

Sensory-Motor Associations in the Treatment of Stroke Patients

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For many years to come there will doubtless continue to be numerous patients suffering strokes and requiring rehabilitation. The following ideas and actions enable the patient to help himself during rehabilitation, and to make the best of what remains to him. Consequently, they are of general interest; they are easily applied by the patient, and afford economies overall, being based on considerable experience both general and personal.

INNATE SENSORY-MOTOR CONTROL

The basic idea underlying this article is that when the patient's mental ability is at its lowest ebb, it is preferable, whenever possible, to bring out his latent reflex pedi-manual abilities, rather than either to teach him fresh activities or even merely to apply passive movements. This procedure aims at checking his fear of falling and encouraging his mental abilities.

The way in which this is done was brought to my mind by the following example of sensory-motor control, now innate in man and ready to be brought into use as required. It seems that this type of sensory-motor control—in which tactile sensations arising in the hands and feet are utilized—evolved as follows:

In *The Antecedents of Man*, Sir William Le Gros Clark describes how our remote ancestors lost their claws in exchange for finger-nails and finger-pads. Being richly supplied by sensory nerves they formed tactile organs with a fantastically high degree of sensitivity. Thus, their locomotion through the forest and the balance of their bodies were governed to a large extent by tactile impulses from their hands. This made their arboreal acrobatics possible.

During subsequent evolution of primate to man this type of sensory-motor manual control was retained, although it was of course no longer used in an arboreal environment. What man had to do was to learn reflexly how to combine the activities of his hands with those of his feet.

The above suggests to any thoughtful physiotherapist that we have inherited from our remote ancestors sensory-motor associations by which tactile impulses from the fingertips can help to regulate the balancing of the body on the feet. It is easy also to demonstrate that this is so: if one stands on an unstable surface or is standing on one leg with one's eyes shut, balance is forthwith improved automatically, the instant one lays a finger on any firm, stationary object.

(continued from page 4.)

SUMMARY AND CONCLUSION

The keys to the prevention of the late, crippling effects of rheumatoid arthritis are early diagnosis and effective treatment before joint destruction and capsular degeneration occur. The application of these principles to the rheumatoid hand and wrist is described and the value of early splintage and synovectomy are emphasised.

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Tactile impulses from the fingers co-ordinate muscular activity throughout the body to stand on the feet.

It will be shown that this inborn sensory-motor association applies even to the stroke patient. He merely requires to be instructed how to utilize these associations under the various circumstances rendered novel by his stroke. He does not need to learn the basic associations afresh; but he may have to learn his poor use of them in his past life.

In man, the balancing element in this arm/foot balance association alters in accordance with the varying proprioceptive impulses coming into the central nervous system from the hand and arm and through muscles down to his feet. If the hand-grasp round a bar, or the hand pressure against a flat surface, utilizes the intrinsic muscles of the thumb and hand, the balance of the body is far better than when the fingers are merely used as a hook (like those of the thumbless West African Colobus monkeys). This contribution to balance by impulses from the intrinsic muscles of the hand occurs not only in the normal human being but also in the stroke patient. These influences due to combined tactile and proprioceptive impulses take effect automatically and should be fully exploited during rehabilitation.

ADJUSTING THE SENSORY FIELD

At the risk of over-simplification, one can say:

- The average patient's sensory field is probably restricted and/or even distorted.
- When he feels that he is upright, his body is probably sloping and vice versa; hence the patient's sideways slump when sitting or reclining. This distortion of his sensory field is linked with his fear of falling.
- If he introduces into his sensory field supplementary sensations, e.g. tactile and proprioceptive sensations from his sound hand stretched out on the horizontal surface of a bedside table, or against a convenient vertical surface, the sensory-motor association which rights his body balance may well over-ride the association which caused his slump sideways and his fear of falling.
- He is adjusting his body in relation to the horizontal or vertical position of his sound hand. Proprioceptive impulses give information concerning the position of the hand in relation to the body; and also of the body and feet in relation to the hand.

In actual practice, the results of evoking these associations are bound to be somewhat patchy. It could not be otherwise, taking into account the wide variety of conditions and brain damage covered by the term "stroke". Two basic factors may interfere. Firstly, the patient may be unable to co-operate or even to grasp these inter-limb relationships. Secondly, confusing influences may emerge from his eyes. It always helps the physiotherapist to have the doctor's opinion. The patient may have double vision or a serious conflict between his visual and vestibular or peripheral sensory balance mechanisms. If these are troublesome, the patient may respond favourably by having one or other eye covered with a shield or a bandage, and thus isolating ocular interference with the other righting reflexes of his body.

The patient's innate tendency to sift/sort and integrate the various sensory-motor associations, and to overcome his fear of falling whilst eliminating past faulty associations or learning old reflexes anew, is hard to explain.

If the patient can achieve control of his slump, by this simple use of his hand in bed, it gives him confidence from

the outset, and he is set fair for improvement in balance and action, whilst walking afterwards.

