PLASTER CASTS IN THE CONSERVATIVE TREATMENT OF CEREBRAL PALSY*

J. A. TE GROEN, DIP. PHYS., *Pretoria,* AND G. F. DOMMISSE, M.B., CH.B. (CAPE TOWN), F.R.C.S. (EDIN.), *Pretoria*

Damage to the human cerebral cortex results in the loss of the inhibition which the cortex normally exercises over sub-cortical centres, and in cerebral palsy this is responsible for 2 types of motor disturbances which have been designated the positive and the negative signs.

Positive signs take the form of 'released' abnormal patterns of reflex movements, i.e. movements which are released from the controlling influence of the higher, cortical centres.

The negative signs manifest themselves in the inability of the patient to perform certain purposeful movements.

PHYSIOTHERAPY

Physiotherapeutic efforts were formerly directed at the negative signs, and patients were encouraged (and assisted) to develop movements hitherto beyond the limits of their ability. Bobath[1] reversed the approach to the problem and concentrated initially on the positive signs. She directed her

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efforts at the reduction of muscle tone and the inhibition of abnormal movements. She developed reflex inhibiting postures (RIP),[2] which promoted muscular relaxation and permitted the performance of simple, voluntary movements and actions, hitherto prevented by the state of muscular spasticity which prevailed in the affected limb or limbs.

The normal developmental sequence of movements and movement patterns was accepted as the basis for instruction,[3] and great care was taken to avoid excessive demands upon the patient's cooperative capacity. Movements which were responsible for a sensation of pleasurable accomplishment were encouraged, while those which caused frustration because of difficulty of execution were temporarily abandoned.

The Bobath technique included a detailed and meticulous analysis of the abnormal patterns of movement, the definition of the effective RIP for each individual patient, and the institution of a regime of graded exercises and movements according to a planned programme in predetermined chronological sequence, thus:[3]

1. The passive, assisted adoption of the appropriate RIP, and their assisted maintenance over periods prolonged sufficiently to permit the performance of simple, voluntary movements and actions,
2. The unassisted, active maintenance of passively adopted RIP, and the performance of voluntary movements and actions while the RIP are held, and
3. The active, unassisted adoption and maintenance of the appropriate RIP, and the performance of voluntary actions and movements during their maintenance.

Abnormal patterns of movements vary from case to case and are difficult to define because they seldom occur as clearcut, single reflexes. They take the form of mixed or combined reflexes, altered or modified by the patient's voluntary efforts.

There are a number of abnormal reflexes which, in the spastic case particularly, play a dominant role, and they include:

(i) Spasm of the extensor muscles of the lower extremities, as exemplified in the crossed extensor and the positive supporting reflexes.

(ii) Spasm of the adductors and internal rotators of the hips, together with the extensors and flexors of the knees, as exemplified in the 'scissors' gait of the spastic quadriplegic and diplegic.

(iii) Spasm of the flexors of the elbows, wrists and fingers, as exemplified in the associated movements of the arm which are observed during walking in patients with spastic hemi- and quadriplegia.

Associated reactions in the upper extremities, which accompany movements of the legs during walking, may constitute a crippling disability, because they may operate as a handicap in their own right, or as a limiting factor in the use of walking aids.

The success of the Bobath treatment, which aims at the inhibition of abnormal reflex activity and the facilitation of normal, automatic movements within the reflex inhibiting postures,[3] is modified or limited in cases of severe spasticity on the one hand, and of incipient or real contractures on the other. In these cases, desirable RIPs either cannot be achieved, or else cannot be held for effective periods of time. Under these circumstances, the use of plaster-of-paris casts has proved advantageous.[1]

During the past 19 months 38 patients have been treated in this manner; 23 suffered from spastic hemiplegia, 14 suffered from spastic quadriplegia, and 1, the most recent in the series, was a quadriplegic of the non-tension, athetoid type (case 3, see below).

