Early and Intensive Maternal Antenatal Decompression and the Electro-encephalograms of 4-year-old Children

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SUMMARY

Electro-encephalograms (EEGs) were recorded from 44 first-born children aged 4 years, whose mothers had undergone a mean number of 148 decompression treatments initiated before the 29th week of pregnancy, and from 40 controls of the same age whose mothers had received no decompression during pregnancy. For only 7 of the 45 EEG measures did the groups show a statistically significant difference. This is less than the number of statistically significant differences to be expected purely on the basis of chance, and suggests that the groups showed no basic differences in their EEGs. It is concluded that early and intensive maternal antenatal decompression treatment produces no lasting changes in EEG measures. Previous claims that antenatal decompression leads to enhanced cortical development and cognitive function in children are thus not upheld.

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Previous attempts, utilising the EEG as an index of maturational status, to find support for Heyns's[1,2] claim that prenatal maternal decompression permits realisation of the full developmental potential of the fetus and child have failed. No consistent differences in EEG measures between the children of non-decompressed mothers and children whose mothers had received 12 half-hour decompression sessions during the last 2 months of pregnancy,[3] or from 10 to 30 half-hour treatments during the last 10 weeks of pregnancy,[4] were seen. Since it is possible that these negative findings resulted from a relatively ineffective decompression treatment procedure, it has been previously suggested[4] that significant EEG changes in the child might be produced by early initiation and more intensive utilisation of decompression during pregnancy. The present report concerns an attempt to test this hypothesis.

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SUBJECTS AND METHODS

The experimental (decompression) group consisted of 44 children (16 males) aged 47 to 61 months (mean 53,48; SD 4,47). The mothers of subjects in this group had, as a result of their own interest in decompression or that of their general practitioner or gynaecologist, been referred to a private clinic, where the technique was demonstrated and decompression apparatus provided for home use. Decompression treatments were begun between the 23rd and 29th weeks of pregnancy and the mothers were instructed to utilise the apparatus for half-hour sessions daily from the time of initiation, and twice daily during the last trimester of pregnancy. Few mothers adhered rigidly to this schedule, so that the total number of individual treatments ranged from 77 to 224 (mean 148,36; SD 39,05). This mean treatment number corresponds closely, however, to the optimum for maximal realisation of intra-uterine development postulated by Blecher[5] (140 treatments), and is very considerably more than the number of maternal treatments applied in previous EEG studies[3,4] of decompression.

The control (non-decompression) group consisted of 40 children aged between 45,5 and 61 months (mean 53,44; SD 4,19), of whom 25 were males. Children in the control group were the playmates of the decompression subjects. The groups were thus presumably well-matched in terms of socio-economic variables. No mother of a control child had undergone decompression treatment during pregnancy. However, the incidence of those who had received physiotherapy or other specialised antenatal treatment was not determined. The mothers of children in the control and experimental groups were matched on several variables which could affect the congenital development and hence possibly the EEG status of the child. Mothers, therefore, did not differ significantly in age and educational status, nor in incidence of smoking during pregnancy, of threatened miscarriage and of antepartum bleeding. Control and experimental groups were also matched on the variables of paternal educational status, weight at delivery, method of delivery, neonatal problems, childhood illnesses and attendance at nursery school. All subjects were firstborns.

Procedure

EEG recordings. These were performed in the laboratories of the Division of Neuropsychology of the National

TABLE I. SIGNIFICANT* DIFFERENCES BETWEEN CONTROL AND EXPERIMENTAL GROUPS ON EEG MEASURES

	Experimental			Control				
Measure	Range	Mean	SD	Range	Mean	SD	t	N
$P_4 - O_2\alpha$	8,0 - 9,5	8,42	0,45	8,0 - 10,88	8,7	0,76	2,04	82
$T_4 - T_6\alpha$	8,0 - 8,88	8,29	0,28	8,0 - 10,25	8,61	0,71	2,31	60
Mean α R hemisphere	8,0 - 9,38	8,43	0,39	8,0 - 10,34	8,67	0,61	2,15	83
$P_3 - O_1\alpha$	8,0 - 9,75	8,38	0,41	8,0 - 10,25	8,64	0,69	2,09	81
Resting abnormality	0 - 2	0,5	0,67	0 - 1,5	0,2	0,42	2,44	84
Number of alpha components	1 - 6	3,56	1,16	2 - 6	4,29	1,23	2,06	46

* $P<0,05$.

Institute for Personnel Research. The decompression subject and his control were brought together for testing, but were allowed to decide between themselves who would first have the EEG. Thus, at no time were the recording personnel aware of the group designation of the subject. If necessary, adults accompanying the subjects were present while the EEG was recorded. Incidence of refusals was low.

A Galileo E8b electro-encephalograph with 5 different bipolar electrode montages was used. Electrodes were positioned according to the 10 - 20 system.[6] Routine photic stimulation and hyperventilation techniques were applied where possible. One decompression child refused photic stimulation, and 4 decompression and 6 control subjects could not hyperventilate for 3 minutes according to standardised procedure.

