IDIOPATHIC SCOLIOSIS : A COMPLEX MODEL OF NEUROMUSCULAR GROWTH DISTURBANCES. W. Lokietek M.D., G. Marechal M.D., L. Plaghki M.D., G. Ferriere M.D., Ph. Knoops M.D. UCL-BELGIUM.

Investigations on idiopathic scoliosis can be interpreted on the basis of at least 4 major interacting factors : GROWTH-Segmental spinal DEFORMATION-Segmental spinal IMMOBILIZATION - Disturbances in the neural AFFERENCES. The contribution of each to the "inducing mechanism" of idiopathic scoliosis has been studied using four experimental models in 50 dogs. In group A, deafferentation was performed by a dorsal rhizotomy (extramedullar and preganglionic) on 5 consecutive thoracic levels in growing (n=22) and adult dogs (n=4). In group B, segmental spinal deformation was obtained by a curved metallic plate inserted through a two level thoracotomy and fixed to 8 vertebral bodies in young (n=4) and adult (n=4) dogs with no injury to the paravertebral muscles. In group C, segmental spinal immobilization was obtained by a straight rigid plate fixed to 8 vertebral bodies also through a two level thoracotomy in adult dogs (n=4). In group D, a multilevel laminectomy was performed in young (n=4) and adult (n=4) animals. The dorsal roots were approached surgically on five consecutive levels but were not severed. Animals of group A developped scoliosis reaching up to 50° for young dogs but only a mild curvature appeared in adults (less than 10°). Electromyography of the superficial and deep paravertebral muscles was performed on both sides of the spine before surgery, 4 weeks later and at sacrifice (3 to 6 months post-surgery). Denervation and reinervation were detected already at 4 weeks post-op. Histological sections of the spinal chord (transverse and frontal) were performed at the apex and on both extremities of the deafferented segment. Three months post-rhizotomy demyelinisation was only found in the fasciculus cuneatus of group A. There were no obvious damages to the anterior roots that could be ascribed to the surgery. The number of motoneurons was reduced in the homolateral anterior horn exclusively in young animals. Chromatolysis of motoneurons without demyelinisation was already observed at 7 days post-rhizotomy (n=4).

muscles biopsies trom both sides were examined by histochemical methods (ATPase pH 9.4, NADH and PAS) and by biochemical measurement : soluble (SO) and sedimentable (SE) protein concentration, lactico-deshydrogenase (LDH) and isocitricodeshydrogenase activities (ICDH).

In group A, type I fibres are clearly divided into extralarge (PAS -) fibres and moderately large (PAS +++) fibres. All type II fibres were NADH (-) PAS (+). LDH activity was higher on the convex side and ICDH lower for the young scoliotic animals, whilst both LDH and ICDH were reduced in adults. For group B marked hypotrophy of type II fibres was observed on the -.oncave side. Both LDH and ICDH activities were ,ignificantly increased on the convex side. In group C similar hypotrophy was present on both sides; LDH and ICDH activities reduced on either sides. In group D, histochemical finding were similar qualitavely to group A. However LDH and ICDH activities were reduced in young dogs whereas only ICDH was reduced in adult. Histochemical and biochemical studies were similarly performed on muscles of 22 idiopathic scoliotic patients (mean Cobb's angle : 66° +/- 4 S.E.M.). On the convex side : (SE) protein, LDH and ICDH activities were found to be marketely higher whereas reduction of type II fibres and principally type IlEfibres was observed. On the concave side the relative muscle hypotrophy can thus be related to "immobilization" factors in a "shortened" position during growth. A better muscular maturation on the convex side does not imply that convex muscles have a better enzymatic machinery. A change in the proportion of type IIB fibres may suggest a mechanism of "neuronal collateralisation" as observed in the reactions of 'denervation - reinervation" in the group A experiment.

Jonclusion : changes observed in muscles of scoliotic patients are primarily due to immobilization of the spine in a curved configuration during growth.

A imbalance in the sensory afferents to the motoneurons affects the mechanism of neuromuscular maturation.