VISUAL INFLUENCES

During evolution, man has learnt to rely largely on his eyes for balance. The association of his visual influences with impulses from his tactile pads of high sensitivity is of great importance as regards sifting/sorting and integrating sensory data.

Let us take four examples of acts that are specially relevant to the stroke patient:

- (a) If the patient's tendency to slump sideways whilst sitting has not been improved by utilizing messages from his sound hand, the association of these with visual influence may help. He can glance with his sound eye at a horizontal line. If the line appears to be running uphill (compared with the data from his hand), this is a signal that his sideways slump requires adjustment. This sensory-motor association becomes automatic.
- (b) If he stands and looks at one or both eyes in a mirror or stands and looks along a broad white line, his balance is probably improved forthwith, whilst walking.
- (c) The same occurs, when he gazes at a small, easily recognizable object approximately in line with his eyes.
- (d) On the contrary, when he is turning and thus swinging his line of sight from one object to another, his balance tends to be disturbed. Accordingly, it is wise for him to safeguard himself against this disturbance of visual influence by bringing into play messages from his sound hand in contact with an appropriate object.

If he has made himself handy with his stick in his sound hand, the messages from the end of a firmly placed stick will reach his brain via his finger which points down the shaft of the stick and will help to preserve his balance.

The above actions are of value during rehabilitation, because they can be utilized with the minimum of instruction. These visual influences are based on ancestral behaviour.

This article does not attempt to cover the whole of this subject, but there are a few further visual matters that should be mentioned. For instance, the sensory input due to side to side motion of the head is a disturbing factor for many stroke patients. The sifting/sorting mechanisms of normal persons deals with this so effectively that one is usually unaware of this sideways motion, when walking.

That it exists can be demonstrated if one hangs a cord down in front of a long mirror, then stands with the images of one's eyes on either side of the cord, and walks towards the mirror. The images of one's eyes dart from side to side across the cord. In fact, the surprise caused by this may cause some apparently normal persons to experience momentary conflict, due to unco-ordinated visual and labyrinthine influences, comparable to that suffered by the stroke patient.

Blacking out the visual influences of patients who suffer from abnormal head postures has already been mentioned. Transient relief from the patient's distress which results from the abnormal sensory-motor associations may be given by using an eye-shade on one eye or the other, or by blind-folding him, or by advising him to sit mostly with his eyes closed; but the requirements of individual patients may vary from day to day or even during the span of each day in this respect.

A section on "Optokinetic Postural Reactions" (The Cerebral Control of Movement—The Sherrington Lectures VIII, 1966, Derek Denny-Brown) discusses experimental damage to the mid-brain of a monkey and shows two photographs of the monkey sitting with his head well on one side and sitting blindfolded with his head straight. "Immediately he was blindfolded the head became straight,

only to deviate immediately the eyes were uncovered". There is no record of the result of covering a single eye. Adjustment of the patient's sensory field, i.e. reducing the visual influence and increasing the tactile input, as explained earlier, appears to need further investigation for the treatment of stroke patients.

ACTION AND BALANCE WHEN ERECT

A number of points arise in this connection, but taking into account what has been discussed, they can be dealt with briefly.

Self-Help and Fear of Falling. During rehabilitation after a stroke most patients suffer from an exaggerated fear of falling. In order to encourage the patient to help himself, he should be shown safe working under conditions which he can improve by experiment. Clearly, what he is allowed to do must depend on his medical state; but the emphasis should be on self-help.

He should re-learn to stand with most of his weight over his sound foot, taking part of his weight, and balancing himself, by a firm handgrip on a horizontal bar with his sound hand above or at shoulder level. In this position he can safely accustom himself to any confusion or giddiness due to swings of his line of sight from one object to another, or to turning his head and body. He can also balance on his sound foot, whilst he moves his sound hand, thereby checking the relationships between balancing and the variations in positions of his body's supports. Again, he can discover how much weight his sound hand must take, when his weak leg begins to bear weight or he begins to move it. With his pelvis and trunk firmly held by the musculature of his sound side and with the forepart of his weak foot in contact with the ground, he has supplied himself with the sensory element of the sensory-motor association which encourages his weak leg to begin to bear weight.

Provided that the patient is capable of grasping the relationships between sensations and actions, these preliminary experiences in this safe position introduce him to two further fundamental self-help activities: first, adjusting his actions and balance whilst rising with assistance from a chair; and second, strengthening his weak leg by the frequent use of an "artificial floor" in bed.

Rising from a Chair. The patient sits down on a chair in front of the horizontal bar which he has been grasping; the higher the chair, the easier it will be for him to get up again. At first, when practising getting up, the patient should adopt what must have been the ancestral method: looking up, reaching up and rising. This is a sensory-motor association initiated by visual impulses and regulated by their association with tactile and proprioceptive impulses from the hand and arm.

