Quantitative Assessment of Changes in Brain Activity After a Chiropractic Adjustment

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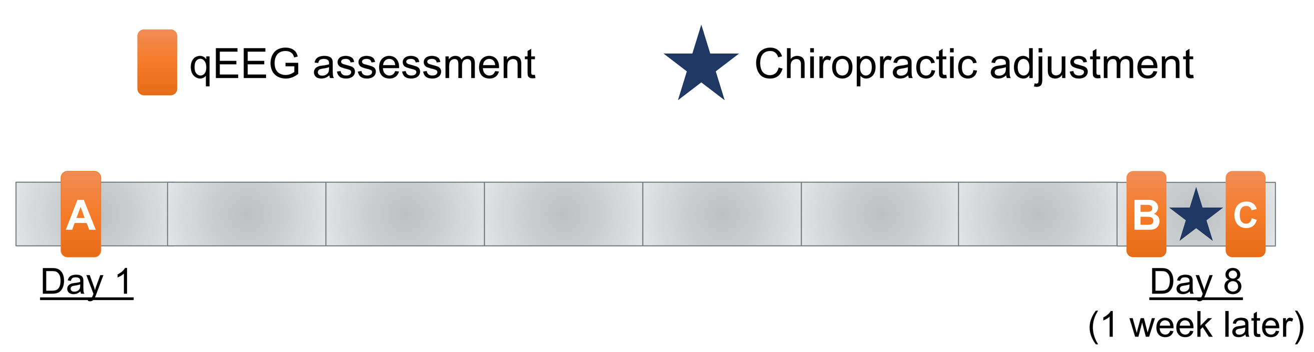
Background / Introduction

- Despite the abundance of theories concerning the effects of chiropractic adjustment on brain function, this topic remains an understudied area of the profession
  - This may be due to the limited availability of cost effective, objective measures representing changes in brain function
- Quantitative electroencephalography (qEEG) is a technique that allows for an in-depth analysis of brain activity, and may provide a cost-effective method for studying the effects of chiropractic intervention on the brain[1]
- qEEG allows for real-time analysis of brain activity which cannot be achieved with any other brain imaging technology[1]
- As with all source imaging methods, care must be taken to prevent distortion in and production of artifacts[2]
  - Body movement artifacts represent one of the largest challenges to clean data
  - Many chiropractic adjustments generate enough force to disrupt the qEEG data acquisition
  - Low-force techniques provide intervention with minimal production of artifact

Methods / Procedures

Schedule of events



Overall description of case study

- A 33-year-old female patient received a preliminary qEEG assessment with no intervention on 3/10/14 (Day 1)
- One week later (3/17/14, Day 8), a follow up qEEG was conducted before and after receiving a chiropractic adjustment

qEEG methodology

- A Cadwell® EASY II system on 19-channels using the 10/20 system with a linked-ears montage was used
- Neural functioning was evaluated via qEEG using Neuroguide™
- Surface qEEG was analyzed using raw qEEG values Low Resolution Electromagnetic Tomography (LORETA) and connectivity measures were compared with a normative database[3,4,5,6,7,8]
- Eyes-closed data was collected on Day 1 and Day 8
- Approximately 120 seconds of data was analyzed for each recording

Chiropractic methodology

- Analysis and intervention was based on Sacro Occipital Technique® (SOT®)[9]
- An Activator® II instrument was used for adjusting non-pelvic segments

