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ELECTROENCEPHALOGRAPHIC INVESTIGATION OF PATIENTS WITH ADOLESCENT IDIOPATHIC SCOLIOSIS

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An EEG study was carried out on 57 children, aged 10–16 years, with idiopathic scoliosis. Treatment (brace or surgery) was required in 37 cases; 20 were being observed only. Controls were 10- to 16-year-old healthy children meeting well-defined criteria of normality. Thirty-four of the scoliotics fulfilled these criteria, thus providing a group matching the controls except for the presence of scoliosis. Thus, any differences occurring could, with reasonable probability, be referred to the disease in question.

The comparison with healthy children showed a generally greater EEG pathology in the scoliotics. This was the case in all patients, even those meeting the same criteria of normality as the controls. A highly significant difference was noted in the occurrence of paroxysmal activity. Type and localization of abnormality (bilaterally synchronous discharges) indicated involvement of subcortical structures.

Comparison within the scoliotic group showed that EEG abnormalities were not correlated with the magnitude of the disease except for the variable "paroxysmal activity at rest". Patients submitted to observation only presented paroxysmal activity significantly more often than patients requiring treatment. The localization of abnormality within the hemispheres did not agree or disagree systematically with the convexity of the curve.

A possible relationship between the higher incidence of scoliosis in females and the higher sensitivity to afferent stimuli as found in the female EEG is also discussed.

Key words: aetiology; electroencephalography; equilibrium; scoliosis

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The aetiology of idiopathic scoliosis remains an enigma. This type of scoliosis is the most frequent, constituting about 85 per cent of our scoliotic patients (Nordwall 1973).

As part of a larger study designed to elucidate different aspects of the equilibrium function in idiopathic scoliosis, a group of patients has been investigated with electroencephalography. This neurophysiological approach to an aetiological problem has been considered as a natural step because of the important role the central nervous system plays in postural equilibrium. No other study of this type has been published previously.

Several reports during recent years have focused attention on the central nervous system when searching for the cause of idiopathic scoliosis or for contributory factors. Analysis of the literature indicates that scoliosis may appear together with various neurological disorders involving different levels in the central nervous system

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(Robin 1975). Functional and organic involvement of the brain stem has been described in works of Tezuka (1971), Yamada & Yamamoto (1972), Crisfield (1974), Dretakis & Kondoyannis (1974), and Sharpe et al. (1975). Martin (1967) and Duvoisin & Marsden (1975) pointed out that diseases in the basal ganglia may be of importance for the aetiology of a lateral curve. Martin (1967) quoted previous authors who had found that unilateral lesions of the caudate nucleus in dogs may cause scoliosis concave to the same side.

In the present study we have compared the EEG findings in a group of patients suffering from idiopathic scoliosis with those in healthy children. In addition, it was thought of interest to investigate if electroencephalographic signs of deficient maturation in the CNS were to be found in these patients, especially in view of the fact that a retarded development of the equilibrium function had been reported by Yamada & Yamamoto (1972) in patients with idiopathic scoliosis.

METHOD

EEG was recorded with a 16-channel electroencephalograph. The 10–20 electrode system of the International Federation was used with longitudinal and transverse bipolar derivations. The EEG investigation included resting EEG and activation procedures by means of hyperventilation, intermittent photic stimulation and sleep. The recordings were classified according to the customary visual technique. For definitions of normal and pathological findings reference is made to Selldén (1964), Eeg-Olofsson et al. (1971) and Petersén & Eeg-Olofsson (1971).

The following EEG patterns were distinguished: normal EEG; slight or moderate increase of low frequency activity in resting EEG; paroxysmal activity in resting EEG, 14–6 Hz positive spike phenomenon and/or 6 Hz spike and wave activity and paroxysmal activity occurring with any of the activation procedures applied. Electroencephalographic findings included in the patterns mentioned above were noted in the total material and in the following subgroups: patients requiring treatment (brace or operation), patients placed under observation only and patients meeting criteria of normality according to Petersén & Eeg-Olofsson (1971).

