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Electromyography for the investigation and early diagnosis of scoliosis

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Summary. A clinically normal 5 year old child with a family history of scoliosis was studied. Electromyography of the thoracic and lumbar erector spinae muscles and roentgenography of the spine were both done on two separate occasions, six months apart. On the first electromyographic investigation, moderate predominance of activity was found over the left thoracic erector spinae muscles. At that time, spinal roentgenography showed normal results, whereas six months later left thoracolumbar scoliosis was evident. It was concluded that electromyographic investigation is useful for the early diagnosis of scoliosis in school-age children.

L'électromyographie, moyen d'exploration pour le diagnostic précoce de la scoliose

Résumé. On a comparé les données électromyographiques des muscles paravertébraux thoracolombaires et les examens radiographiques de la colonne vertébrale effectués à une distance de six mois les uns des autres chez un enfant de 5 ans, cliniquement normal appartenant à une famille de scoliotiques. Il faut noter, pour les examens paravertébraux thoraciques de gauche, l'apparition d'une activité prédominante, bien que modérée, des muscles paravertébraux lombaires de gauche. L'examen radiographique de la colonne, qui était entièrement négatif six mois auparavant, a révélé un tableau de scoliose thoraco-lombaire gauche six mois après. On peut conclure que l'examen électromyographique est un moyen utile pour le diagnostic précoce de la scoliose chez des enfants en âge scolaire.

Key words : Muscle function – Electromyography – Scoliosis

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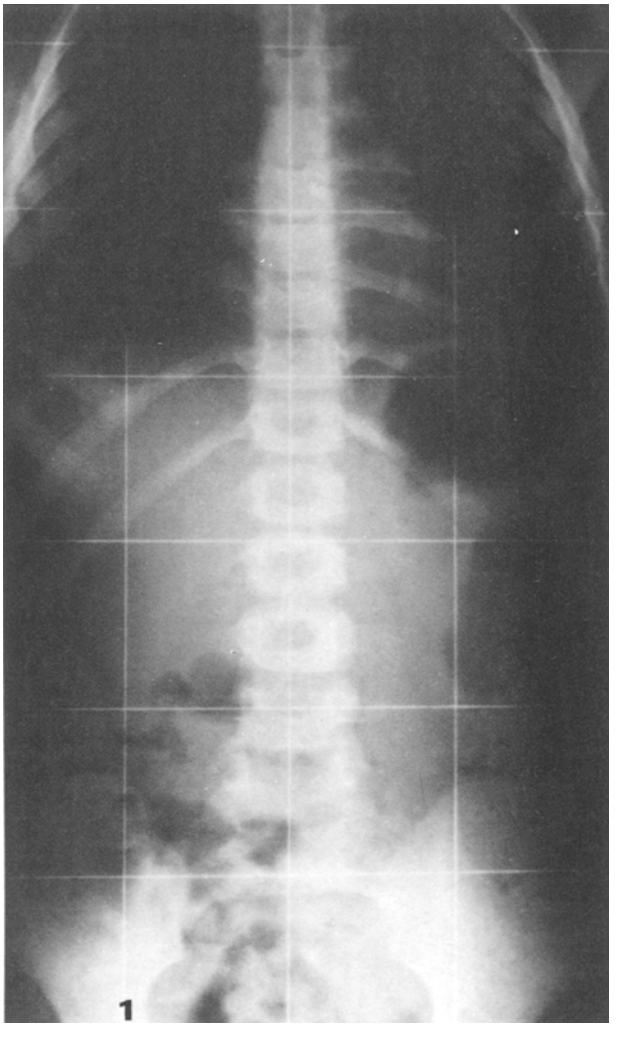


Fig. 1
Initial X-ray of the spine

Première radio de la colonne vertébrale

Many studies have been published on electromyographic (EMG) investigation of the erector spinae muscles in the course of spinal movements and their electrical activity in certain cases of well established idiopathic scoliosis (Morris et al. 1962, Horn 1969, Redford et al. 1969, Jonsson 1970, 1973, Hoogmartens and Basmajian 1976, Valentino et al., 1983 a, b). In the reports by Valentino et al. the authors studied erector spinae function by EMG in three siblings aged 9, 7 and 5 years old. Both parents of these children presented scoliosis. The two eldest siblings (sisters) displayed signs of scoliosis, whereas initial clinical roentgenological study (Fig. 1) gave normal results. Accordingly, we decided to follow up the results of investigation in this child at regular intervals. The above mentioned examinations were repeated six months later and their results are reported and discussed in this paper.

