Familial infantile scoliosis associated with bilateral paralysis of conjugate gaze

MENACHEM GRANAT\textsuperscript{1}, ZVI FRIEDMAN, AND TAMAR ALONI

From the Genetic Unit and Department of Ophthalmology, Rothschild University Hospital, Faculty of Medicine, Technion, Haifa, Israel

SUMMARY A family with two sibs suffering from idiopathic infantile scoliosis associated with bilateral paralysis of conjugate gaze is reported. Although the parental consanguinity and the involvement of patients of both sexes in this family are suggestive of an autosomal recessive mode of inheritance, a dominant or multifactorial pattern remains a possibility.

The familial association of idiopathic scoliosis and conjugate gaze paralysis has been reported in three families (Dretakis and Kondoyannis, 1974; Sharpe \textit{et al.}, 1975). Autosomal recessive inheritance has been suggested. We report two affected sibs in a consanguineous family where the skeletal and ocular manifestations appeared relatively early.

Case reports

A couple was referred for genetic counselling because their two children were affected with the same combination of skeletal and ocular abnormalities. The couple were double first cousins (Fig. 1).

The mother had given birth to another child who died 40 hours after birth and was reported to have had 'spina bifida', but no further details were available. A fourth gestation ended in a late spontaneous abortion.

The family history disclosed two maternal cousins, an 8-year-old girl (AS) and a 5\textfrac{1}{2}-year-old boy (AA), suffering from moderate structural scoliosis of the thoracic spine, first noticed at the ages of 6\textfrac{1}{2} and 4 years, respectively (Fig. 1).

CASE 1 (FL)

A 4\textfrac{1}{2}-year-old girl presented with obvious deformities of the thoracolumbar spine and some impairment of her eye movements. She was born after an uncomplicated term pregnancy, weighing 3500 g at birth. A suspicion of 'strabismus' was initially noted by the parents at the age of 2 weeks. The skeletal defect was noticed at about 6 months of age when the child...
Familial infantile scoliosis associated with bilateral paralysis of conjugate gaze

attempted to sit. Physical findings were consistent with infantile scoliosis of the thoracolumbar spine with no underlying abnormalities of the vertebral body. Her head was markedly tilted to the left. X-ray of the cervical spine was normal (Fig. 2). There was no shortening of the neck muscles. A detailed re-examination at the age of 4½ years disclosed severe progressive kyphoscoliosis (convex to left, angle 43°) in spite of the continuous use of a Milwaukee brace (Fig. 3). The head tilt seemed to improve spontaneously.

The eye examination showed visual acuity of 3/7 in each eye. The anterior segments and ocular fundi were normal. Refraction under cycloplegia showed emmetropia. There was paralysis of horizontal movements, both saccadic and slow pursuit, to both sides. Optokinetic nystagmus could not be elicited. Vestibular nystagmus, both rotational and that induced by the caloric test using ice cold water, was absent on both sides.

There was slight convergence on attempted dextroversion and levoversion. Convergence, as well as upward and downward conjugate movements, were all normal. The pupils were equal and reacted to light and to near stimuli. Intermittent unilateral blinking movements could be seen from time to time. No abnormal synkinesis could be detected.

Mental development was normal for age. Dermatoglyphic analysis did not disclose unusual findings. Neurological examination did not reveal any additional abnormalities.

CASE 2 (FS)

A 2½-year-old brother of case 1 was referred to the eye clinic with the suspicion of a similar impairment

Fig. 2 X-ray of cervical spine showing tilt to the left with no structural abnormalities (case 1).

Fig. 3 X-ray of thoracolumbar spine showing severe kyphoscoliosis (case 1).

Fig. 4 X-ray of thoracolumbar spine showing severe kyphoscoliosis (case 2).
of ocular movements. He was born after an uncomplicated term pregnancy, weighing 3750 g. The parents suspected impaired ocular movements and a skeletal deformity at the age of one year.

The scoliosis of the thoracolumbar spine (Fig. 4) was less marked than that of his sister (convex to left, angle 130°), but severe enough to necessitate the use of a Milwaukee brace. There was also tilting of the head to the left.

The eye examination showed a visual acuity of 4/7 in each eye. The anterior segments and ocular fundi were normal in both eyes. Refraction under cycloplegia showed emmetropia.

Again, there was paralysis of horizontal saccadic and slow pursuit movements to both sides. Optokinetic nystagmus and vestibular nystagmus, both rotational and that induced by the caloric test using ice cold water, were absent on both sides. There was slight convergence on attempted dextroversion and levoversion. Convergence, as well as upward and downward conjugate movements, were all normal.

The pupils were equal and reacted to light and to near stimuli. Intermittent unilateral blink could occasionally be seen. No abnormal synkinesis could be detected. The ophthalmological findings are illustrated in Fig. 5. Neurological examination was otherwise normal.

Mental development appeared average. Dermatoglyphic analysis did not show unusual findings.

Physical and x-ray examination of the mother showed a mild non-functional thoracic scoliosis which had not been noted previously.

### Discussion

Descending pathways for horizontal saccadic and smooth pursuit movements originate in the frontal and the occipital cortex, respectively, aggregate in the midbrain reticular formation, decussate in the lower midbrain and upper pons, and descend to the pontine paramedian reticular formation (PPRF) near the nucleus of the abducens nerve (Gay et al., 1974; Duane, 1976).