The EEG findings encountered were compared a) between patients requiring treatment and those placed under observation only, b) between the total groups of scoliotic patients and healthy children, c) between scoliotic patients meeting the criteria of normality and healthy children. Most of the patients were girls (49 out of 57) and the normal material comprised an equal number of both sexes. Comparison by sexes was not considered suitable, however, because of the fact that further grouping would have resulted in groups too small for adequate statistical treatment.

Visual evaluation of the EEG was complemented to a certain extent by automatic frequency analysis. A previously described method for calculation of "EEG age" from the frequency spectra (Matousek & Petersén 1973) was applied in order to reveal any electroencephalographic signs of cerebral immaturity. This procedure implies a comparison between "EEG age" as measured from maturation of EEG frequency spectra and the biological age of the patient.

In the statistical analysis, X^2 test in a fourfold table with Yates correction was employed. When the expected frequencies were less than five in any of the cells, an exact confidence interval for proportions was also constructed (Scientific Tables, Documenta Geigy, 1975).

MATERIAL

The study comprised 57 patients with idiopathic scoliosis referred to the Department of Orthopaedic Surgery I at Sahlgren Hospital during 1975–1976. Age and sex ratio are shown in Table 1. The patients were divided into subgroups with regard to the magnitude and convexity of the curve (Table 2). The magnitude of the scoliosis has been classified according to whether the deformity required treatment or not. As a rule, the indication for treatment has been a curve of more than 20° (Cobb 1948) in a patient still skeletally immature. In two patients with curves of 17°, however, a brace was applied. The two different subgroups requiring treatment have been analysed together, and they were investigated with EEG prior to treatment. All patients

Table 1. Material

Range (years)	Mean age ± s.d. (years)	Sex ratio ♂/♀
10–16	13.3 ± 1.7	8/49

Table 2. Grouping of scoliotic patients with regard to magnitude and convexity of the curve

	Patients placed under observation	Patients requiring treatment	Total
Right convex single curve	9 (5)*	19 (11)	28 (16)
Left convex single curve	11 (8)	10 (6)	21 (14)
Double primary curve		8 (4)	8 (4)
	20 (13)	37 (21)	57 (34)

* Figures within brackets indicate number of patients meeting criteria of normality in control group.

had a thorough somatic investigation, emphasizing the neurological status according to a special schedule.

The EEG findings in the patients were compared with those in the healthy children belonging to a material previously described by Petersén & Eeg-Olofsson (1971) and Eeg-Olofsson (1971).

These children were selected according to well defined criteria of normality. This means that children not possessing signs or symptoms which imply a risk of the appearance of certain EEG patterns, looked upon as abnormal in the literature, have been investigated. The selection is based on the following criteria of normality: 1) An uneventful prenatal, perinatal, and neonatal period; 2) No disorder of consciousness (sporadic syncope, however, was accepted); 3) No head injury with cerebral symptoms; 4) No history of central nervous system diseases; 5) No obvious somatic disease; 6) No convulsions; 7) No family history of convulsive disorders other than those secondary to acquired cerebral damage; 8) No paroxysmal headache or abdominal pain; 9) No enuresis or encopresis after the fourth birthday; 10) No tics, stuttering, pavor nocturnus or excessive nail-biting; 11) No obvious mental diseases; 12) No conduct disorders; 13) No deviation with regard to mental and physical development. For the present investigation all children in the same age-group as the patients with scoliosis were chosen (362 children; 194 girls and 168 boys. Sleep recording was done in 275 children; 152 girls and 123 boys.)

RESULTS

Out of the 57 cases (49 girls and 8 boys) with scoliosis 34 (29 girls and 5 boys) met the criteria of normality. Among the 23 patients not meeting these criteria the majority had had some problem during the perinatal period (e.g. prematurity, forceps extraction), others moderate head trauma or enuresis. Absence of the earliest history because of adoption constituted the deviation from criteria of normality in three patients. Psychological or cosmetic problems were admitted in six cases only. None of the children presented any pathological neurological signs.

