Whole head high density EEG provides R. EEG technologists new techniques for higher definition analysis of brain activity

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INTRODUCTION

High density EEG, also known as high definition EEG (HD EEG), provides technologists and physicians a powerful tool for capturing and visualizing data to provide new insights into understanding pathology and individualizing patient care.

HD EEG records electrical activity using many electrodes (>32, up to 256) distributed across the head, neck, and face. This whole head coverage facilitates the recording of activity from additional areas of the brain including the ventral region of the cortical surface.

Application is rapid and gentle, avoiding scalp abrasion or the need for sedation. These methods can reduce preparation time, improve patient comfort and compliance (1), and may reduce infection risk.

METHODS

General Study Scope:

In this study, 12 participants with a demonstrated history of epilepsy received HD EEG with 256 electrodes recorded over a period of three days at the Mayo Clinic in Phoenix, AZ.

For each recording session, HD EEG electrode application times and participant comfort and compliance were measured.

Figure 1. High density EEG 256-electrode sensor net application.

Figure 2. Whole head sensor net distribution of 256 electrodes.

Philips HD EEG Sensor Net Application:

Each sensor net contained 256 silver-silver chloride electrodes situated within an elastomer-based "net" and housed in ”HydroCel” chambers, containing sponges saturated in a solution of warm water, potassium chloride salt, and baby shampoo. No gels or pastes were required for the recording.

Sensor nets were applied to each individual by stretching the net over the head. No electrode site preparation or blunt-tipped needles are required for HD EEG.

Philips HD EEG Sensor Net Recording:

HD EEG with video was acquired for each participant with the Geodesic EEG System 400. Recordings were sampled at a rate of 1000Hz and duration of 45-50 minutes each session. During recording individuals were instructed to rest with eyes closed.

RESULTS

For all 12 participants, HD EEG expanded technologist’s ability to visualize waveform morphology, voltage fields, and orientation of source generators. With the capability to view up to 256 channels simultaneously, HD-EEG allowed for quick and easy identification and differentiation from artifact of both high and low amplitude patterns of epileptiform activity.

Technologists and patients reported easier application of HD-EEG electrodes, reducing exam preparation time when compared with traditional electrode application methods.

Reduced Preparation Time:

Electrode application time ranged from 3-15 minutes, with an average of 9 minutes (n=12). Male subjects (n=4) averaged 4.5 minutes application time, and female subjects (n=8) averaged 11.5 minutes.

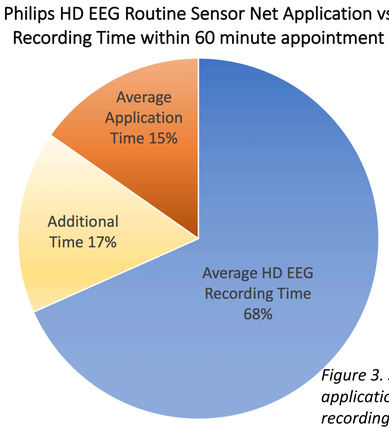


Figure 3. Sensor net application vs recording time.

Individual Comfort and Compliance:

Of the 12 participants, 3 surveys were completed and returned. Of these, all rated their comfort level with HD EEG as 10 out of 10, and rated their overall experience with HD EEG as a 10 out of 10.

All 12 participants in this study were compliant with sensor net application and recording. This resulted in an ***overall compliance rate of 100%.***

One of the patients wrote this about their experience, *“It was much more convenient than the previous EEG equipment I had to carry around with me and does not pull on my hair or leave glue in it. This was a much more relaxing appointment as well. I must prefer this new EEG over the previous type.”*

EEG Visualization with Higher Definition:

HD EEG allowed technologists and physicians access to new visualization tools showing whole-head scalp voltage fields on a millisecond time-scale. The additional characterization of these voltage fields (see Figures XX) offered additional information about EEG patterns across the scalp and provided additional indication of source generator orientation on the cortex.

After the study, an R. EEG Technologist provided feedback stating, "I *think this technology could be very useful. I have heard in some cases high density can be as effective as SISCOM.”*

See Figures 4-10.

RESULTS

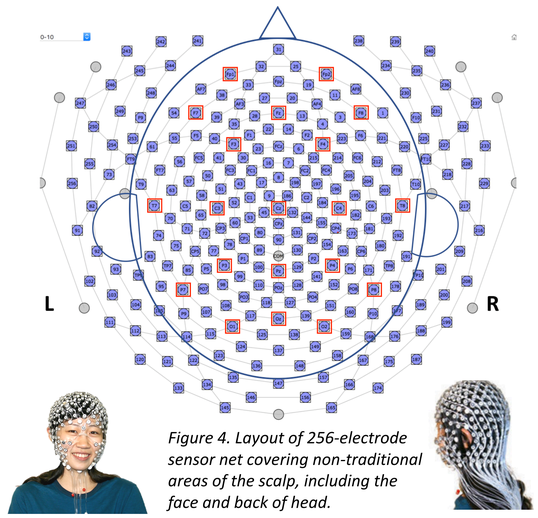


Figure 4. Layout of 256-electrode sensor net covering non-traditional areas of the scalp, including the face and back of head.