To encourage this, a walking stick is hung on the horizontal bar. The sound foot is placed slightly on the medial side of the stick; the patient looks at the crook of the stick, and, as he rises, reaches up and grasps the bar just lateral to the crook of the stick. The vertical shaft of the stick serves to position his hand in relation to his sound foot. He is already accustomed by balance safely in the upright position with his sound hand grasping the bar, so that the fear of falling does not inhibit his effort, and he gains increased confidence.

THE "ARTIFICIAL FLOOR" IN BED

The main task for the patient is to re-connect hands and feet. He must first strengthen the action of weak buttock and quadriceps muscles for the act of weight-bearing by beginning at the earliest possible stage to make some use of them "little and often". His sensory experiences during his attempts at straightening the weak leg in the safe erect position, as already described, will enable him to re-enact and thus strengthen this action in bed, starting with the forepart of his weak foot against the vertical board. He can adjust the position of the board by means of his sound hand

while holding a loop of cord attached to either end of the board, and by his sound foot's positioning the board. In this way he learns and acquires the sensory aspect of and element in the sensory-motor association of thrusting the heel of the weak leg towards the vertical board. This board is valuable: it holds the bed-clothes off his feet, while it is held down by the weight of the clothes. A horizontal member at either end of the board helps to hold the board upright.

The strength of the patient's foot actions need only be small. Co-ordination and the sensory-motor association are the aims: these are encouraged, if the index finger of the sound hand feels the proximal border of the patellae, as they begin to move.

CONCLUSION

The essential feature of this neurological approach to rehabilitation of the stroke patient is its impact on rehabilitation of his mental abilities. The latter is encouraged by the linking up under favourable working conditions of numerous sensory-motor associations.

This mental rehabilitation approach applies also to other geriatric cases. It is not just a flash in the pan. It was explained in my book on *The Adjustment of Muscular Habits* (1933) and Sir Wilfred Le Gros Clark pointed out in his Foreword thereto the importance of the psychological elements in this type of self-help by which the patient encourages himself to continue his progress.

This article has discussed some practical methods by which the patient can be taught to gain control of sensory-motor associations despite the unfavourable items in his sensory field. They can doubtless be extended and improved by others. The essential feature of this neurological approach to rehabilitation of the stroke patient is its impact on rehabilitation of his mental abilities.

As the general principles underlying the foregoing remarks and recommendations were discussed at length in my last little book *Natural Movement* (1962, Lewis Lond. 103 pp.) and were found in the works of the numerous well-known authorities quoted therein it is unnecessary for me to repeat them here.

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Giving those Fibrocystics the Bird (and other Treatments)

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Many are the vicissitudes in giving children with fibrocystic disease treatment with the Bird respirator, and its aftermath of "coughing and spitting". I have been on this job for over a year now, and have learned many precious points in this time.

The object of this article is not for the benefit of those wishing to know the whys and wherefores of coping with the actual down to earth handling of the Bird respirator itself, or any other type of treatment. On the contrary, my whole idea is to present the psychology in coping with each specific case under treatment.

I have found these children on the whole plucky, intelligent, curious and last but by no means least, obstinate to the last frustrating degree. Of course there are exceptions to every rule, but I myself, in the 14 years I have worked at the Children's Hospital have met only two exceptions to this overall description.

Let me explain here that, although I have only been giving these children treatment with the Bird respirator for just over a year, I have sweated my heart out with other forms of treatment prior to the introduction of the Bird.

Whatever treatment I have given, I have found their obstinate trait the greatest stumbling block and have learned to tread very gently in this respect. At the time of writing, there is no known cure for this devastating disease, so these children have to look into a future where "coughing and spitting" is a perpetual and daily MUST.

I have found that the most effective attitude to adopt is a taking for granted that they cough and spit just as routinely as they clean their teeth and do their hair.

Playing games takes up time and becomes boring—"Fancy coming all this way to play when I can play much more happily with Egbert next door!"

Thumping and banging and postural drainage, etc., are all very well and very orthodox, but, after all, the main issue is the *amount* of sputum raised and this they *must* do themselves. By the time one has thumped, breathed, percussed, exercised, played games and given the Bird, you are not likely to raise the same amount of sputum and the treatment would not be much short of a life stretch.

The Bird inhalations make coughing easier and quicker, so I concentrate on this. Mother can, after being coached, do the percussion and postural drainage at home. If she is not co-operative about this, you might as well cut your losses for she probably will not be regular in bringing the child either, and your occasional odd treatments would be like taking a thimble full of water out of a fish pond.

So now, with a really co-operative mother doing her stuff at home, I make my part of it a routine. I sit the child down in front of the Bird and, regardless of snot and trane let them know that they have to breathe in their airbron in the most efficient manner to the last drop and then cough and spit 20, 25, 30 times, etc. I gradually raise them to about 50 "spits" a time.

This, with mother's homework, seems to keep them fairly clear. Of course, this is no rigid rule and some are definitely dry before 50, and others can do more. However, whatever I feel each child is capable of, I stick to through thick and thin until they knuckle down to the fact that the sooner they get going and finish, the sooner they can go home.