Comparison within scoliotic patients after grouping with regard to magnitude and convexity of the curve

Among the different EEG-patterns, "paroxysmal activity at rest" occurred to a greater extent in patients placed under observation than in those requiring treatment ($P < 0.05$) (Table 3). Otherwise no difference was present between these two subgroups. The localization of EEG abnormality within the hemispheres tended neither to agree nor to disagree systematically with the direction of the scoliosis.

Comparison between EEG findings in scoliotics and healthy children

A. Visual assessment (Table 4)

Increase of low frequency activity

Slight increase of low frequency activity within the theta range occurred in ten cases and

Table 3. Distribution of EEG patterns in patients with scoliosis

EEG pattern		a Patients placed under observation 20 (13)* cases	b Patients requiring treatment 37 (21) cases	Difference a – b	Total 57 (34) cases
I.	Increase of low frequency activity	7 (4)	6 (3)	NS (NS)**	13 (7)
II.	Paroxysmal activity at rest	6 (5)	2 (1)	$P < 0.05$ (NS)	8 (6)
III.	14–6 positive spike and/or 6 Hz spike phenomenon with sleep	8 (6)	11 (6)	NS (NS)	19 (12)
IV.	Paroxysmal effects with either of the activation procedures (III excluded)	3 (2)	5 (3)	NS (NS)	8 (5)

* Figures within brackets indicate number of patients meeting criteria of normality in control group.
** NS = not statistically significant.

Table 4. Distribution of EEG patterns in patients and controls

EEG pattern		A. Total group of scoliotics $n = 57$	B. Scoliotics meeting criteria of normality $n = 34$	C. Healthy children $n = 362$ (I + II), $n = 275$ (III)	Statistical differences A-C	B-C
I.	Increase of low frequency activity	13 (23%)	7 (21%)	54 (15%)	NS*	NS
II.	Paroxysmal activity in rest	8 (14%)	6 (18%)	9 (3%)	$P < 0.01$	$P < 0.01$
III.	14-6 positive spike and/or 6 Hz spike phenomenon	19 (33%)	11 (32%)	67 (24%)	NS	NS

* *Not statistically significant.*

moderate increase in three cases. This implies an EEG by definition referred to as pathological in 23 per cent. For the patients fulfilling the normality criteria applied to the healthy children the figure was 21 per cent. Neither of these figures showed any statistically significant difference from those in healthy children (15 per cent). Nor did the type of abnormality or localization within the hemispheres differ in any notable way. In four cases, however, some kind of paroxysmal activity appeared in addition to the increase of low frequency activity (see below).

Paroxysmal activity at rest

In agreement with Eeg-Olofsson et al. (1971) paroxysmal activity is defined as discharges of spikes (14–6 Hz positive spike phenomenon excluded) or sharp waves and spike-and-wave complexes as well as burst of delta and/or theta activity with amplitudes exceeding at least twice that of the background activity.

i) *Frequency of paroxysmal activity.* Paroxysmal activity occurred in eight out of 57 cases (14 per cent) in the total material of

scoliotic children, and in six out of the 34 cases (18 per cent) which met the normal criteria of the healthy group. In the normal series, nine out of 362 children presented some kind of paroxysmal activity (3 per cent). Thus the occurrence of paroxysmal activity was higher in the patients than in the normals. This applied to the total group of children with scoliosis as well as to those meeting the criteria of normality. The difference was highly statistically significant in both groups ($P < 0.01$).

ii) *Type and lateralization of paroxysmal activity.* Focal paroxysmal activity occurred in only one out of eight patients, a 12-year-old girl with sharp waves in the left fronto-temporo-central leads. Two cases showed more or less distinct sharp waves fronto-temporal left and fronto-temporal bilaterally, respectively. The remaining five cases presented bilateral synchronous paroxysmal slow activity (Figure 1), including sharp wave and/or spike potentials in four cases. Slight side dominance to the right was noted in three cases and no side difference in the remaining two. Four children presented increase of low frequency activity as well.

Paroxysmal activity of the healthy children was mainly focally distributed. Only one out of nine in this group showed diffuse bilateral paroxysmal slow activity.

iii) Age of patients with paroxysmal activity. All eight patients were 12 years of age or more; one case 12 years, two cases 13 years, three cases 14 years and two 15 years. In the normal series five out of nine were 12 years or below, and the remaining cases below 15 years.