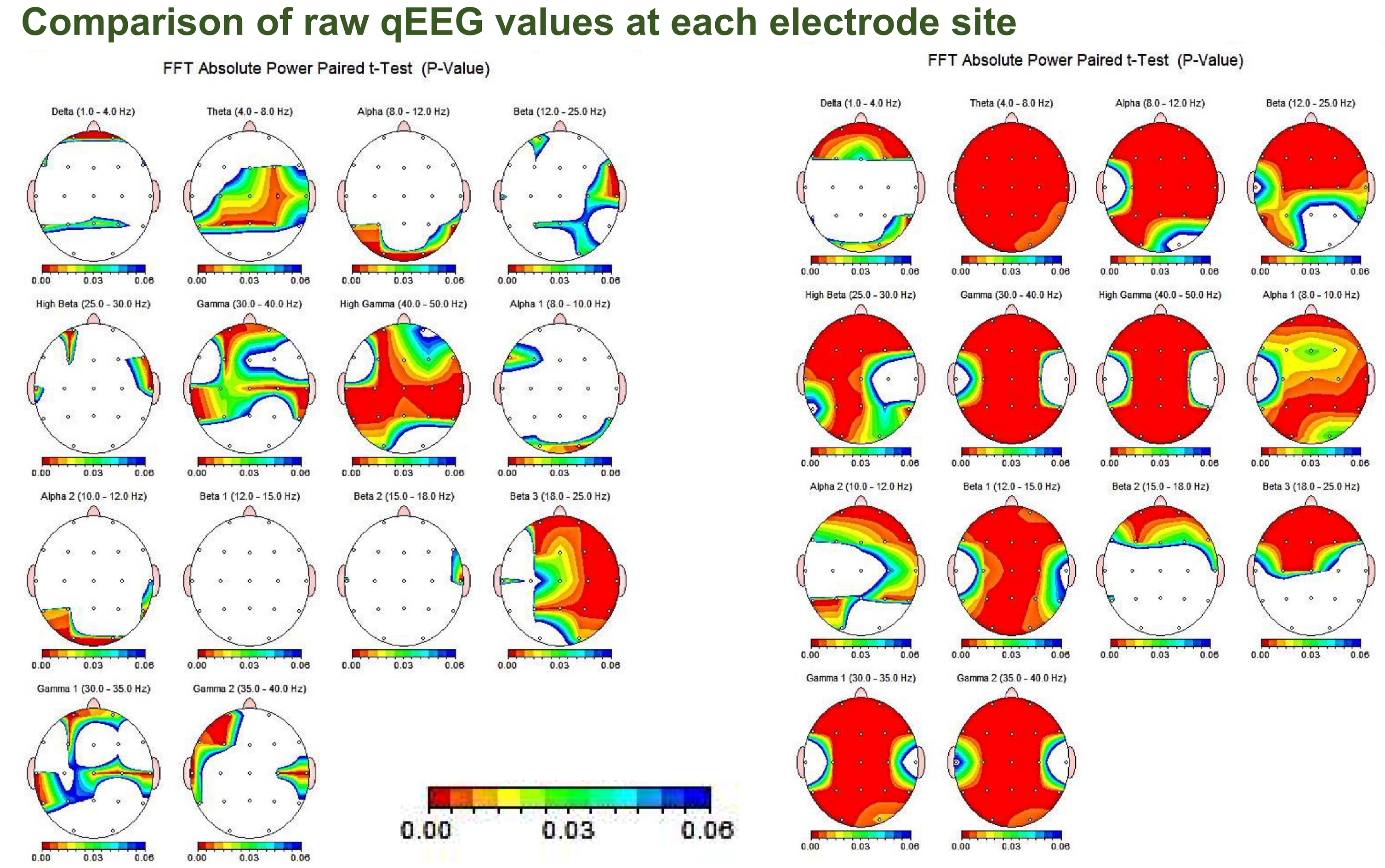
Results

Chiropractic evaluation (Day 8)

Findings
- Right leg short Category II
- PS occiput-right
- Left sacroiliac joint involvement

Adjustments given
- First: PS occiput right with Activator® instrument
- Supine Category II blocking, right leg short position

