Article

Geodesic Technology in Clinical Practice:

"Comfort, Peace of Mind, and Confidence"

One year after installing a 128-channel Geodesic EEG System, pediatric neurologist Dr. Mark Mintz said the system has brought "unprecedented comfort, peace of mind, and confidence" to his clinical practice.

Board certified in pediatrics, neurodevelopmental disabilities, and neurology, Dr. Mintz currently serves as president of both The Center for Neurological and Neurodevelopmental Health, L.L.C., and the Clinical Research Center of New Jersey, L.L.C. He is also on the faculty of the University of Pennsylvania School of Medicine.

Comfort

Conventional EEG methods, which involve scraping the scalp to remove the top layer of skin, can be quite painful for patients of all ages. For children, particularly those with neurobehavioral conditions such as autism or Attention Deficit Hyperactivity Disorder (ADHD), the procedure can be particularly traumatic. It is therefore not surprising that in many clinical settings children are routinely sedated or physically restrained for the EEG recording.

"From the patients' perspective, particularly those with chronic, neurobehavioral conditions who must undergo repeated EEGs, the benefits of the Net's comfort, its lack of sloppiness and messiness, and the quick application cannot be understated," Dr. Mintz said. "Not only are these kids better able to tolerate this procedure, but it helps with future EEGs because they now have a history of a good experience."

The Geodesic Sensor Net (GSN or "Net") allows painless application of an array of EEG electrodes, from 32 to 256 channels. For routine EEG up to two hours, the saline-sponge method with the HydroCel GSN technology allows rapid application with no cleanup. For long-term monitoring, there are extended electrolyte hydrogels that provide 8- to 12-hour recordings with excellent patient comfort, low-noise EEG, and improved resistance to artifacts.

"Not only are these kids better able to tolerate this procedure, but it helps with future EEGs because they now have a history of a good experience."
— *Dr. Mark Mintz*

On a visit to Dr. Mintz's practice, GeoMedica manager of sales Dee Dee Carver said she was "blown away" by the patients' response to the Net. "It warmed my heart when I heard a child proclaim, 'Mommy, I don't want to do this the old way again—I want these new Nets again!'"

Peace of Mind

Sedation carries medical and malpractice risks, and it is often not tolerated by parents. As a result, many pediatric neurology laboratories use child-restraint devices (also known as "brat racks") for EEG recording. Although considered necessary to obtain clean recordings, it is clear that even brief restraint (such as holding the child's hands still) can cause panic in a young child.

With the GSN, these methods are no longer necessary. In fact, Dr. Mintz and his colleagues said they are acquiring high-quality, low-noise EEG from children of all ages and medical status.

Article reprinted with permission from the *GeoMedica* newsletter, May 2006, Volume 1/Number 1, pp. 5–6. Photos did not appear in the original article and were added for the reprint. Published by Electrical Geodesics, Inc., 1600 Millrace Drive, Suite 307, Eugene, OR 97403, 541-687-7962, www.egi.com.

Perhaps no one sees the benefits of the GSNs more than EEG technician Kim Catterall. To obtain a 20-minute EEG using 19 traditional electrodes, Catterall must schedule an hour and 15 minutes between patients. Using the 128-channel GSN, she is now able to obtain 40-minute recordings in less than an hour.

"It seems impossible, but we are actually able to gather twice the recording time with more than six times as many electrodes in less time," Dr. Mintz remarked. "Now the only limitation on our patient throughput is me. Week after week I have all of this beautiful data; the only challenge is scheduling the time to review it all!"

Physician Confidence

Dense-array EEG can be integrated into clinical practice with a moderate increase in the cost of equipment and supplies (Geodesic Sensor Nets). This cost is minimal compared with the facilities and personnel costs of a medical laboratory, and, according to Dr. Mintz, it results in advantages that may not be obvious at first.

There is an obvious improvement in accuracy of EEG localization. The improved spatial sampling allows effective registration with magnetic resonance or computed tomography images, and the capacity for source localization of the electrophysiological activity allows interpretation of neural sources in relation to specific regions of the patient's cortex.

It has only been recently appreciated with the advent of dense-array EEG that accurate detection may be as important as accurate localization. Although deep sources are typically diffuse in their scalp projections (and thus can be detected by a sparse 19- or 32-channel array), more superficial sources (for example, in gyral cortex) may be missed entirely with a sparse array.

What is not widely acknowledged is that artifacts are also better detected, and separated from cephalic sources, with a dense array. "The confidence I've gained in my ability to separate artifact from a neural source cannot be understated," Mintz said. "It's now clear to me that it's often impossible to confidently separate artifact from signal using low-channel methods."

An eye blink may be confused with a vertex sharp wave in a 2-channel polysomnographic EEG recording, but it appears as a characteristic (and quantitatively separable) component in a 128- or 256-channel EEG. Electromyographic and electrocardiographic signals similarly have highly unique patterns in the dense array that allow them to be extracted with computational algorithms, leading not only to more efficient interpretation by the physician, but to improved capability for automated pattern recognition (such as spike and seizure detection).

It is also not well-known that the error of spatial undersampling is particularly problematic in the pediatric EEG. Because the skulls of the infant and young child are highly conductive, the spatial smearing of volume-conducted potentials is substantially less than in the adult brain. Furthermore, epileptic discharges are more often neocortical in the infant and child, whereas they become focalized in mesial temporal cortex in adults.

The result of these factors is that, in contrast to what has been assumed in the traditional medical EEG literature, greater spatial sampling density is required to adequately evaluate the infant and child brain than the adult brain. With the pediatric versions of the Geodesic Sensor Net, dense-array recordings are now applied quickly and painlessly for infants and children of any age.