Thus the paroxysmal activity was significantly more frequent in children with scoliosis than in normals; the type and localization of paroxysmal activity were different – paroxysmal slow activity bilaterally being the most usual pattern with patients, and focal sharp waves occurring in healthy children.

14–6 Hz positive spike and/or 6 Hz spike phenomenon

This pattern was clearly age dependent. In the age groups concerned, the incidence was high in normals, percentages varying between 17 and 38. 11-year-old boys presented the

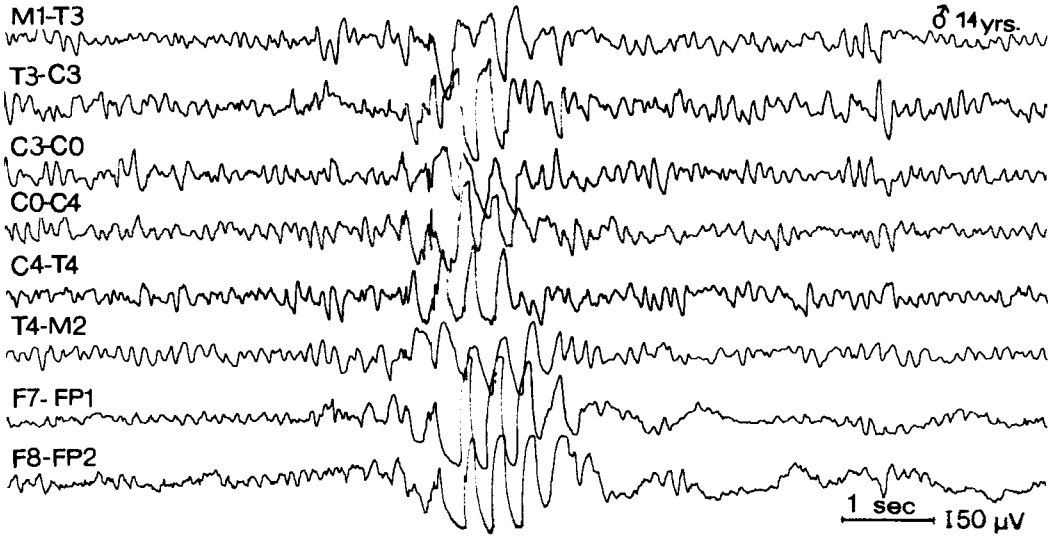

Figure 1. An example of bilaterally synchronous paroxysmal activity in a 14-year-old boy.

highest figure and 10-year-old girls the lowest. It occurred in 19 out of 57 children with scoliosis (33 per cent) and in 12 out of 34 patients meeting criteria of normality (32 per cent). Of the total of 19 patients showing this pattern, 13 had only 14–6 Hz positive spikes, 4 had 14–6 Hz positive spikes + 6 Hz spike-and-wave activity, and 1 had only 6 Hz spike-and-wave activity. The healthy children presented this phenomenon in 67 cases out of 275 (24 per cent).

Paroxysmal effects occurring with any of the activation procedures

As described above children with scoliosis showed a large amount of paroxysmal activity in the resting EEG. With activations, however, the paroxysmal effects were comparatively few. The number of effects encountered was only 13 in the total scoliosis material. The corresponding figure found in normals was 38 in 362 cases.

In summing up the results, the statistical outcome as to representation of EEG findings was the same in patients meeting criteria of normality as in the total material. Only the pattern "paroxysmal activity at rest" was found significantly more often in children with scoliosis than in normals. It should be mentioned, however, that there was a marked tendency towards greater EEG pathology in patients. This was invariably true, even after subgrouping patients into those who met the normality criteria and those who did not. When considering deviation from strictly normal in resting EEG on the whole, 17 out of 57 children with scoliosis (30 per cent) exhibited at least one of the patterns "increase of low frequency activity" and "paroxysmal activity". The corresponding figures in the healthy children were 63 out of 362 (17 per cent). The difference was statistically significant ($P < 0.05$). Moreover the number of cases without any deviation from strictly normal EEG was 15 (44 per cent) in patients and 236 (65 per cent) in healthy controls ($P < 0.05$).