Bilateral paralysis of conjugate gaze involving both the frontomesencephalic saccadic and the occipitomesencephalic smooth pursuit systems may be caused by lesions extending between the upper brain stem region, where these two systems converge anatomically, and the PPRF.
Familial infantile scoliosis associated with bilateral paralysis of conjugate gaze

Since in both cases described in this report there was bilateral paralysis of both saccadic and slow pursuit horizontal movements and absence of both the vestibulo-ocular nystagmus and the oculoocephalic response (doll's eye movement), it is clear that the lesion in these cases was localised in the pons at the level of the PPRF. This is supported by the fact that the vertical conjugate movements and the convergence, the pathways of which descend and synapse with the oculomotor nuclei, were all intact.

Lesions at upper areas spare the vestibulo-ocular nystagmus and the oculoocephalic reflexes, whereas conjugate vertical movements and convergence may be affected.

Congenital bilateral paralysis of conjugate gaze may be sporadic (Zweifach et al., 1969) or familial (Dretakis and Kondoyannis, 1974; Sharpe et al., 1975). It may be isolated (Zweifach et al., 1969) or associated with facial palsy and other anomalies, such as are found in Möbius's syndrome.

Only three families have been previously reported where the association of bilateral conjugate gaze paralysis and idiopathic scoliosis was encountered (Dretakis and Kondoyannis, 1974; Sharpe et al., 1975). The Table summarises the clinical features found in our cases as well as in each affected sib in the families reported before (Dretakis and Kondoyannis, 1974; Sharpe et al., 1975). In the family reported here, the oculomotor manifestations were virtually identical with those described in these reports, apart from the absence of nystagmus. This may denote a similar supranuclear involvement in the pons. Our family is unique in the very early onset of scoliosis, which was therefore of the infantile type. The skeletal deformity in our cases also seems to be more severe.

Dretakis and Kondoyannis (1974) suggested that absence of postural reflexes because of neurological damage could cause the scoliosis associated with the brain stem lesions.

Sharpe et al. (1975) reported a family in which four sibs had bilateral paralysis of lateral gaze, pendular nystagmus, and progressive scoliosis. In all sibs, lateral gaze paralysis was not present at birth, but appeared during childhood or early adolescence. The electromyogram suggested a supranuclear lesion. Recessive autosomal inheritance was suggested by the authors, as indicated by absence of these abnormalities in three antecedent generations and involvement of patients of both sexes.

The close parental consanguinity in the family reported here seems to substantiate an autosomal

| Table  Clinical data on 4 families affected by conjugate gaze paralysis and idiopathic scoliosis |
|---------------------------------|-----------------|-----------------|-----------------|-----------------|
| **Sex**                         | **Family 1** (Dretakis and Kondoyannis, 1974) | **Family 2** (Dretakis and Kondoyannis, 1974) | **Family 3** (Sharpe et al., 1975) | **Family 4** (This report) |
| **Ocular manifestations**       | M | M | F | M | M | F | M | F | M |
| Age when first noticed (y)      | + | + | + | + | + | + | + | + | + |
| Lateral gaze paralysis          | + | + | + | + | + | + | + | + | + |
| Vestibular stimulation         | + | + | + | + | + | + | + | + | + |
| Subjective visual field         | + | + | + | + | + | + | + | + | + |
| Facial contractions             | + | + | + | + | + | + | + | + | + |
| Head oscillations               | + | + | + | + | + | + | + | + | + |
| **Skeletal manifestations**     | M | M | F | M | M | F | M | F | M |
| Age when first noticed (y)      | + | + | + | + | + | + | + | + | + |
| Lower thoracic curve to right   | + | + | + | + | + | + | + | + | + |
| Associated abnormalities        | + | + | + | + | + | + | + | + | + |
| Parental consanguinity          | + | + | + | + | + | + | + | + | + |
| Other family members affected   | + | + | + | + | + | + | + | + | + |
| Parent's country of origin      | Greece | Greece | China | Israel |
| No of unaffected sibs           | 4 | 0 | 6 | 0 |
recessive mode of inheritance, as suggested in the aforementioned report (Sharpe et al., 1975). However, the presence of two maternal cousins with early onset idiopathic scoliosis, born to unrelated parents, and the mild structural scoliosis detected in the mother cast doubt on this assumption. Autosomal dominant or multifactorial inheritance, as usually implicated in familial idiopathic scoliosis (Roseborough and Wynne-Davies, 1973), may be operative in this family also. The ocular findings could be a coincidental genetic disease transmitted via a different gene. The present data are not sufficient to determine the pathogenesis of this syndrome. Additional neuro-ophthalmological surveys of patients with idiopathic infantile scoliosis may help to clarify the question of whether a syndrome of conjugate gaze paralysis and congenital scoliosis does exist, or whether the few families reported with this combination, including the one in this report, merely represent coincidences.

References

Requests for reprints to Dr M. Granat, Department of Obstetrics and Gynecology, Hadassah University Hospital, The Hebrew University, Kiryat Hadassah, Jerusalem, Israel.