Material and methods

The EMG apparatus used in this study was equipped with a three channel tracer and bipolar electrodes with very sensitive plates. The material used was a prototype (Pariante, Napoli) which is not commercially available. The electrodes were positioned 5 cm apart and lateral to the spinous process of the 7th thoracic and 2nd lumbar vertebrae. Anterior flexion of the trunk (with and without resistance) and posterior extension (with and without resistance) were studied. The EMG data obtained were analyzed according to the method of Basmajian (1978).

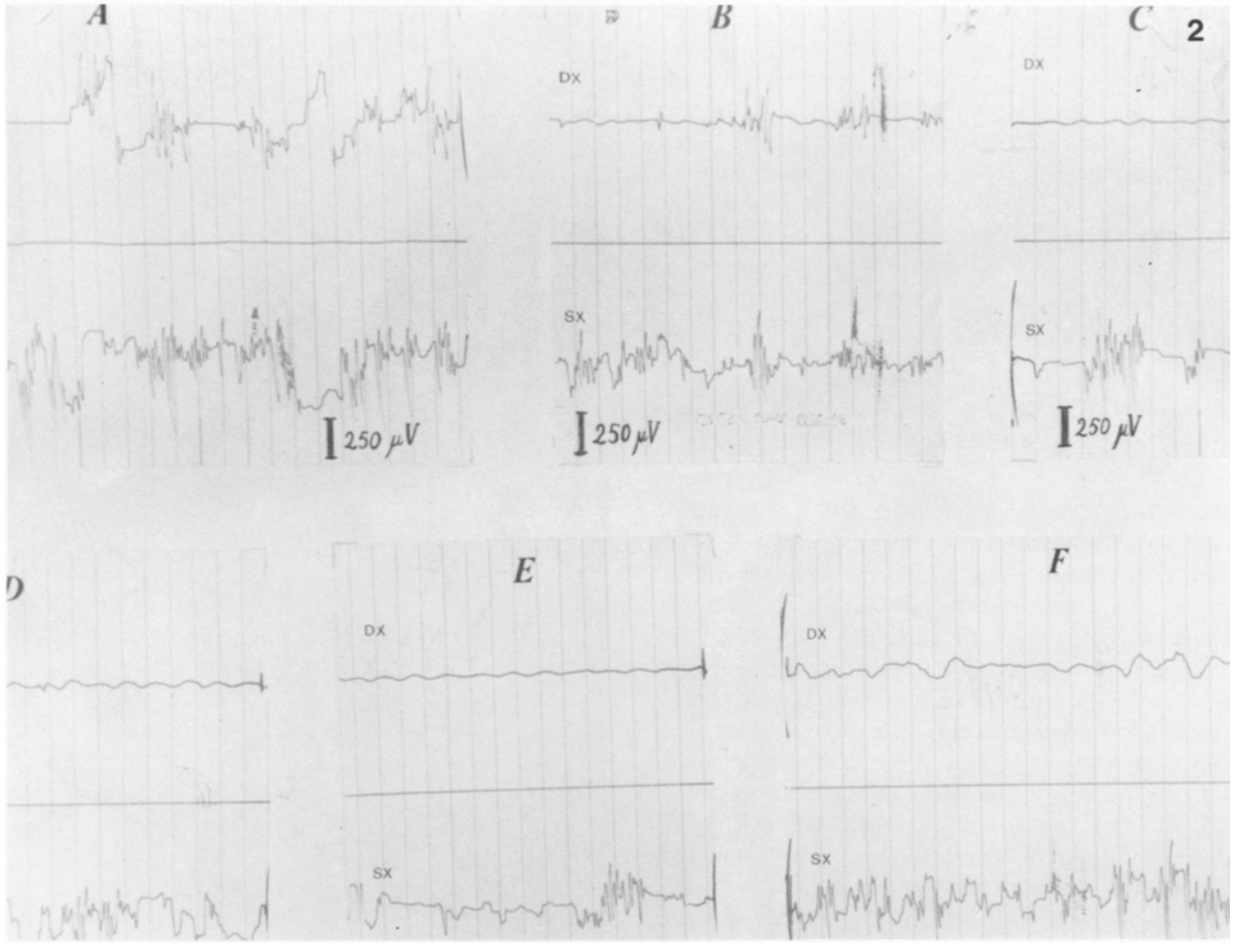


Fig. 2
EMG over the 7th thoracic vertebra during **A** extension of the trunk, **B** extension of the trunk in tilted position, **C** left rotation of the trunk on the pelvis, **D** right rotation of the trunk on the pelvis, **E** lateral left flexion of the trunk on the pelvis, **F** lateral flexion of the trunk on the pelvis

