SURGERY OF THE HAND IN INFANTS WITH CEREBRAL PALSY*

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SUMMARY

Normally a picture or image of the body becomes established in the brain so that eventually activities such as walking, etc., become possible without conscious afferent information. If corrective limb surgery is performed on cerebral-palsy patients as soon after birth as diagnosis and assessment permit, afferents which reach the brain establish an image of the corrected rather than of the deformed body, and natural and unthinking use of the limb is more likely to become established.

A surgical procedure for correction of the common spastic hand and forearm in cerebral palsy which is held flexed at the elbow, pronated at the forearm, flexed and ulnar-deviated at the wrist and with tightly clenched fingers which are closed over the firmly flexed and adducted thumb, is described.

Case reports of 8 infants between the ages of 12 - 18 months operated upon by this procedure and results obtained after a follow-up of 7 - 10 years are presented.

It is generally agreed that the mainstay of treatment in cerebral palsy is by re-education—physical, occupational, speech and drug therapy.[1-4] Orthopaedic surgery is usually considered as an adjunct to therapy[5-7] and is indicated only for its value in preventing and correcting deformities due to muscle imbalance.[8-11] Recently, however, surgery has been recognized as a more rapid and successful procedure than long-continued postural training and stretching.[12,13]

The aim of this paper is to present evidence that where it is possible, and where surgery is indicated, it is rational and advantageous to perform corrective limb surgery as soon after birth as diagnosis and assessment permits.

THE RATIONALE OF EARLY SURGERY

That the brain has a mental picture or image of the body (a sort of 'brain's body image'), is not only an extremely useful concept, but one which has much evidence to support it.[10]

This 'brain's body image' is compiled from the information which reaches the brain in the form of the afferent sensory stimuli from the whole body. Exteroceptive afferents supply information on appearance, voice, smell, skin sensation, etc. Proprioceptive afferents supply information on body strength, joint position, stamina, agility, etc., while enteroceptive afferents supply the information from the viscera, such as appetite, etc.

Commencing as soon after birth as the first sensory impressions are received, the brain's body image becomes more and more firmly established until the brain is so familiar with the size, shape, weight, length, height, strength, etc. of the body, that fully voluntary activities are possible eventually without conscious thought.

All this is manifest in the gradual replacement of the infant's first hesitant exploration of itself and its environment by an increasing agility, manual dexterity and physical self-confidence which improve with practice (or the firmer establishment of the body image in the brain), so that eventually conscious afferent information is no longer necessary for even such voluntary activities as walking, playing the piano, etc.

If corrective limb surgery is performed as soon after birth as possible, the afferents from the corrected body may reach the brain early enough for the image to become established.[11]

Other evidence in support of this idea, is the persistent tilt of the head which results if surgical freeing of a torticollis is too long delayed; and the commonly recorded experience after surgical correction of the hand in cerebral palsy, where the patient, in spite of having the voluntary ability to open and close the hand, never acquires the natural unthinking use of the limb,[14,15] nor the unconscious function which is normal in the daily activities of life.[10,16-19]

MATERIAL

This is an initial report on a surgical procedure and the follow-up results over 7 - 10 years on 8 children with cerebral palsy aged 12 - 18 months, each of whom had an established congenital hemiplegia with spasticity.

In each child in this series, the hand on the affected side was held flexed at the elbow, pronated at the forearm, flexed and ulnar deviated at the wrist, and with tightly clenched fingers over the thumb, which was firmly flexed and adducted into the palm. This is the commonest upper limb deformity in spastic hemiplegia.[11,20]

OPERATIVE PROCEDURES

The operative procedure in each child was identical and was performed through 3 separate incisions. Although surgery in cerebral palsy must be carefully adapted to the needs of the patient,[21] when a common and identical pattern of spasticity is present, as was the case in this series, a common plan of procedure to overcome the disability becomes possible.

The first incision was in the palmar crease nearest the thumb, the tendons of the adductor pollicis and the thenar muscles were cut, and the first dorsal interosseous muscle was stripped from the first metacarpal, so that the thumb was freed from its tightly flexed and adducted position in the hand.[7,22]

The second incision was longitudinally over the dorsal surface of the lower radius, and a tenodesis of the extensor carpi radialis longus, the extensor carpi radialis brevis and the abductor pollicis longus tendons was performed on the radius, to hold the wrist in its position of function of slight dorsiflexion and radial deviation, with the thumb metacarpal in slight abduction.

The tenodesis was performed as follows: the tendons were divided from their muscle bellies as far proximally as was possible. A drill hole was made transversely through the radius about 2·5 cm above the wrist joint. The tendons were passed through this drill hole in the radius in opposite directions, and after the correct degree of dorsiflexion and radial deviation of the wrist and abduction of the thumb was obtained, the tendons were sutured to each other using

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stainless steel wire. Any excess of tendon was excised and discarded.