Plaster casts were retained for periods of from 2 to 7 weeks; they were repeated after 6 months in a number of cases, and after 3 months when the attainment of the RIP proved more difficult. Two spells of plaster immobilization were usually sufficient—the number could however be extended, and a few of our patients were treated in this manner on 3 occasions.

THE TYPES, INDICATIONS AND USES OF CASTS

1. The Below-knee Cast

This is used in cases of spastic hemi- and quadriplegia with resistance to the adoption of desirable, reflex inhibiting postures (Fig. 1B).

The dominating, abnormal reflexes were the crossed extensor reflex augmented by the positive supporting reflex. Their effect was only too apparent and took the form of a rigid knee joint, a plantar-flexed ankle joint, (i.e. the position of physiological extension), and grasping, clutching digits.

The crossed extensor reflex, a segmental, tonic or postural reflex, is responsible for extension of the supporting limb, and is triggered off by flexion of the non-weightbearing leg as it embarks upon the swing phase of ambulation.

The positive supporting reflex supplements the former and is motivated by proprioceptive stimuli from the dorsiflexors of the ankle and the digits, and by exteroceptive stimuli received from the nerve endings in the skin of the sole of the foot, during the support phase of ambulation.[4]

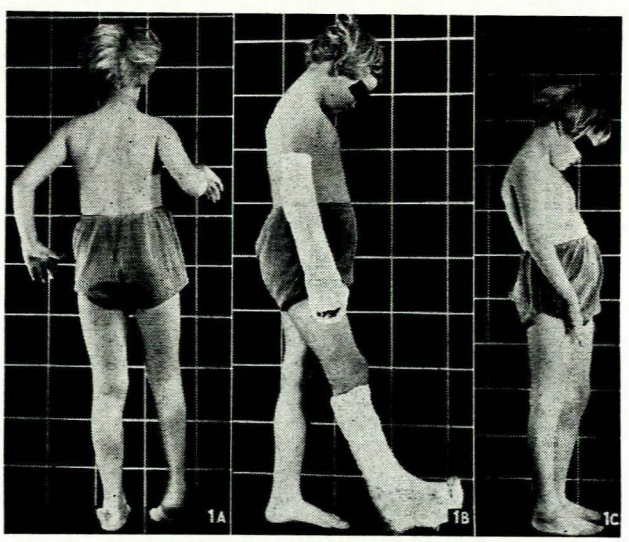

Fig. 1A. Case 1. Right-sided spastic hemiplegia.
Fig. 1B. The below-knee cast with walking iron, and the above-elbow cast. Note the extended digits.
Fig. 1C. Favourable position of lower and upper extremities, following the removal of the plaster cast.

Method. The below-knee cast is applied while the ankle joint is dorsiflexed and the foot pronated; the digits are forcibly dorsiflexed and the plaster is extended distally in the form of a platform which maintains this position.

Meticulous attention is paid to detail, and pressure points are carefully padded in an effort to prevent the development of pressure sores beneath the plaster casts.

When the optimal position for the immobilization of the ankle and toes cannot be attained at first effort, recourse is had to the use of a general anaesthetic, on the one hand, or to the gradual correction of the deformity by the use of frequent changes of plaster cast, on the other.

General anaesthetics are of particular value in severely spastic cases, while gradual correction with repeated plaster casts is the method best suited to patients with incipient and mild contractures.

Walking irons or rockers are applied in such a position (Figs. 1B and 3B) and at such an angle, that they assist in the production of extension of the knee during walking, thus preventing flexion of the knee joint and collapse of the patient, which may result from the maintenance (in plaster) of the reflex inhibiting posture.

Pressure sores constitute a constant threat, and complaints of pain are accepted as indications of their presence. Casts are removed without delay, and are re-applied only when suitable conditions are restored.

