofrequency (RF) spectrum (as are microwave ovens). The energy often is referred to as non-ionizing radiation (NIR) as opposed to the ionizing radiation of radioactive materials. Thus, health risks generally are thought to be minimal. Chronic recurring exposure, however, to bursts of NIR from these devices carried repeatedly in the same location on an individual’s body expose that individual to localized accumulative adverse biological effects of the NIR.<sup>1</sup>

There are two separate categories of potential cell phone health risks. First, the health risks of using cell phones. Second, the health risks of carrying cell phones. They need to be addressed separately. First, using a cell phone may cause health risks because it is normally held close to the ear, side of the head, and neck while it is emitting an electronic signal during a conversation. This potentially exposes the brain as well as the local soft tissues to NIR.<sup>1</sup> There is little agreement how to mitigate possible risks while continuing to use the electronic device.

Second, there has been minimal attention regarding the potential health risks associated with carrying an activated cell phone on one's person. When a cell phone is attached to a belt or placed in a pocket/purse, radiation can penetrate the area near the cell phone handset. Radiant energy is absorbed much faster than at your head because soft tissues and organs provide better conductivity than your skull.<sup>2</sup> Other pertinent points include:

1. Your cell phone emits its highest output levels of radiation just before it rings.
2. Your cell phone sends intermittent bursts of radiation even while in stand-by mode. (These give the cellular system information on where your cell phone is located.)
3. Normal clothing has little or no protective effect against NIR absorption into underlying body tissues.
4. Though the radiation strength is greater while using a cell phone, cumulative exposure is much greater from carrying the cell phone.
5. When cell phone towers are widely spread, as in many rural areas, the NIR energy that is emitted automatically by the cell phone is higher.

At the beginning of a call, a cell phone radiates maximum power but quickly reduces the power so the radiated power is sufficient to have a reliable link to the cell tower.<sup>3</sup> Cell phones radiate far less power in urban areas compared to rural areas, because cell phone towers are much closer in urban areas compared to rural areas.

Many factors including age, body build, co-existing conditions, and individual susceptibility may increase the risk of injury from the local effects of close bodily exposure to the NIR from the electronic device. The above variables are difficult to evaluate and measure. As in the case described above, chronic exposure or frequent recurring exposure to NIR from cell phones and other mobile electronic devices carried repeatedly in the same location on an individual's body may expose that individual to localized deleterious accumulative biological effects of the NIR from that device. Our evidence suggested that the adverse effects (e.g., neuropathy) are reversible by simply not carrying the cell phone. Further scientific investigation is needed.

The adverse effects of cell phone usage on sperm count, motility, and viability were reported in 2008 by a group of researchers at the Reproductive Research Center, Cleveland Clinic Foundation, Cleveland, Ohio.<sup>4</sup> Their findings were confirmed by an Australian study.<sup>5</sup> Recently, there was a fine print warning on the materials given to purchasers of iPhones to not carry the device in your pocket.

NIR exposure of the testes is 4-8 times higher when the device is carried in a pants pocket versus in a "hip holder" attached to a belt.<sup>6</sup> Distance greatly affects exposure when it comes to carrying a cell phone, however, a study of 150 men wearing a cell phone carried on their hip approximately 15 hours a day over six years reported an increase in detectable osteoporoses.<sup>6</sup> This was detected in the pelvis on the side where the electronic device was carried. These results suggest that shielding is needed even for "hip holders".

The whole issue of cell phones and cancer is a highly charged topic. One fascinating case focused on a 39-year-old female who habitually carried her cell phone in her bra.<sup>7</sup> She developed a breast malignancy directly under the cell phone exposed breast area. While it may have been coincidental, the malignancy was uncommonly multifocal and mimicked the cell phone in size and shape.

An unreported case of what seems to be a cell phone related malignancy occurred in a 44-year-old western Kansas farmer. For more than six years, he carried a cell phone clipped to the front left jean pocket for ten to fourteen hours a day. He developed a lump on his anterior upper

thigh directly under the cell phone. The lump, initially thought to be a lipoma grew rapidly. On removal, it proved to be an aggressive pleomorphic undifferentiated sarcoma.

The evidence suggests NIR affects cell function.<sup>7</sup> Signal characteristics and the erratic nature of the signal seem to impair the cells ability to repair cellular damage. Over long exposure periods, the accumulative damage may lead to cellular malignant changes in the localized area exposed to NIR. Whether carrying or using cell phones, there is mounting evidence of a connection between cell phones and cancer, whether it be acoustic neuroma, gliomas, parotid tumors, or the above noted breast malignancy and sarcoma.

Certain cell types are more susceptible and younger cells are more sensitive to injury by NIR.<sup>7</sup> Biological injury is not so much related to power as it is to signal characteristics, specifically the above mentioned erratic nature of the signal emitted by cell phones.

Another probable adverse effect from carrying cell phones is referred to as “Cell Phone Vibration Syndrome.”<sup>8</sup> It is a widely reported occurrence as a feeling akin to a cell phone’s vibration before a ring when there is no cell phone on the body. It mostly has been reported to be a psychological effect (an obsessive disorder). I believe the syndrome to be an early manifestation of a superficial local sensory nerve neuropathy or a residual effect of cell phone neuropathy. It may be described as a dysesthesia (an abnormal sensation) in the area where the cell phone is carried. It is not painful, but is a potent reminder of the potential adverse health effects of cell phones.

Shielding methods are available that significantly reduce NIR to the exposed body area.<sup>2</sup> These shields are not widely distributed. Effective RF local shields function by reflecting or deflecting the NIR when positioned correctly, rather than absorbing or diffusing the RF energy. The nearby body parts and tissues are protected. These reflective materials are effective and most materials are relatively inexpensive. For most individuals, protective shielding is the most practical solution for those who carry the electronic devices on their person.

The adverse health effects associated with carrying a cell phone should be revealed to buyers and users of mobile electronic devices as potential health risks. Shields are simple and effective. When it comes to health risks of carrying cell phones or other electronic devices, there seems to be abundant indications that the only health-wise approach is to shield it, shut it off, or shed it.

Further research and education need to be encouraged as it relates to the health risks of carrying electronic devices. Furthermore, individuals and health care professionals need to consider this diagnosis in evaluating their patients’ symptoms.

## References

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