The third incision was made longitudinally over the ventral surface of the lower radius and tenotomies of the flexor carpi radialis, flexor carpi ulnaris, palmaris longus and all 4 tendons of flexor digitorum sublimus were performed. The tendons of flexor pollicis longus and flexor digitorum profundus were then lengthened as follows:[23] Each tendon was split throughout its length, over as long a distance as was possible, the tendons were divided and a Z-plasty was performed, the tendons being resutured with stainless steel wire so that the fingers were held in their positions of maximum function.

CASE REPORTS

Case 1

B.A., a boy aged 13 months. Birth was difficult and he was cyanosed and distressed. He had an obvious right-sided spastic hemiplegia. Surgery was performed in October 1959.

Result (1971): Although he is predominantly left-handed, he uses the right hand unconsciously when it is needed for lifting large objects and when he is eating (Figs. 1 - 4).

Case 2

R. J., a boy aged 17 months. His birth was normal, but he was severely jaundiced due to Rh-incompatibility. He had an obvious left-sided spastic hemiplegia. Surgery was performed in May 1960.

Result (1971): He uses the left hand spontaneously and unthinkingly. He uses both hands to catch a ball and in dressing and eating.

Case 3

P.A., a girl aged 16 months. Her birth was normal, but she had an obvious right-sided spastic hemiplegia and minimal spasticity of the left lower limb. Surgery was performed in July 1960.

Result (1971): She uses both hands in eating, playing, catching a ball and tying her shoelaces.

Case 4

P. F., a boy aged 12 months. His birth was a difficult forceps delivery and he was cyanosed and distressed. He had an obvious, severe right-sided spastic hemiplegia. Surgery was performed in January 1961.

Result (1971): The function of both the hands is limited, but he uses both hands in playing and for picking up a large ball, etc.

Fig. 1. Case 1. Infant boy with a right-sided hemiplegia.

Fig. 2. Case 1 at age 3 years, showing position of his right hand and fingers 2 years after the surgical procedure described in the text.

Case 5

D. I., a boy aged 16 months. His birth was normal. He had an obvious left-sided spastic hemiplegia, and an extensor plantar response on the right side. Surgery was performed in July 1961.

Result (1971): He uses both hands in playing and eating, can carry a tray and tie his own shoelaces.

Case 6

S. Z., a boy aged 18 months. His birth was normal. He had an obvious right-sided spastic hemiplegia, and slight spasticity on the left side. Surgery was performed in December 1961.

Result (1971): He uses both hands unthinkingly in playing and eating. He holds the spade with both hands when digging.

Case 7

L. W., a boy aged 13 months. His birth was normal. He had an obvious right-sided spastic hemiplegia. Surgery was performed in February 1962.

Result (1971): He uses both hands in eating and playing, and to put on his shoes, and often carries a bucket with the right hand automatically.

Case 8

J. G., a girl aged 15 months. Her birth was normal. She had an obvious left-sided hemiplegia. Surgery was performed in November 1962.

Result (1971): She uses both hands in eating and playing and is able to wash plates. She uses both hands in attempts to catch a ball.

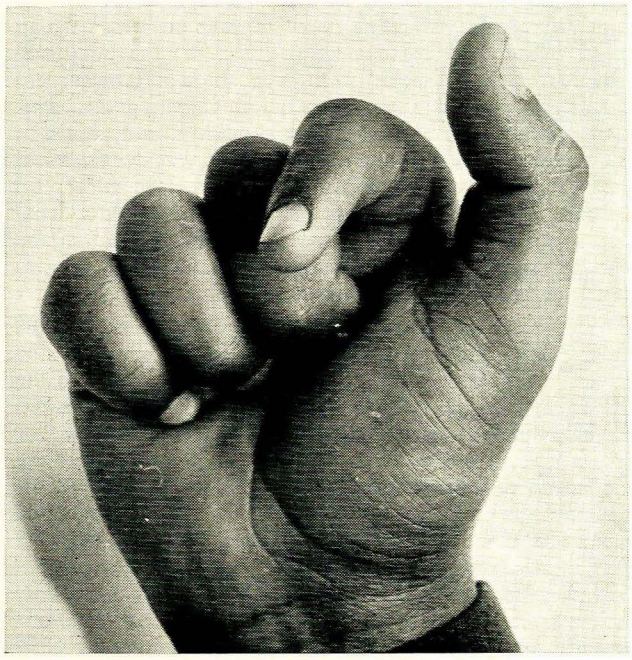

Fig. 3. Case 1 at 13 years, showing his ability to close his hand and yet abduct the thumb.

DISCUSSION

Since diagnosis and assessment of cerebral-palsy patients at this very early age is not easy, only severely affected children were operated on in this series.

From the results of these 8 cases followed up for 7 - 10 years, the results of very early surgical treatment of the hand in cerebral palsy appears encouraging and bears out the theoretical arguments in favour of it.