EEG analysis. All EEGs were done visually by the senior author (B.D.M.) with the aid of a millimetre cursor. Group identifications were only assigned to the EEGs after analysis. Control and experimental groups were compared on 45 EEG measures. Of these, 20 were measurements of alpha activity from posterior derivations, since these would appear to bear a close relationship with maturational processes.[7]

RESULTS AND DISCUSSION

The t-test[8] was used to compare group means on continuous measures. Chi-square in contingency table form, incorporating Yates's correction for continuity[8] where necessary, was used to determine the significance of group differences in incidence on discrete measures. Correlations were computed according to Pearson's product - moment formula.[8]

The above statistics were considered significant if $P<0,05$. Significant results are presented in Tables I and II. Table III gives the correlations between the number of decompression runs and selected EEG measures in the experimental group.

Of the 45 EEG measures in respect of which control and experimental groups were compared, 7 yielded differences which were statistically significant (Tables I and II). Since 9 significantly different measures would be expected for this number of variables on the basis of chance alone,

TABLE II. SIGNIFICANT* DIFFERENCE IN INCIDENCE OF SHARP WAVE AND SPIKE ACTIVITY BETWEEN CONTROL AND EXPERIMENTAL GROUPS

	Experimental	Control	χ^2	df
Sharp wave and spike activity	12	3	4,32	1
No sharp wave and spike activity	32	37		

* $P<0,05$.

and since group profiles on the remaining 38 measures were remarkably similar, a lack of any basic EEG differences between the groups is indicated. Thus, it would appear that early and intensive antenatal maternal decompression does not result in lasting EEG changes, as was found also with less intensively applied decompression treatment.[3,4]

Even if the statistically significant group differences are regarded as meaningful, the validity of Heyns's[1,2] contentions is questionable, as is discussed in detail below. The 4 significant differences in alpha frequency measures obtained (Table I) all favour the control group. Such measures, as has been indicated, appear to reflect the operation of maturational processes quite closely. This result is therefore inimical to Heyns's postulation of a relationship between maternal decompression and advanced cortical maturity in the child. This finding gains support from the lack of statistically significant differences between the groups on a further 9 EEG measures, among them mean theta and delta frequencies and the relative incidences of alpha, theta and delta activity, all of which have been said to reflect cortical changes with maturation.[7]

It has previously been postulated that superior cognitive ability may be associated with increased variability of alpha measures, expressed partially in a greater number of alpha components.[9] In the present instance, the decompression group shows significantly fewer alpha components than the control group (Table I). This finding would also appear to be incompatible with Heyns's statements regarding the superior cognitive ability of decompressed children.

The decompression group was rated significantly higher in resting abnormality (Table I), particularly that involving sharp waves and/or spikes (Table II), than the control group. This contrasts with the findings of a previous study[4] in which a lowered incidence of abnormality in the resting EEG was found in children whose mothers had undergone up to 30 decompression treatments. In the light of these conflicting results, any conclusions regarding the relationship between maternal decompression and ratings of resting EEG abnormality in the child can only be regarded as tentative.

TABLE III. CORRELATIONS BETWEEN NUMBER OF DECOMPRESSION TREATMENTS AND SELECTED EEG MEASURES IN EXPERIMENTAL GROUP

EEG measure	*r*	N
P_4 - $O_2\alpha$	0,042	44
T_4 - $T_6\alpha$	0,071	30
Mean α frequency right hemisphere	−0,002	44
P_3 - $O_1\alpha$	0,197	44
Mean α frequency left hemisphere	0,09	44
Mean theta frequency	0,148	42
Mean delta frequency	−0,11	14
Alpha frequency range	0,237	25
Number of alpha components	0,322	25
Alpha index	0,217	44
Theta index	−0.246	44
Resting abnormality rating	−0,092	44

None of the above coefficients of correlation is statistically significant.

Correlations were computed between number of decompression runs and selected EEG measures, including those which had yielded statistically significant group differences (Table III). This was done on the argument that if decompression treatment was the only factor responsible for differences between the groups, marked and significant correlations between the number of treatments and, at least, those measures on which significant group differences were found, should be obtained. Table III shows that all correlations were small and of apparently random direction, and in no case approached statistical significance. This suggests that, in spite of the variables on which control and experimental group children and their parents were equated, matching procedures were not adequate. Further research thus appears to be indicated. However, the rigid control procedures necessary will probably not be achieved unless animal subjects are used.

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REFERENCES

1. Heyns, O. S. (1963): *Abdominal Decompression—A Monograph.* Johannesburg: University of the Witwatersrand Press.
2. *Idem* (1963): Leech, **33**, 98.
3. Nelson, G. K. (1961): *Electroencephalograms of Infants in Relation to Prenatal Maternal Decompression.* Confidential report. Johannesburg: NIPR, CSIR.
4. Murdoch, B. D. (1968): S. Afr. Med. J., **42**, 1067.
5. Blecher, J. A. (1968): *Ibid.*, **42**, 379.
6. Jasper, H. H. (1958): Electroenceph. Clin. Neurophysiol., **10**, 371.
7. Petersen, I. and Eeg-Olofsson, O. (1971): Neuropaediätrie, **2**, 247.
8. Guilford, J. P. (1956): *Fundamental Statistics in Psychology and Education*, 3rd ed New York: McGraw-Hill.
9. Murdoch, B. D. (1974): S. Afr. Med. J., **48**, 606.