EMG obtenu au niveau de la 7e vertèbre thoracique dans les mouvements de : **A** extension du tronc, **B** extension du tronc avec position inclinée, C rotation à gauche du tronc sur le bassin, **D** rotation à droite du tronc sur le bassin, **E** flexion latérale à gauche du tronc sur le bassin, **F** flexion latérale du tronc sur le bassin

Results

The initial EMG investigation revealed the following results : the recording over the 7th thoracic vertebra (Fig. 2) showed predominant activity of the left erector spinae in all spinal movements examined; recording over the 2nd lumbar vertebra (Fig. 3) demonstrated slightly predominant activity of the right erector spinae. Six months later, the EMG recording made over the 7th thoracic vertebra showed pronounced hyperactivity of the left erector spinae flexion (Fig. 4) and extension (Fig. 5) of the trunk against resistance. The recording made over the 2nd lumbar vertebra (Figs. 6-7) demonstrated a lesser degree of hyperactivity of the left erector spinae, especially during movements against resistance. Spinal X-rays gave the following diagnosis : scoliosis with left-sided convexity accompanied by accentuation of lumbar lordosis; ontomorphia of the trunk and lower limbs (Fig. 8).

Discussion and conclusion

One striking finding of this study was the clear difference between the results of the two EMG investigations done six months apart. These differences involved the recordings made over the 7th thoracic and 2nd lumbar vertebrae. Furthermore, the initial EMG results, showing typical signs of established scoliosis, were in clear contrast to the initial results of spinal X-rays, showing typically no modifications of the spine.

