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GROWTH PROBLEMS IN CERVICAL INJURIES

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INJURY to the vertebral column with resulting cord damage is relatively uncommon in the young adolescent, and when it does occur one has to take into consideration the problems of continuing growth upon the subsequent behaviour of the fractured vertebral column.

Normal growth rate of a child slows at a steady rate after the age of 3 years until the spurt of growth occurring at puberty (Tanner, 1970). At puberty a very considerable change in growth occurs; for a year or more the velocity of growth approximately doubles; the child is likely to be growing at a rate he last experienced at about the age of 2 years.

We have also noted that in the young adolescent spontaneous fusion at the site of vertebral fracture is far more less likely to occur than in the corresponding fracture in the adult population. In our series of cervical fractures in adults, we have found that between 6 and 10 per cent. require stabilisation; the remaining 90 to 94 per cent. stabilising normally by bony fusion (Bedbrook, 1969).

The problem of continuing growth in the young adolescent, with consequent vertebral column deformity, and deterioration in the neurological state, was brought to our attention some years ago by our experience in a boy aged 11 years with a cervical fracture and incomplete tetraplegia, whom we followed until his death some 7 years later.

Our experience in this case has led us to consider surgical intervention in young adolescents with similar cervical fractures with incomplete tetraplegia to prevent recurrence of this tragic course of events.

Case 1. J. L. A boy aged 11 years admitted in December 1961 with incomplete tetraplegia resulting from a diving accident into a swimming pool. X-rays showed a flexion injury to the vertebral bodies of C3, C4 and C5. He was treated by conservative management with skull caliper traction and made a good recovery with good power in both lower limbs, better on the right side. The right upper limb also had quite good power, and he recovered to the stage of being ambulant with calipers and elbow crutches.

By September 1963 his neurological status was much the same; he walked well with an incomplete Brown-Sequard lesion, there being good motor power in the right lower limb, spinothalamic function was excellent in the left lower limb but not so good in the right, i.e. he had an incomplete Brown-Sequard lesion. X-rays of the cervical spine now began to show signs of a kyphotic deformity commencing in the cervical spine.

In February 1965 it was noted that his walking was deteriorating and both of his lower limbs increasing in spasm. There was no change in the right upper limb, but the left upper limb had become a little more spastic. At this stage a suggestion was made to the parents that further surgical intervention was indicated, but this was refused.

In January 1966 he had become worse with loss of function in the lower limbs and increased spasm in both upper limbs, and again surgery was advised after discussion with Professor Hodgson of Hong Kong, but again was refused by the parents.

Fig. 1.—J. L. aged 11 years on admission.

Fig. 2.—J. L. Two years after injury, aged 13 years.

FIG. 3

J. L. Showing progressive deformity over 3 years. Due to asymmetry of growth of vertebral body?

At this time deterioration had occurred to a marked degree and the patient was no longer ambulant; he could only sit with difficulty in his wheelchair with extreme spasm. During this period of increasing spasm various procedures were undertaken to relieve this with lengthening of tendo achilles, obturator neurectomy and later, intrathecal phenol was inserted with some relief.

In 1967 eventually operation was agreed to by the parents, and cervical laminectomy was performed, but without any improvement in his neurological state.

The patient died from a terminal bronchopneumonia in December 1968, having been completely tetraplegic below the fifth cervical dermatome and myotome for the preceding months.

FIG. 4

U. L. Post-mortem specimen showing gross wedging of vertebral bodies C3-4 with deformation of neural canal.

FIG. 5

Section of spinal cord at fifth cervical level.

It will be seen from the X-ray appearances that there has been progressive deterioration from the initial state seen in 1961 to a gross deformity of the cervical spine.

Post-mortem examination sections of the vertebral column showed well preserved disc spaces and no evidence of any anterior callus formation showing an attempt at spontaneous fusion. Sections of the spinal cord taken at the C5 level showed a difficulty in distinguishing between the grey and the white matter, there was thickening of the covering meninges; some anterior horn cells were recognisable, but on the left half of the cord there was shown disappearance of nerve tissue and presence of irregular spaces. Section through the cord at T1 level showed loss of fibres in the descending tracts, especially the cortico-spinal. Again, distinction between the white and grey matter was very poor. Section through the cord at the first lumbar segment showed similar condition to that at the first thoracic level.

The conclusion was that there was marked degeneration of both ascending and descending tracts following cervical cord trauma initially, with subsequent deformation of vertebral column due to continuing growth.

Following our experience with this boy, we thought it wise to look for evidence of skeletal maturity in any subsequent adolescents who came under our care, and to try and avert any similar deterioration.