Comparison of raw qEEG values at each electrode site

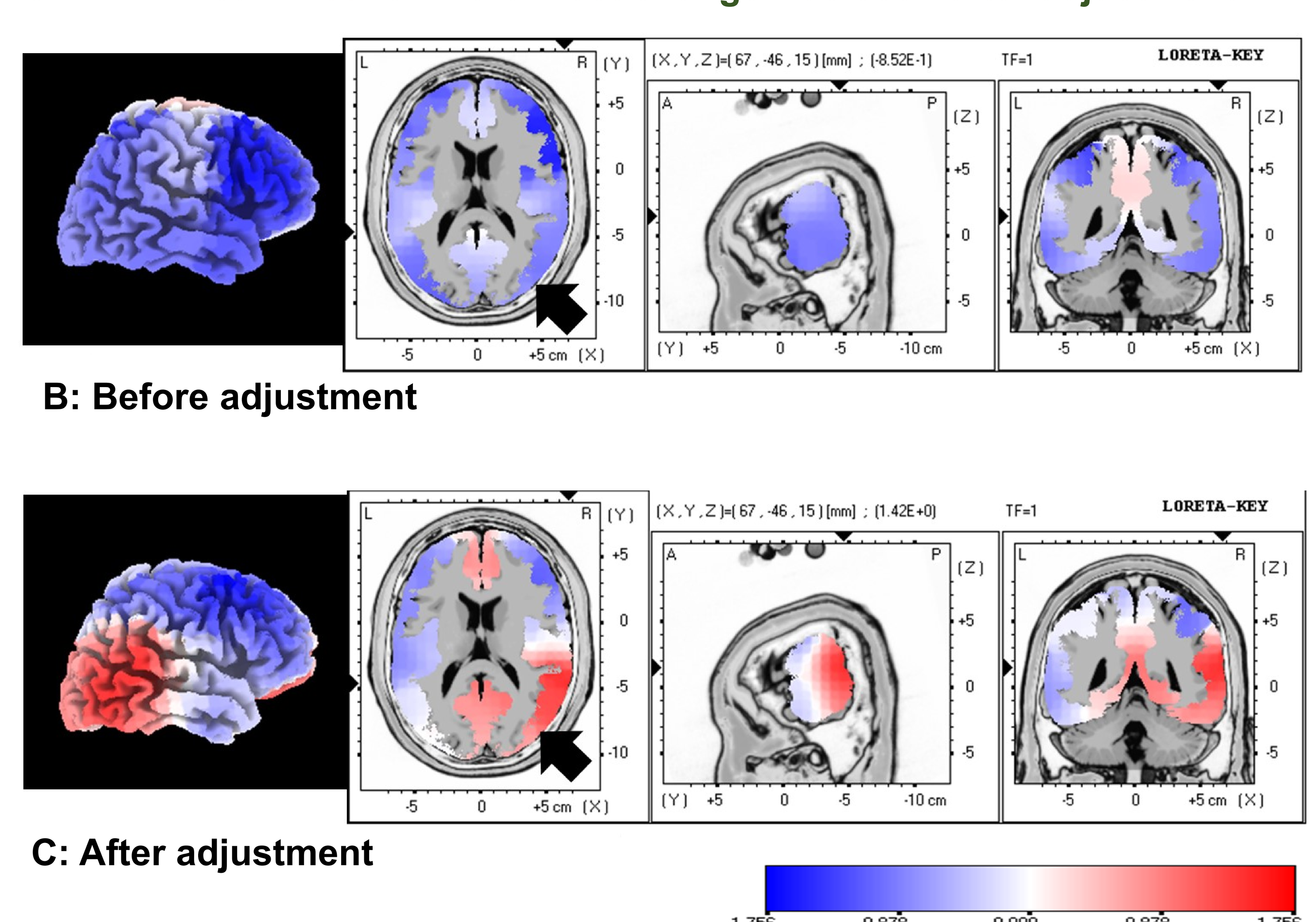


A vs. B: No adjustment
- Minimal change on Day 1 vs Day 8 baseline

B vs. C: Adjustment given
- Widespread change on Day 8 before vs after adjustment

Areas of red indicate significant ($P < 0.001$) change between the 2 time points being compared