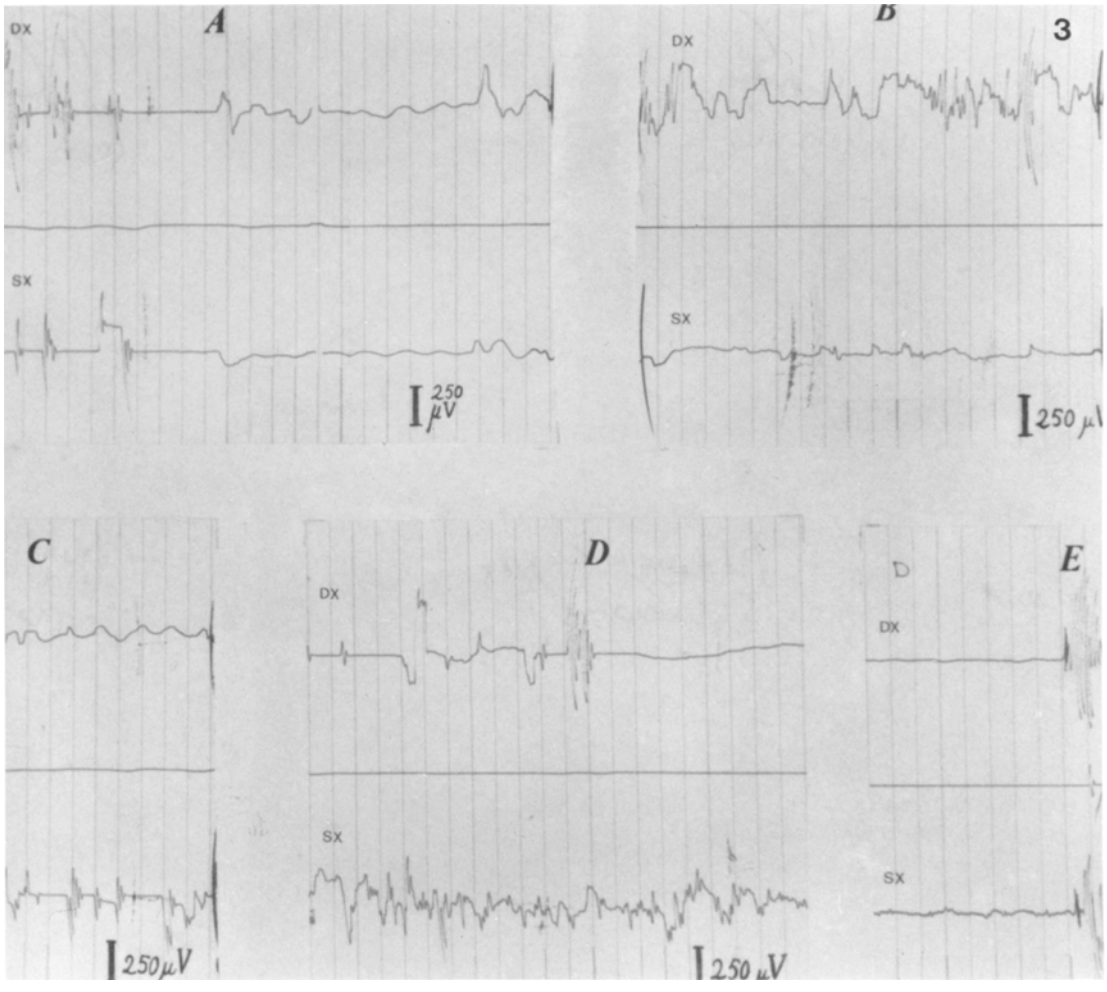
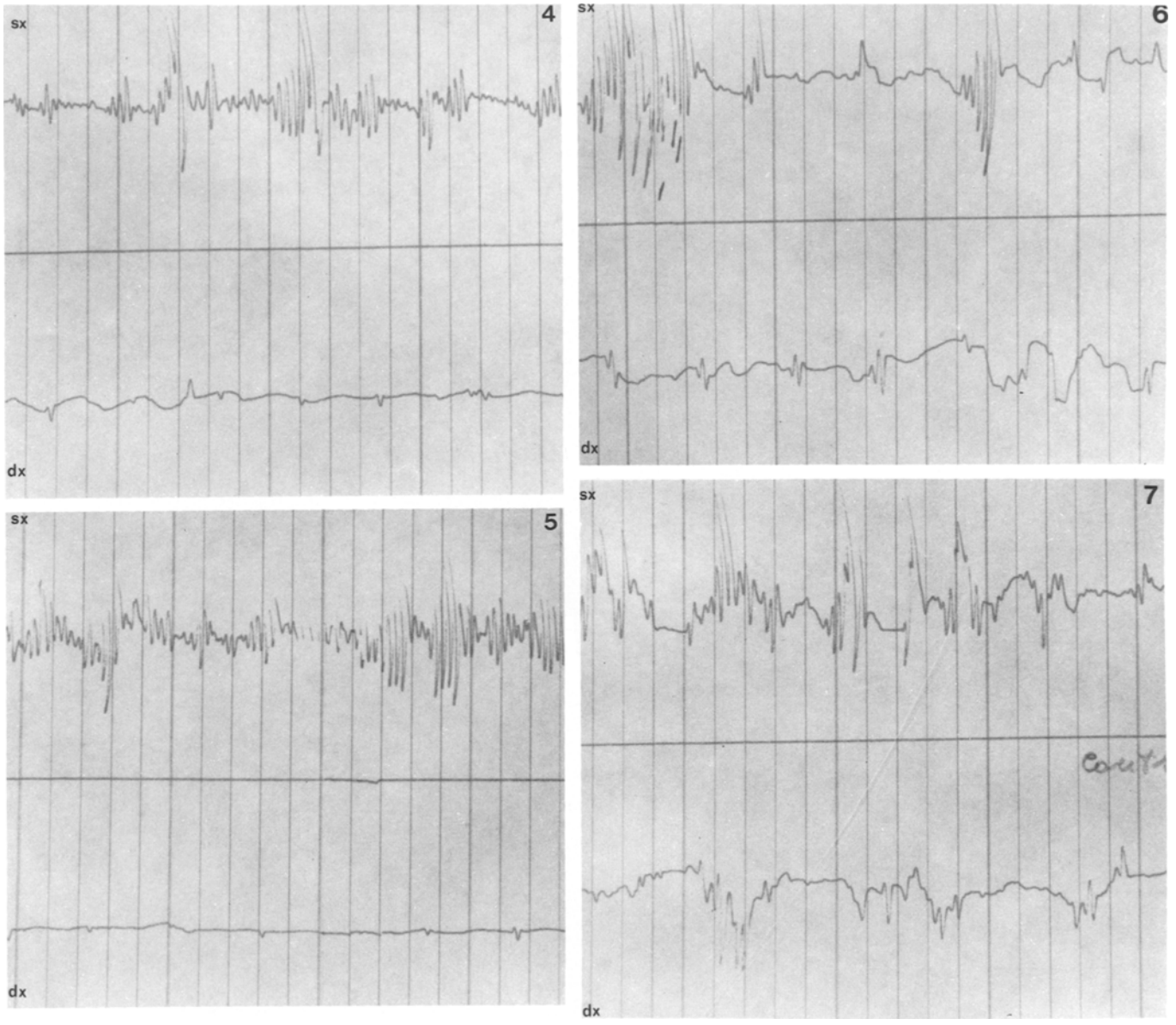


Fig. 3
EMG : **A** over the 2nd lumbar vertebra during anterior flexion and **B** posterior extension of the trunk; **C** over the abdominal muscles during anterior flexion of trunk, **D** during posterior extension of trunk and **E** during tilting