Because of the danger of the development of pressure sores, the practice of removing casts shortly before the dates when the school term closes, was adopted as routine procedure. The below-knee plaster cast with walking rocker proved the most successful and useful in the series, and was applied in 23 cases.

2. The Above-elbow Cast

This is seldom indicated, and was used in only 3 cases of spastic hemiplegia in this series (Fig. 1B). It is of value in the control of associated reactions, which usually take the form of flexion at the elbow, wrist and digits, during ambulation. It may be combined with the use of the below-knee cast, and the combination of casts is associated with considerable benefits to the patient.

Walshe[6] drew attention to these associated reactions and believed that their importance was not always appreciated. He described the typical example in which there was flexion of the affected arm, in association with flexion of the affected leg during walking. Yet a further example was the flexion of the affected arm, in response to any form of activity of the unaffected hand, such as might occur in the act of gripping a walking aid.

Walshe pointed out that since walking took up a great deal of the patient's time, the purposeful use of the affected arm was in some cases reduced to a bare minimum, while the development of flexion contractures was not an uncommon occurrence.

3. The Hip-abduction Cast

The hip-abduction cast is used in spastic quadriplegia and may prove useful also in cases of spastic hemiplegia (Fig. 2B).

The patient most likely to benefit is the one who displays adduction and internal rotation at the hip joints with flexion of the knees, the deformity responsible for the characteristic 'scissors gait' (Fig. 2A).

Plaster shells are applied to both legs (Fig. 2C), and the shells are connected with wooden crossbars at knee and ankle levels. The hip joints are abducted so as to form an angle of 20° with the mid-sagittal plane, while the ankle joints are held at right angles.

Unencumbered flexion and extension of the hip joints proved of inestimable value, and the patient was able to lie down, sit up and even to stand up. Standing erect, with assistance, presents little difficulty and the upper extremities remain free (in great measure) of undesirable associated reactions.

These casts are effective in reducing the degree of spasm and deformity so typical of spastic quadriplegia and they permit the facilitation of normal movements. Daily use may be made of them, for varying periods in different patients and even from day to day in the same patient. The splints are held in position with gauze or crepe bandages.

They are used for as long as necessary, and may be renewed when they break or when they became outgrown.

Twelve patients were aided in their rehabilitation by the use of the hip-abduction cast described above, and the method proved a very useful aid to treatment. In 3 other patients, use was made of the formal type of double-hip, plaster-of-paris spica—the degree of spasticity in these patients was too severe to permit the retention of the lesser cast. Unfortunately, the double-hip spica, which was perforce applied with the patient anaesthetized, proved unsatisfactory and unacceptable because of the amount of pain and the number of pressure sores it caused.

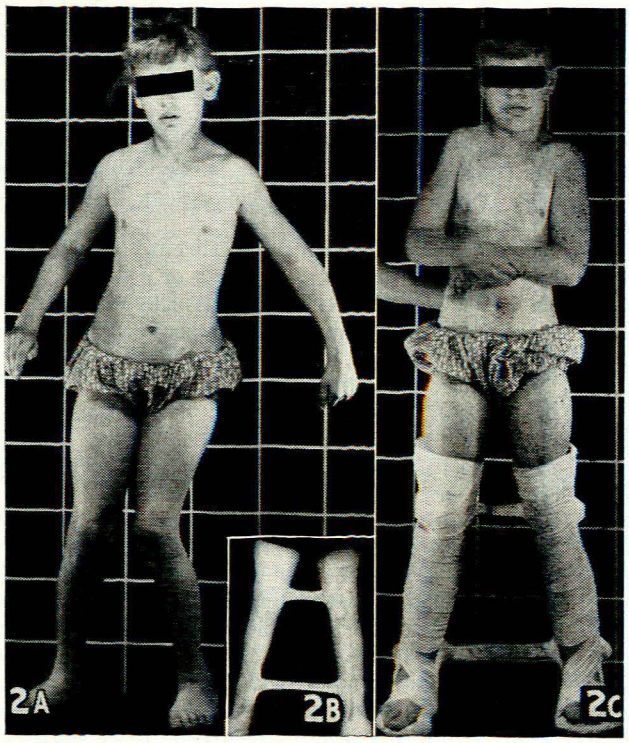

Fig. 2A. Case 2. Spastic quadriplegia with 'scissors gait'.
Fig. 2B. The hip-abduction plaster cast or shell, with connecting cross bars.
Fig. 2C. The abduction splint, with control also of the knee and ankle joints, shown in use.