B. Assessment by means of automatic frequency analysis

Frequency analysis was performed in 29 of the 57 cases. Age and sex distribution in these cases, as well as the number of patients meeting criteria of normality, were essentially the same in this group as in those not submitted to frequency analysis. Twenty of these cases met the normality criteria. The results in the nine cases not meeting these criteria were disregarded. – The outcome of the analysis did not support the hypothesis that children with scoliosis might show signs of delayed cerebral maturation. Thus all cases exhibited a frequency spectrum within the limits encountered in the healthy group.

DISCUSSION

As stated in the introduction, no EEG studies have previously been made of patients with idiopathic scoliosis. A number of writers, however, have suggested the possibility of a functional disturbance or organic injury in the CNS as a contributory cause in the development of this disease. An EEG study was therefore thought to be justified, partly to ascertain whether there would be pathological findings at all, and partly to investigate the type and localization of any abnormalities. To some extent, different EEG patterns stem from different cerebral structures, and the EEG may therefore help us to find out what levels in the CNS could be involved in a pathological process. Furthermore, the EEG can give certain information about the degree of cerebral maturity since its frequency development, among other things, is a function of age. Normally, this development goes on continuously during the period of growing up, and is virtually completed at puberty. The last phase of maturation coincides with an age that is particularly susceptible to the rise and progress of adolescent idiopathic scoliosis. A delay in CNS maturation ought therefore to be reflected in these patients' EEGs. As shown earlier by

Japanese writers (Yamada & Yamamoto 1972) scoliosis patients are behind in the development of the equilibrium function as compared with normal children of the same age. This might perhaps indicate that the scoliosis patients have a deficient CNS maturation in relation to their age.

When judging the probability that an EEG abnormality is connected with a particular disease in the patient, possible sources of error must be taken into account. Special difficulties in evaluation arise from the fact that similar EEG abnormalities may appear with different diseases and that some deviations from a strictly normal EEG also occur in clinically and anamnestically healthy individuals. The cause of the latter may perhaps be incomplete diagnosis, where it is a question of confirming earlier more or less important injuries. In the evaluation of EEG findings in a clinical material, therefore, the material must be well defined, not merely as regards the disease dealt with by the investigation but also in other respects, particularly where diseases or injuries which may involve the CNS, primarily or secondarily, are concerned. In addition, the same demand must be made of so-called control or normal materials, in order to avoid as far as possible erroneous conclusions about the significance of the EEG findings. Unique possibilities for making relevant comparisons are obtained when the clinical material fulfils the same criteria of normality as the comparison material except for the particular disease which is the object of study. Any differences which appear in the EEG findings may then, with reasonable probability, be attributed to the factors connected with the disease in question.

In the normal material published by Petersén & Eeg-Olofsson (1971) the children selected were children who did not possess any special signs or symptoms which imply a risk of the appearance of certain EEG patterns looked upon as abnormal. The materials compared in our own study were investigated in the same way, both anamnestically and clinically.

In our scoliosis material, some patients fulfilled these criteria while others did not. All the scoliosis patients showed normal findings in the clinical neurological examination. As will be seen in the account of the results, 34 patients fulfilled the criteria applied in the selection of the control material. This provided a unique opportunity to compare EEG findings in groups of individuals where the disease studied in the patient group constituted the main difference between them.

It should be emphasized in this connection that the scoliosis in itself can be thought of as forming a more or less pronounced factor of mental stress for the patients. The difference between the normal cases and the scoliosis patients would then also include possible effects secondary to the stress patients were exposed to on account of their disease. Reports on EEG responses to stress, however, are fairly few and mostly concerned with considerable physical strain on the individual, e.g. gravitation force during flight, and major surgery.