EMG obtenu en **A** au niveau de la deuxième vertèbre lombaire dans le mouvement de flexion antérieure du tronc et **B** d'extension postérieure du tronc; **C** au niveau des muscles abdominaux dans le mouvement de flexion antérieure du tronc; **D** dans le mouvement d'extension postérieure du tronc et **E** dans le mouvement d'inclinaison



Figs. 4-7

4 EMG over the 7th thoracic vertebra during flexion of the trunk against resistance. **5** EMG over the 7th thoracic vertebra during extension of the trunk against resistance. **6** EMG over the 2nd lumbar vertebra during flexion of the trunk against resistance. **7** EMG over the 2nd lumbar vertebra during extension of the trunk against resistance

4 EMG au niveau de la 7^{e} vertèbre thoracique dans le mouvement de flexion du tronc contre résistance. **5** EMG au niveau de la 7^{e} vertèbre thoracique dans le mouvement d'extension du tronc contre la résistance. **6** EMG au niveau de la 2^{e} vertèbre lombaire dans le mouvement de flexion du tronc contre résistance. **7** EMG au niveau de la 2^{e} vertèbre lombaire dans le mouvement d'extension du tronc contre résistance

Taking into account theses results, we calculated that the child would not only develop scoliosis but that the future deformity would show left-sided convexity and mainly involve the thoracic region. Indeed, the second EMG investigation done 6 months later demonstrated far more pronounced hyperactivity of the left erector spinae in the area of the 7th thoracic vertebra and an increase in activity of the left lumbar erector spinae, whereas on the initial EMG the right lumbar erector spinae showed slight hyperactivity. This progression of the EMG results was in agreement with the second set of X-ray findings showing thoracic curvature with left-sided convexity and to a lesser extant scoliotic curvature of the lumbar spine. It should also be borne in mind that this

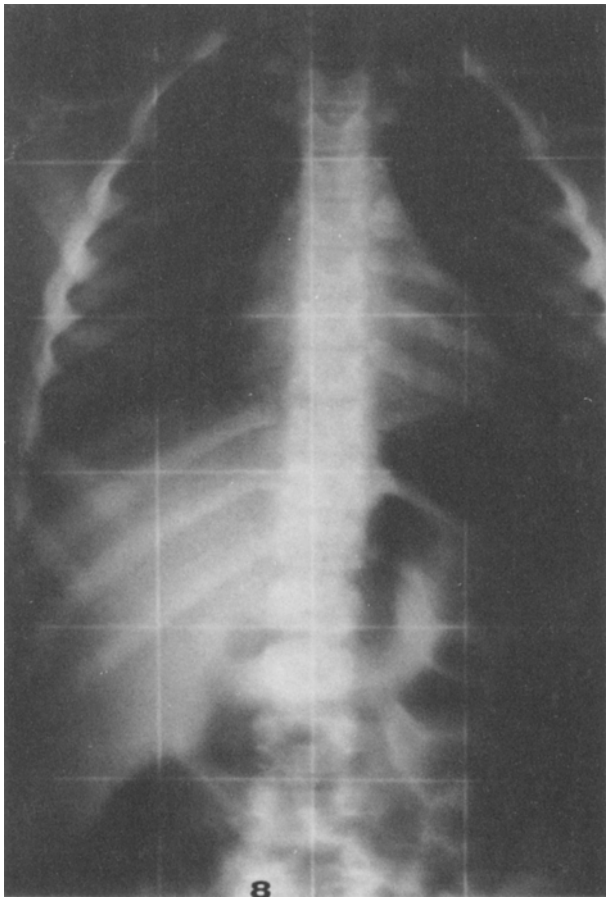


Fig. 8
X-ray of the spine 6 months later.

Radio de la colonne vertébrale six mois après

5 year old child has a family history of scoliosis. It is conceivable that constitutional factors inherited by the child played a role in the development of the deformity. Indeed the child's sisters (9 an 7 years old) both presented thoracic scoliosis with left-sided convexity and dysmetria of the lower limbs (0.5 and 1.0 cm, respectively). It would be of interest to follow up the child described in this paper for the eventual development of dysmetria resulting from the spinal deformity.

In conclusion, EMG is a useful procedure for diagnosis of scoliosis which is not yet visible on spinal X-rays. EMG may thus be appropriate for the early diagnosis of scoliosis in schoolage children. This conclusion is in agreement with recent findings reported by Dixon (1983). According to this author, mass X-ray screening for prevention of scoliosis in schoolage children is inappropriate since the incidence of radiologically identifiable scoliotic alterations of the spine is far too low in this population.

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