CASE REPORTS

Case 1. Spastic hemiplegia. A.B., White female, aged 8 years. Spasticity of arm and leg muscles and resistance to reflex inhibiting postures were severe. The strong positive supporting reflex in the lower limb, and the associated reactions in the upper (flexion of elbow, wrist and fingers, shown in Fig. 1A) constituted a severe handicap during efforts at walking.

Plaster casts were applied simultaneously to the upper and the lower extremities (Fig. 1B) and were retained for uninterrupted periods of 6 weeks. The interval between applications of casts was 7 months.

Response to the use of this modality was good (Fig. 1C) and the gain in the range of movements was maintained by the use of simple supportive appliances[7]—a cock-up splint for the wrist, used at night only, and a lateral wedge to heel and sole of the boot, the upper of which was stiffened in its lateral portion.

Case 2. Spastic quadriplegia. C.P., White female, aged 11 years. The hips displayed spastic flexion, adduction and internal rotation, while flexion at the knees (Fig. 2A) was an equally distressing feature—the child exemplified the 'scissors gait', and was considered an ideal candidate for the hip abduction cast (Fig. 2C).

Response was notable and immediate, and there was a striking improvement in posture, with good head control, trunk erectness and the assumption of a relaxed, erect posture which approached the normal.

The use of this type of cast proved a valuable aid in the

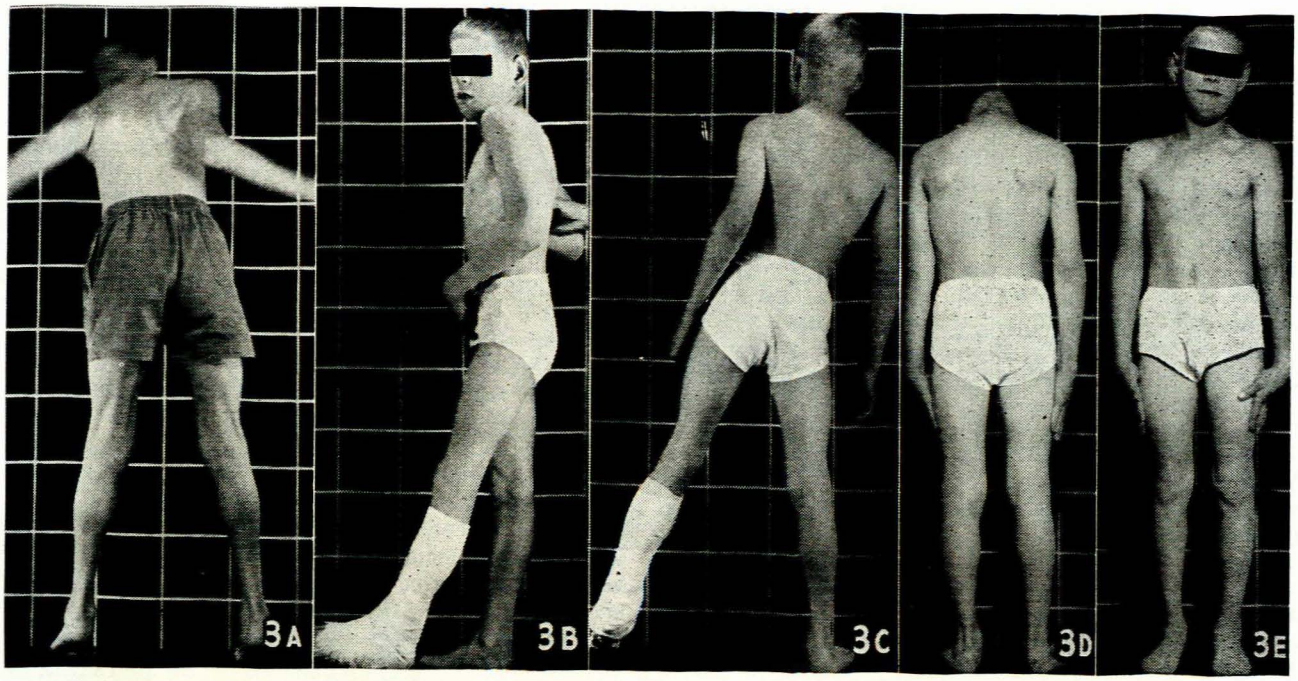

Fig. 3A. Case 3. Athetoid posture. Note the positive supporting reflex in both legs, and the associated reactions in the arms.
Figs. 3B and 3C. The below-knee plaster cast has eliminated undesirable movements in arms and legs, and the child has a relaxed posture and gait.
Figs. 3D and 3E. The easy and relaxed posture which followed the application of below-knee plaster casts to both legs. Improvement in both posture and gait has been maintained for 5 months, up to the time of writing. (Pressure sores on the heels developed under the casts.)

treatment and training of the spastic child, and it gained strong preference over the more formal plaster spica which was poorly tolerated.

Case 3. Athetoid. H.v.V., White male, aged 12 years. Mindful of the risk of 'shift' or 'shunt' of athetoid features, in exaggerated form, to other extremities, we applied below-knee casts as a desperate measure in 'a disease desperate grown', and we were prepared for an immediate switch in policy, should it prove necessary. The boy (Fig. 3A) displayed non-tension, athetoid features in all extremities, and his disability was severe to the point of complete frustration.

