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Reproducibility of the P100 pattern reversal visual evoked potential during a long testing session

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Introduction: Several groups have attempted to determine the normal range of variability in the latency (in some cases also the amplitude) of the P100 component of the pattern reversal visual evoked potential (PRVEP), both within the same experimental session and in sessions more or less spaced in time. Oken *et al.* [1] have recently suggested a range of variability in P100 latency of 11–12 ms.

In general, the objective of such studies has been to validate clinical applications of these parameters and/or to make manifest the variables that may influence them. The experimental designs employed have been different in several aspects such as the number of subjects studied, the range of ages and the stimulation procedure applied [2].

There have also been differences in the structure of the recording sessions and procedures. The majority have been follow-up studies with very varied test-retest intervals: from two to four weeks [3], from three to five months [4], an average of six months [1, 5] and up to an average of 20.5 months [2].

One study combined a follow-up of one year with continuous recordings over 17–18 min [6], but only in a recent study were 16 serial averages recorded in a single session lasting approximately one hour [17]. However, we are not aware of the existence of any studies in which sequential averages were recorded over several hours within the same experimental session.

The principal objective of the present study was to determine whether P100 latency and N75-P100 amplitude are reproducible across averages recorded over 6 h with inter-average intervals of approximately 13 min. We also hoped to determine whether variations in sublingual temperature influenced the P100 parameters studied.

Materials and methods: The sample consisted of seven healthy volunteers, all females, with a range of ages from 20 to 24 years. None had clinical evidence of ophthalmological or neurological disease, and all had a corrected visual acuity of better than 20/25 in each eye (with corrective lenses where appropriate). Recordings were made between the fifth and eighth days of the menstrual cycle in all subjects.

PRVEPs were recorded between 16:00 and 22:00. Subjects were comfortably seated in a partially soundproofed, electrically isolated room. Stimuli were full-field checkerboard reversals subtending a visual angle of 30 min of arc and with a reversal rate of 1/s. The distance from the monitor to the subject's eyes was 92 cm. Background lighting was kept low and constant, and room temperature was between 22 and 24°C.

EEG activity was recorded using Ag/AgCl electrodes, with the active emplacement at Oz, referred to Fpz and with Cz as ground, using the 10–20 system. Impedances were kept below 5 KΩ. Filter bandpass was 1–100 Hz and sensitivity was

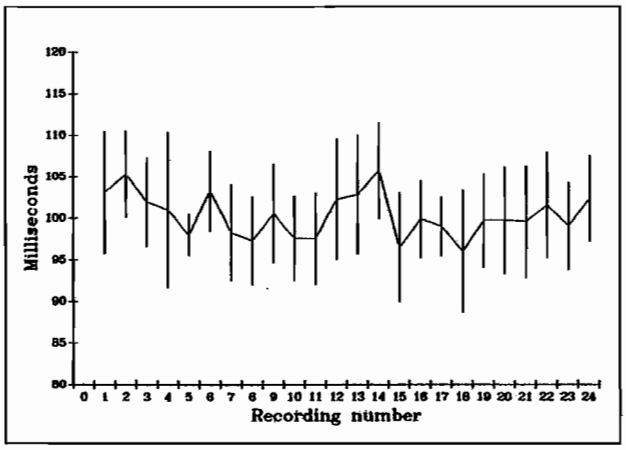

Figure 1: P100 latency plotted across recordings sequence (means ± SD for seven subjects).

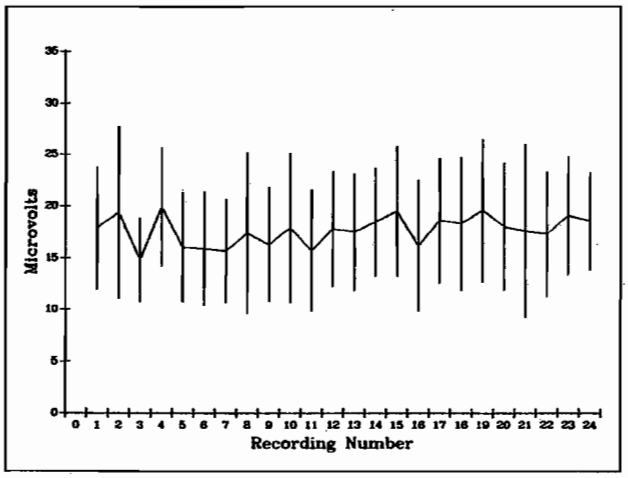

Figure 2: N75–P100 amplitude plotted across recordings sequence (mean ± SD for seven subjects).

of 100 μV. A total of 100 sweeps were averaged with a sampling epoch of 250 ms following each pattern reversal.

Sublingual temperature was taken in each subject by means of a digital thermometer before each of the recordings. The variables for the statistical analysis were P100 latency, N75–P100 amplitude and sublingual temperature. Linear regressions (SPSS–PC+) were computed between sublingual temperature and each of the P100 parameters to test the possibility of any possible relationship.

Two repeated measures analyses of variance (SPSS–PC+) were applied to P100 latency and N75–P100 amplitude separately, in order to examine variability across the 24 averages recorded in all subjects. Due to the small sample size, adjustments of the degrees of freedom were made by the methods described by Vassey and Thayer [8]. The ε value used is reported in each case.