Case 2. P. W. This was a 13-year-old schoolgirl who was thrown off a trampoline in May 1968 and became incompletely tetraplegic. X-rays showed there to be a fracture of the fifth and sixth cervical vertebrae, and she was treated conservatively with Crutchfield calipers with subsequent improvement following quite quickly. She progressed to the stage of having an incomplete Brown-Sequard lesion and being ambulant with a below-knee caliper on the left side and incomplete recovery in the hands in the eighth cervical and first thoracic segments.

By October 1968, *i.e.* 5 months after her injury, she proved to be still unstable and with no evidence of callus formation on X-ray, and as she was still very immature and had not yet reached her major pubertal spurt of growth, anterior cervical fusion was undertaken on 21 October 1968.

Her condition remained good and she did not deteriorate neurologically, and her cervical spine remained in good alignment with no deterioration or deformity. The last X-ray of the cervical spine 16 months after her cervical spine fusion showed there to be sound consolidation of the graft with good alignment of her cervical spine. This girl is now working as a clerical assistant and driving her own motor vehicle. She still has difficulties with her reflex bladder on occasions.

Case 3. A. Y. A boy aged 17 with fractures of both fifth and sixth cervical vertebrae. He presented at first with incomplete tetraplegia with normal sensation terminating below C7 but with deep sensation and position sense present throughout the lower limbs. He had no motor power in either lower limb and motor power in the upper limbs was absent below the fifth cervical myotome.

He was treated by conservative management with skull traction and made a good recovery, eventually becoming ambulant with the aid of crutches and below-knee calipers, but again showed no evidence of spontaneous fusion at the site of his fracture some 4 months later. This boy, though aged nearly 17, was very immature with small genitalia, no beard, and cervical fusion was carried out as it was felt that there was a considerable period of growth still ahead of him.

Cervical fusion was accordingly carried out with an anterior strut being placed between C4 and C6, and his condition later remained without any further deterioration,

and no deformation of his cervical spine occurred despite some absorption of the graft at its lower end. He is now working as a carpenter in our Paraplegic Workshop, ambulant, but with considerable spasticity.

Fig. 6.—P. W. Aged 13 years.
Fracture of fifth and sixth
cervical vertebral bodies.

Fig. 7.—P. W. Displacement
occurring 5 months after in-
jury with no sign of union.
Anterior cervical fusion per-
formed at 5 months.

FIG. 6

FIG. 7

FIG. 8

Fig. 8.—P. W. Sixteen months after fusion and 21 months after injury. Union occurred — no further deformation.

Fig. 9.—A. Y. X-ray on admission showing fracture of Cr, C5 and C6, cervical vertebrae.

Fig. 10.—A. Y. Two and a half years after injury.

Case 4. K. B. Aged 15. This aboriginal boy was admitted in December 1970 with incomplete tetraplegia resulting from a fracture of the third, fourth, fifth and sixth cervical vertebral bodies following a diving accident.

On admission he had complete motor loss below the fifth cervical segment, but had incomplete sensory loss with sharp sensation, vibration sense, and deep pressure sense throughout the trunk and in the lower limbs.

Fig. 11.—K. B. Ten weeks post-injury. No evidence of anterior ossification or maturity.

Fig. 12.—K. B. Eighteen months after cervical fusion. Solid union present-extension view.

He was treated by conservative management with skull caliper traction and made a good recovery, but again at 10 weeks showed no evidence of callus formation at all and the beginning of a kyphotic deformity at the mid-cervical spine. This boy was pre-pubertal and accordingly cervical fusion was undertaken in March 1971. He proceeded to a complete recovery with no detectable motor weakness in either upper or lower limbs at last review, and no further deformation occurring in the cervical spine.

In the light of our experience with Case 1, we have then proceeded to surgery and stabilisation by anterior cervical fusion in three subsequent cases coming

under our care in which we suspected that the growth factor could obtain and could produce further deformation in the vertebral column with regression in the neurological state.

In cases 3, 4 and 5, overall growth of the patient continued with onset of puberty, but no further deformation occurred in the stabilised area of the cervical spine. In other words, the grafted area has not grown, nor would be expected to (Winter, 1970). We consider then there is a place for consideration of early

FIG. 13

K. B. Eighteen months after cervical fusion. Flexion view of spine—good fusion present. No deformity.

stabilisation of the cervical spine in young adolescents where further deformation of the vertebral column may occur with growth in subsequent years. In each of the last three cases presented, though considerable skeletal and vertebral growth occurred in the subsequent follow-up period, no deformation of the cervical spine occurred and there was no neurological deterioration.

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