Methods

Search Strategy

comfortable levels. Potentials were recorded from 30 electrode locations and the vertex (Cz) location was used to report the data. Statistical data used the exponential fit function on a semi-logarithmic scale. Post hoc, the implanted subjects were divided into three groups based on the duration of deafness prior to implant, with short duration, medium and long duration. The results showed that the maturation rate is the same for both implanted and normal hearing children. For the short duration deafness group, the P1 latencies are near the upper boundary of normal range. For the long duration deafness group, the P1 latencies are well above the normal range and considerably longer than medium duration deafness group's exponential fitting curve. Overall, the results found that children implanted at an earlier age will only show minor maturational delays, but if implanted at a later age, the maturational process will equal the duration of deafness. The authors stated that it is not known at what age limit cochlear implantation will be not effective in restoring cochlear maturation, and therefore, a longitudinal study needs to be conducted.

Discussion

The evidence from these five studies needs to be interpreted with caution because all of these studies, (except Sharma et al., 2002a) included fairly small sample sizes for the subjects with cochlear implants and no study used random selection to obtain subjects. The sample sizes for studies #2-5 ranged from 12 to 22 cochlear implanted subjects. However, study #1, Sharma et al., 2002 had 107 cochlear implanted subjects, which was statistically significant. In addition, the experimental methodologies were diverse which made it difficult to make comparisons across studies and could have a large effect on the overall findings extrapolated from the studies. For the CAEP procedure and data analysis, some of the differences included; stimuli, duration and rate of stimuli, presentation levels, transducers used to test, averaging, artifact rejection and sweeps criteria for data analysis. Despite the sample size limitations and the diversity of experimental CAEP procedures used, some important and contradicting trends emerged. First, all the studies demonstrated differences in P1 latencies measured in cochlear implant subjects at different ages, however, only one study, Sharma et al., 2002a showed an optimal age limit for implantation for development of the central auditory system. Sharma et al., (2002a), demonstrated a sensitive period of about 3.5 years where the central auditory system remains maximally plastic. This study had sufficient statistical significance to support the conclusion that cochlear implantation should be done prior to age 3.5 in congenitally deaf children, and that after age 7, the plasticity in the brain is greatly reduced. Also, the research from Sharma and colleagues found that P1 latencies will be in normal range within months after initiation of a cochlear implant for early implanted children (Sharma et al, 2002a, 2002b). In comparison, the results from Ponton and colleagues did not suggest a critical period for implantation for deaf children. Ponton and colleagues, however, demonstrated that children with cochlear implants will have P1 latencies develop at the same rate as normal hearing subjects, but with a maturational delay that is related to the amount of years of auditory deprivation (Ponton et al., 1996, 1996 & Eggermont et al., 1997). Also, these three studies showed that the morphology is different in children with cochlear implants, as the typical N1/P2 complex will either be delayed or absent compared to age matched normal hearing children, which demonstrates the maturational delay. Therefore, the shorter duration deafness subjects or earlier implantation will provide P1 latencies that are closer to normal range than the longer duration deafness subjects. These three studies failed to provide sufficient statistical evidence to allow for an accurate evaluation of the experimental evidence, and the findings should be viewed cautiously.

Another limitation in interpreting the findings of this research involves differences in the subjects across the studies. The studies varied in their tendency to control for differences between cochlear implant subjects on variables that can affect the CAEP results, such as age of implantation, duration of implant use, type of implant, amount of habilitation or hearing aid use prior to implantation, and timing of deafness. Three of the review