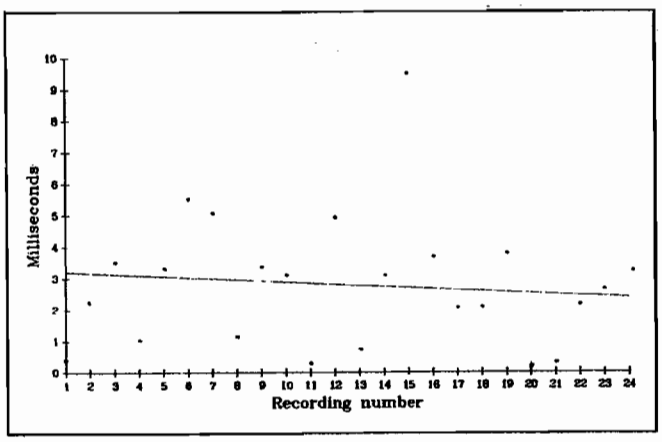

Figure 3: Mean absolute values of change in P100 latency between recordings plotted against sequence and best fit line. Each point represents the change in milliseconds.

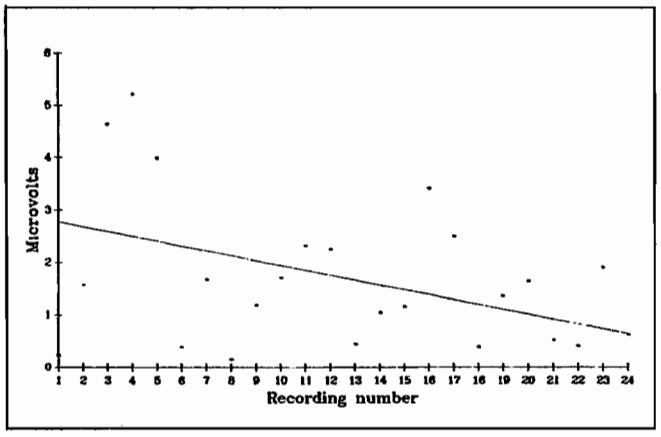

Figure 4: Mean absolute values of change in N75–P100 amplitude between recordings plotted against sequence and best fit line. Each point represents the change in microvolts.

Absolute values of change between serial averages were computed in each subject and in mean values of the entire sample for both P100 latency and N75–P100 amplitude. Least squares adjustments (Microsoft Chart) were performed in mean values of change to assess possible trends during the recording session.

Results are expressed as means ± SD.

Results: There was no linear relation between sublingual temperature and P100 latency or N75–P100 amplitude. None of the correlation coefficients reached statistical significance in any of the subjects.

P100 latency ranged between 96 and 105.7 ms (100.34 ± 2.66) and N75-P100 amplitude between 14.8 and 19.9 μV (17.6 ± 1.4) in all subjects (Figures 1 and 2). Repeated measures analyses of variance showed changes in P100 latency (F (df 23, 138) = 1.7, $p < 0.03$, $\varepsilon = 0.36$) but not in N75–P100 amplitude (F (df 23, 138) = 0.96, $p < 0.52$, $\varepsilon = 0.47$) across successive recordings.

The mean of the absolute value of change between successive recordings in all subjects was, for P100 latency 2.77 ms (range 0–9.35) and for N75–P100 amplitude 1.66 μV (range 0.06–5.12). As shown in Figure 3, there was a very large change of 9.35 ms in P100 latency between recordings 14 and 15 (3.5 h from the beginning of the session). This was due to the fact that in each of the subjects maximum values of change occurred between recordings 13 and 15.

Simple fits by means of least squares adjustments showed a marginal, non-significant linear decrease in change values of P100 latency across recordings. As shown in Figure 4, there was also a marked, significant linear decrease in change values of N75–P100 amplitude (t (df 6) = −2.3, $p < 0.05$).

Discussion: The lack of any relationship between sublingual temperature and P100 parameters appears to indicate that these variables are independent. Oken *et al.* [1] have pointed out that changes in body temperature may contribute to some variability in P100 latency, but this seems unlikely according to our results.

We have found significant variations in P100 latency across recordings, but not the increase in the variability reported recently during prolonged testing [7]. Unlike these authors, we did not find any decrease in N75–P100 amplitude across recordings. On the contrary, we observed no changes in this parameter throughout the testing session, as the results from the analysis of variance show.

The range of change values between recordings observed in our sample for P100 latency was similar to others in the literature [1, 7]. These authors reported mean ranges in latency changes of 0.30–11 and 0.81–5.78 ms respectively, and we found a range of change of 0–9.35 ms (mean 2.77 ± 2.09).

We found a similar range of changes in N75–P100 amplitude to that of other authors [7]. But with regard to the temporal trend in inter-recording changes, the non-significant changes shown by N75–P100 amplitude tended to decrease with repeated testing. This may indicate that this parameter tends to stabilise around a mean value as the recordings increase.

In general, the reasons for the variability in P100 latency remain uncertain. We interpret the larger change in each subject between recordings 13–15 in two ways, which may be related to each other. Firstly, a transitory saturation may have happened in neural pathways after recording for 3.5 h. Secondly, it is possible that rhythmic fluctuations with an ultradian periodicity (periods of 30 min to 20 h) may have influenced the efficiency of the neural transmission along the visual pathways and in the primary visual cortex. This would explain the greatest variation in P100 latency at about 19:30 or 20:00 o'clock.

Nevertheless, further studies with larger samples concerning the physiological nature of P100 changes across repeated testing will be necessary before such possibilities can be considered as explanatory hypotheses.

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