With less dramatic strain on the individual, discrete EEG changes are described by Kamp et al. (1970). These authors found only slight shifts of the peak in the alpha frequency band when submitting experimental persons to minor physical and mental loads. These were mostly psychological tests of different kinds. In our investigation, however, only six cases admitted psychological or cosmetic problems, and only one of these patients showed an EEG finding which deviated from the normal.

Certain other problems connected with our comparison between the EEG findings in the scoliosis cases and those in normal children will be taken up for discussion. It is a fact that some EEG patterns show age and sex variations, and therefore the age and sex distribution in the material to be compared ought to be more or less the same. Our scoliosis material presents essentially the same age distribution as the control material, and sources of error due to uneven age distribution can thus be disregarded. On the other hand there is a very uneven distribution where sex is concerned. In the normal

material the sex distribution was equal, whereas the scoliosis material contained a clear majority of girls. The reason for this is that such a sex distribution is inherent in the nature of the disease, particularly if one considers progressive curves and curves which require treatment.

Of the EEG variables discussed, however, only the "14–6 Hz positive spike" pattern and "paroxysmal effect on intermittent photic stimulation" showed a sex difference in the relevant age groups in normal children. Boys showed a higher frequency of the first-mentioned activity than girls, and girls a higher frequency of the second than boys (Eeg-Olofsson 1971, Eeg-Olofsson et al. 1971). As regards the "14–6 Hz positive spike" pattern, it is pointed out that the small number of boys in the scoliosis material should help to weaken any significant differences, as the comparison was made with a normal material with an even sex distribution. As to "paroxysmal effect on intermittent photic stimulation", this occurred in so few scoliosis cases that statistical calculation would be irrelevant.

Some findings of special interest emerged in the EEG investigation of the scoliosis patients, in particular with regard to the occurrence of paroxysmal abnormalities in resting EEG. These appeared to a statistically very significantly higher degree ($P < 0.01$) in the scoliosis cases than in the normal ones. It could be observed, furthermore, that the scoliosis patients presented a strikingly higher percentage of deviations from strictly normal resting EEG on the whole. These deviations were of the same magnitude in the group which fulfilled normal criteria as in the total material (32 per cent and 30 per cent, respectively). Consequently, possible cerebral pathology referable to cases excluded by the normal criteria was not likely to represent a source of error when evaluating the statistical outcome.

The paroxysmal abnormalities in the scoliosis cases were to a large extent bilaterally synchronous, and as a rule were spread over large areas of both hemispheres. The changes were of a type considered to be generated in subcortical, deep-lying midline structures, thus including the brain stem region (Fortuyn & Jasper 1947, Magoun 1953). An example of an abnormality of this kind will be seen in Figure 1. These findings are of particular interest, as they may indicate a lesion or a dysfunction of cerebral structures at the level of the brain stem. In the CNS, it is also the brain stem level which is of most interest, from the aetiological point of view, in idiopathic scoliosis, first in the light of the reports mentioned in the introduction and second in the light of what we know about its fundamental importance for postural equilibrium.

In this connection, the high percentage of occurrence of "14–6 Hz positive spikes and/or 6 Hz spike waves" should also be recalled. This activity appeared to the same extent in the whole group of scoliosis cases as in the 34 patients meeting normal criteria (33 per cent and 32 per cent, respectively). It has been said that clinical correlatives to this pattern in children include autonomic dysfunction, behaviour problems and convulsive phenomena (Niedermeyer & Knott 1961, Henry 1963, and Hughes 1965). In no case, however, was the reason why some patients did not fulfil the criteria of normality due to the occurrence of these clinical symptoms.

"14–6 Hz positive spikes" and "6 Hz spike wave" activity often occur in the same patient and it is sometimes difficult to distinguish between them, since so-called transitional forms are common (Silverman 1967). Particularly "14–6 Hz positive spike" activity (occurring in 18 of the 19 patients in this pattern group) is regarded as being generated in the hypothalamus region (Gibbs & Gibbs 1951, Little & Bevilacqua 1962, Niedermeyer et al. 1967).