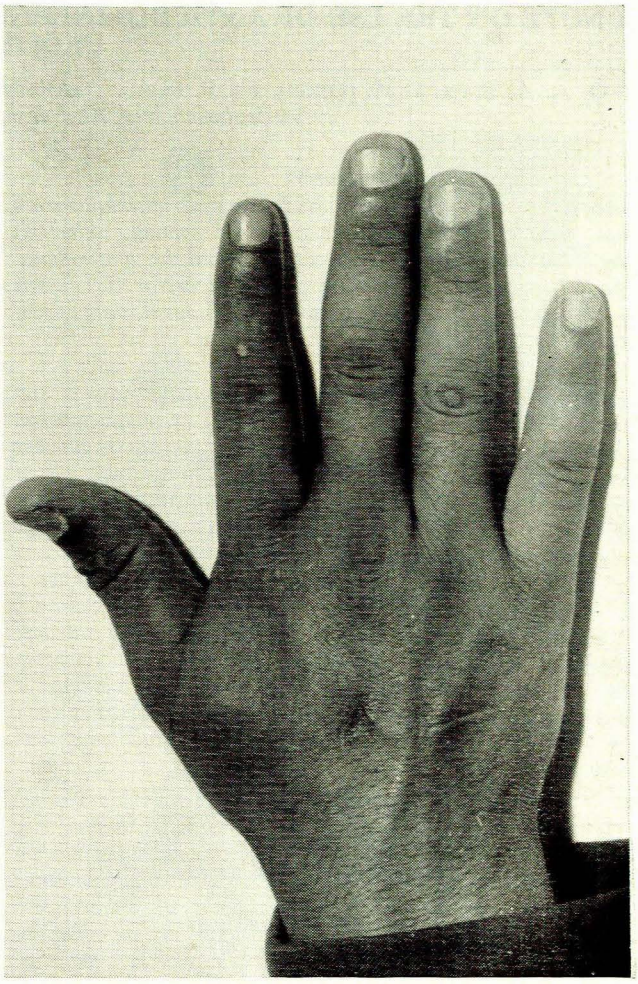

Fig. 4. Case 1 at 13 years, showing his ability to extend his fingers and abduct the thumb.

REFERENCES

1. Baker, L. D. (1956): J. Bone Jt Surg., **38A**, 313.
2. Bost, F. C., Ashley, R. K. and Kelly, W. J. (1956): J. Amer. Med. Assoc., **160**, 256.
3. Boyes, J. H. ed. (1964): *Bunnell's Surgery of the Hand,* 4th ed. Philadelphia: J. B. Lippincott.
4. Burman, M. S. (1945): J. Bone Jt Surg., **20**, 133.
5. Cooper, W. (1952): Quart. Rev. Pediat., **7**, 139.
6. Goldner, J. L. (1961): *Upper Extremity Reconstructive Surgery of the Hand in Cerebral Palsy or Similar Conditions,* AAOS Instructional Course Lectures, vol. 18, p. 169. St. Louis: C. V. Mosby.
7. Goldner, J. L. (1955): J. Bone Jt Surg., **37A**, 1141.
8. Carroll, R. E. (1958): Bull. N.Y. Orthop. Hosp., **3**, 23.
9. Carroll, R. E. and Craig, F. S. (1951): Surg. Clin. N. Amer., **31**, 385.
10. Pollock, G. A. (1963): *Surgical Treatment in Cerebral Palsy,* AAOS Instructional Course Lectures, vol. 45A, p. 1275. St. Louis: C. V. Mosby.
11. Swanson, A. B. (1960): J. Bone Jt Surg., **42A**, 951.
12. Keets, S. (1965): *Ibid.*, **47A**, 274.
13. Pollock, G. A. and Sharrard, W. J. M. (1958): *Recent Advances in Cerebral Palsy,* ed. R. S. Illingworth, p. 313. Boston: Little Brown.
14. McCarroll, H. R. *Surgical Treatment of Spastic Paralysis,* AAOS Instructional Course Lectures, vol. 6, p. 169. St Louis: C. V. Mosby.
15. Phelps, W. M. (1957): J. Bone Jt Surg., **39A**, 53.
16. Barnett, H. E. (1948): *Orthopedic Physiology,* AAOS Instructional Course Lectures, vol. 5, p. 181. Ann Arbor: J. W. Edwards.
17. Dowd, M. S. (1938): J. Bone Jt Surg., **20**, 133.
18. Eggers, G. W. N. and Burke Evans, E. (1963): *Surgery in Cerebral Palsy,* AAOS Instructional Course Lectures, vol. 45A, p. 1275. St Louis: C. V. Mosby.
19. Inglis, A. E. and Cooper, W. (1966): J. Bone Jt Surg., **48A**, 847.
20. Samilson, R. L. and Morris, J. M. (1964): *Ibid.*, **64A**, 1203.
21. Stelling, F. H. and Meyer, L. C. (1959): Clin. Orthop., **14**, 70.
22. Matev, I. (1963): J. Bone Jt Surg., **45B**, 703.
23. Green, W. T. (1942): Surg. Gynec. Obstet., **75**, 337.