Visualization of interictal discharge with HD EEG, Example #1

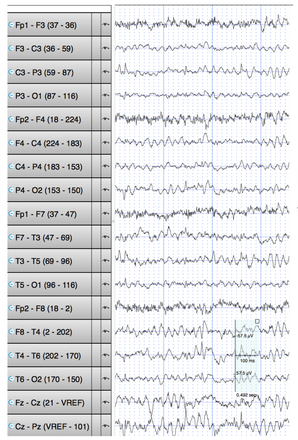


Figure 5. Standard double banana 10-20 montage in chart view (left).

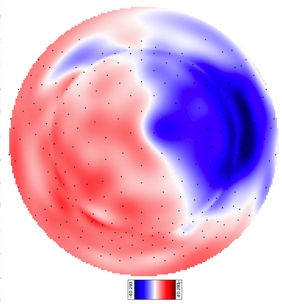
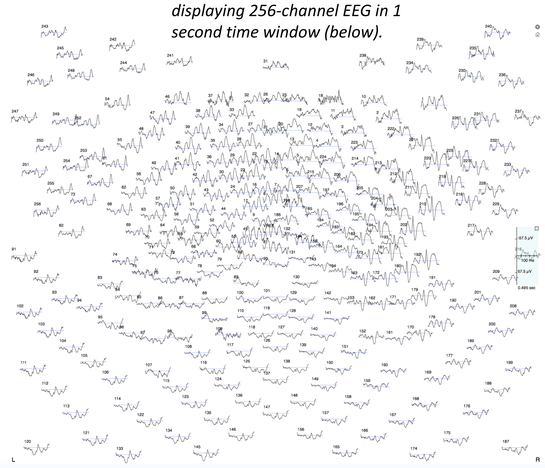


Figure 6. Topographic voltage map, red=positive and blue=negative potentials (above).

Figure 7. Topographic plot displaying 256-channel EEG in 1 second time window (below).



RESULTS

Visualization of interictal discharge with HD EEG, Example #2

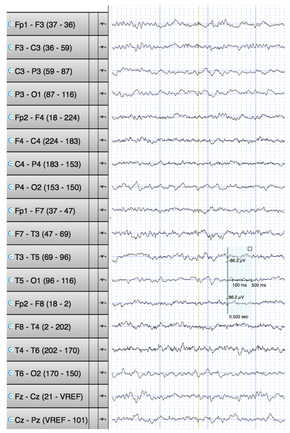


Figure 8. Standard double banana 10-20 montage in chart view (left).

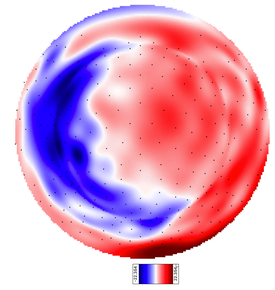
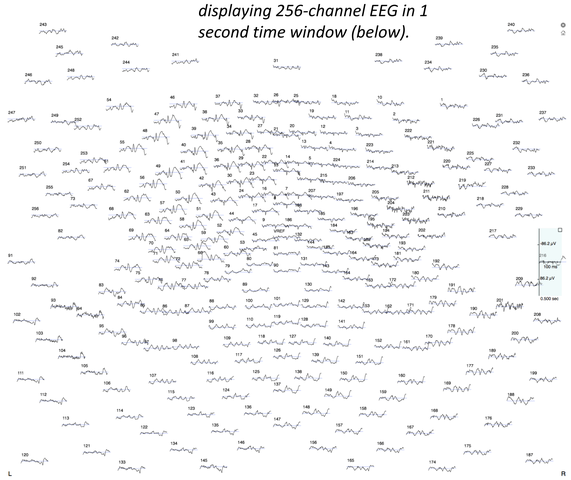


Figure 9. Topographic voltage map, red=positive and blue=negative potentials (above).

Figure 10. Topographic plot displaying 256-channel EEG in 1 second time window (below).



CONCLUSIONS

HD-EEG may allow technologists to improve confidence in identifying abnormal patterns in EEG as well as dedicating more time towards patient care, improving overall healthcare delivery for patients with epilepsy.

REFERENCES

1. *Szklarski, L., Mintz, M., Catterall, K. High Density Electroencephalography (HD-EEG) and Desensitization Techniques Improve Compliance Without Sedation of Restraint for Children and Adults with Behavioral Challenges. ASET 2016 Poster Presentation.*

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- This study was funded by Philips Neuro, Eugene, OR
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