The difference in incidence between scoliosis and normal cases was not statistically significant, it is true, but this may be due to the fact that the boys in one of the

age groups of the normal material showed a notably high percentage of this pattern. Thus, compared with 11-year-old girls, the percentage among 11-year-old boys was about twice as high. It was also twice as high as the figures found in the neighbouring age groups in both sexes. This might have induced an error, as the calculation was based on equal numbers of both sexes in the healthy children, while the patients were mainly girls. In spite of this souce of error, the percentage of this pattern was considerably higher in the scoliosis cases than in the normal ones.

Another circumstance that may be interesting to note is the appearance of paroxysmal changes in relation to age among the scoliosis patients. From studies of a normal material (Petersén & Eeg-Olofsson 1971, Hagne 1972) it appears that paroxysmal activity shows a pronounced dependence on age. From a very high frequency postpartum (about 40 per cent), a marked and thereafter successive decrease in frequency takes place during the first year of life. At the time when scoliosis develops the figures stands at about 3 per cent. Among the scoliosis cases a greatly increased frequency could be observed without the tendency to a decrease in occurrence in the older children. It may be asked, then, whether this is really a reflection of cerebral pathology or perhaps, instead, of cerebral immaturity in these individuals, but the type and localization of the paroxysmal changes rather suggest cerebral pathology than cerebral immaturity. The investigation by means of frequency analysis carried out on a part of the material gave no support, either, for the possibility of a lack of cerebral maturity in relation to age in these children.

In the natural history of idiopathic scoliosis there is the interesting tendency, hitherto unexplained, for an affected girl to run a definitely higher risk, as compared to a boy, of her scoliosis progressing during puberty (Rogala et al. 1976). The incidence of idiopathic scoliosis, too, is higher in girls, especially with more important curves, e.g. over 10° (Rogala et al. 1976, Brooks et al. 1975). Unexplained sex differences are also to be found with certain EEG variables. By means of EEG investigation of healthy individuals between the ages of 1 and 60 years (Selldén 1964, Petersén & Eeg-Olofsson 1971) these sex differences have been documented. In particular, women show more frequent and more powerful effects than men with different types of activation. These EEG effects often appear with an extension over the hemispheres which points to an involvement of subcortical midline structures. The reason for this increased sensitivity in women to various stimuli, of course, can only be a matter for speculation. One wonders whether a lower tolerance for various afferent stimuli can contribute in some way to the higher frequency of scoliosis among the girls.

In healthy children, the pattern "increase of low frequency activity" also shows certain sex differences during the period of growing up (Petersén & Eeg-Olofsson 1971). Thus a higher frequency appeared among the boys than among the girls up to the age of 8 years, while the reverse was the case after 14 years. It is possible that this reflects a sex difference in the maturity profile of the EEG and is not exclusively a sign of cerebral pathology of some kind. In this connection it may be mentioned that the incidence of "increase of low frequency activity" in boys and girls at different ages showed the same profile as the incidence of idiopathic scoliosis. James (1970) has shown that there is a majority of boys among the cases of infantile idiopathic scoliosis ($\leqslant 3$ years), after which the proportions alter successively until the relation is the opposite during adolescence ($\geqslant 10$ years).

Finally, one wonders if the result of an EEG investigation can be used in some way to assess the probable development of scoliosis in the individual case. It is still not clear what factors cause the scoliosis in some patients to progress so that some form of treatment becomes necessary, while in others it remains unchanged or even regresses.

The number of EEG findings deviating from the strictly normal was not larger in

patients with scoliosis of greater magnitude than in other scoliosis patients. On the other hand, for the variable "paroxysmal activity at rest" the opposite could be observed. This tendency towards a higher frequency of paroxysmal activity in patients with smaller curves cannot be explained by difference of age, since the age distribution was the same in both groups. No tendency to accumulation of particular EEG patterns was found in the cases requiring treatment, but the present material was too small to throw light on this problem. In order to do this, a longitudinal study of a larger group of scoliosis cases would be needed.

To conclude, it should be pointed out, however, that the number of pathological EEG findings in the scoliosis group as a whole was remarkably large. In addition, the type and localization of the various abnormalities gave support for the hypothesis that centrally situated subcortical structures are involved in the pathological process in idiopathic scoliosis.

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