First one leg, then the other, was encased in a below-knee cast with walking appliance (Figs. 3B and 3C), and the advantages so conferred were unassociated with any of the disadvantages (other than the development of pressure sores on the heels) which might have been anticipated.

The relative normalcy of posture and gait which followed, (Figs. 3D and 3E), was of a striking and most gratifying nature, and was maintained up to the time of writing, some 5 months later.

No other athetoid patient was submitted to this form of therapy, and it would seem premature to offer further comment.

SUMMARY AND CONCLUSIONS

In 38 cases of cerebral palsy, temporary use was made of plaster-of-paris casts in order to maintain reflex inhibiting postures and to facilitate training in the execution of voluntary movement and action.

Below-knee, plaster-of-paris casts with metal rockers were employed in 23 patients, with good results in 15, indifferent results in 6 and no response in 2 of them. Operation for the lengthening of the triceps surae was advised in the latter 2 patients, while supportive splints (2 patients) and altered footwear (7 patients) were advised as a follow-up measure in the former.

Hip-abduction casts were made for 12 patients, 9 of whom responded favourably, 2 of whom were unable to continue with the method because of the severe degree of their spasticity, and 1 of whom was lost and could not be followed up.

Arm casts, applied from above-elbow to fingertip level, were applied to the arms of 3 patients only, with 1 good result (case 1), 1 poor result in which operation for wrist arthrodesis was advised, and 1 case which was lost and could not be followed up.

Reference has been made in an earlier publication[5] to the limitations and the advantages of surgical procedures in the treatment of cerebral palsy, and to the fact that all available modalities of treatment should be placed at the disposal of the victim of this distressing condition.

The use of plaster-of-paris casts as an aid to patient and physiotherapist alike, constitutes yet another valuable procedure in the equipment of the doctor responsible for the care of children suffering from cerebral palsy, and the simplicity, the effectiveness and the innocuous nature of the method serve to recommend its use.

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