LORETA: Area in red is where most change was seen after adjustment

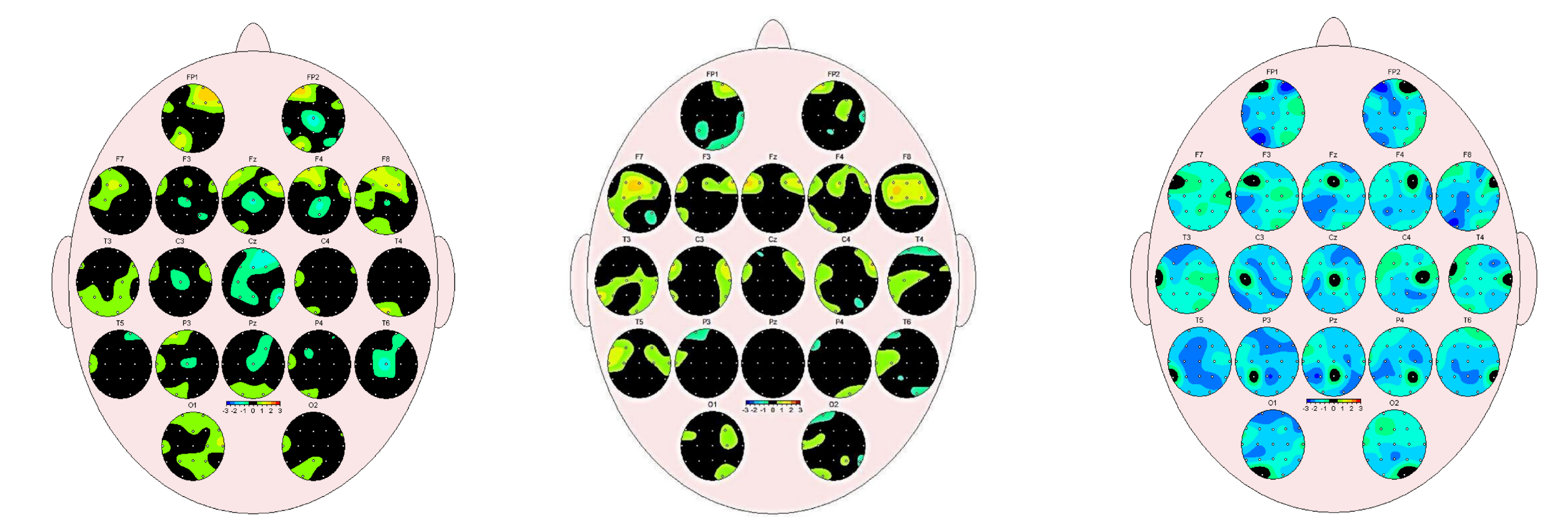


B: Before adjustment

C: After adjustment

Image of brain activity in delta band at 1 Hz
A: Before chiropractic adjustment: Z-score = −0.85
B: After chiropractic adjustment: Z-score = 1.42
Total Z-score = 2.27, BA 22, superior temporal gyrus, temporal lobe.
Changes in Z-score > 2.0 also noted at BA 21/22 (superior temporal and middle temporal gyrus), BA 13 (insula), BA 29, BA 39, BA 21, BA 40 (submarginal gyrus, temporal lobe and inferior parietal lobule, temporal lobe)

Connectivity significantly changed after chiropractic adjustment



A: Day 1 baseline **B: Day 8 before adjustment** **C: Day 8 after adjustment**

Statistically Significant Change ($2.0 < Z < -2.0$):	A vs. B	B vs. C
	0/177 measures	41/177 measures

Connectivity in the delta band (1-4 Hz) was measured in phase lock duration

-3 -2 -1 0 1 2 3

Discussion / Conclusion

- Three types of measures statistically significantly changed after a chiropractic adjustment, but not in a control scenario
  - Surface qEEG measures using raw values
  - Source localized measures using LORETA and a normative database
  - Connectivity measures using a normative database
- Source localization of the greatest change was on the same side of the brain as the short leg and occiput listing; left sacroiliac involvement was contralateral to said source localization
- Connectivity measures demonstrated changes both intra- and inter-hemispherically
- The chiropractic adjustment resulted in changes in phase lock, which is a measure of EEG synchronization. Synchronization and desynchronization in the brain is found in function and dysfunction including epilepsy, dementia, traumatic brain injury, cognitive function, working memory, sensory-motor interactions, hippocampal long term potentiation, intelligence, autism and consciousness[1]
- qEEG appears to be a viable method to document chiropractic effects, or absence thereof, on brain function
- A study using a larger sample size, active, sham and control groups is currently underway: *Effects of chiropractic adjustments on brain function using quantitative electroencephalography*, NCT01953614

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