

ORIGINAL PAPER

OBSERVATIONS ON THE EFFECTS OF  
PROPRIOCEPTIVE NEUROMUSCULAR FACILITATION  
TECHNIQUES IN THE TREATMENT OF HEMIPLEGIA\*

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SUMMARY

Observations were made on nine patients with hemiplegia until a period of one year or more had elapsed since the onset of their paralysis. The results of simple tests of function showed that improvement occurred up to one year from the onset of the hemiplegia, though the important improvement was in the first six months. Observation on four patients receiving treatment with PNF techniques showed that there was no improvement in dexterity which could be solely attributed this treatment, though there was some evidence of improvement in strength.

KABAT (1950) points out that in addition to the initial improvement in hemiplegia dependent on recovery from shock and subsidence of oedema there is more gradual recovery due to a "compensation through the taking over of the function of voluntary movement by the extrapyramidal pathways". He says it has been possible to demonstrate conclusively that the process of compensation by which other central motor mechanisms take over function for the damaged areas can be greatly accelerated and vastly extended through the use of proprioceptive neuromuscular facilitation (PNF) techniques, and that once the substitute pathways have been developed in this way the restoration of motor function is permanent.

There seems no doubt that voluntary movement can be facilitated in upper motor neurone paralysis by appropriate techniques. Facilitation of finger flexion by stretch and the use of the finger jerk is well described by Twitchell (1951). More recently Holt et al. (1969) have produced evidence of the efficacy of the reversal of antagonists technique. Although PNF techniques can facilitate voluntary movement in hemiplegia, it is still necessary to demonstrate that their use produces lasting benefit, or, if lasting benefit occurs, that it is superior to that obtained by simple and less exciting methods of treatment. Licht (1968) in his book *Rehabilitation and Medicine* emphasizes this point when he says, referring to PNF techniques, "whether they have any permanent value, that is carry over, is difficult to say and even more difficult to prove".

In this study observations were made on nine patients over a long period with a view to determining whether there was any striking difference between those receiving PNE treatment and those receiving ordinary exercises in the gymnasium. In addition observations were made on four patients who had not been treated by PNF techniques and in whom improvement appeared to have ceased, in order to determine whether any further improvement resulted from introducing PNF treatment.

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## METHODS

An assessment of daily living activities was made, the possible score for men being 69 and for women 86. The score was based on questioning rather than testing the patients. In addition, progress was followed by making some simple measurements of function. Six tests were used for the upper limb.

1. The cream carton test. This is the simplest test for the hemiplegic patient to perform. Cream cartons are fixed to a board and the patient is required to lift other cream cartons and place them inside those on the board. The time required for the patient to place ten cream cartons on the board was measured with a stop watch.

2. The egg tray test. The patient has to place bobbins, ordinary cotton reels, in spaces for the eggs, of which there are 30 in all. The time taken for the patient to fill the tray is measured.

3. Bobbin peg test. The patient has to lift up the bobbins and place them on 33 pegs attached to a board. The pegs are about the same length as the bobbin. The time taken for the patient to fill the board is measured.

4. The small peg test. In this test the number of small pegs the patient can insert into round holes in a board in one minute is recorded. The pegs and holes are not much bigger than those of a cribbage board.

5. The grip strength using a rolled sphygmomanometer cuff, the result being in mm. Hg.

6. The patient's ability to use a special pump. This pump consists of a large bottle (capacity 1 1/2 litres) in which a perforated rubber bung is inserted. Copper tubes are placed through the bung, one passing to the bottom of the bottle and the other being above water level, and to the latter a sphygmomanometer bulb is connected by pressure tubing. The patient squeezes the bulb, working as hard as possible for one minute, and the amount of water expelled is measured. A mean of three readings is taken.

7. Strength of shoulder abduction was measured in one patient using a spring balance.

Two tests were made for the lower limbs.

8. The walking time over a course of 30 feet from start to finish, including a complete turn around a chair in the middle. An average time for a normal person on this course is six seconds.

9. Ankle dorsiflexion strength was measured with a spring balance.

These methods were used in making observations on nine patients over periods ranging from 7 to 20 months. The observations were continued until one year or more had elapsed since the onset of the hemiplegia. Four patients received treatment with PNF techniques for periods ranging from 5 to 9 months. The other five patients were given simple exercises in the gymnasium for periods ranging from 3 to 9 months after the first observation. The results showed that, if improvement occurred, it was in the early months, though it could continue until one year from the onset of the hemiplegia. Only slight improvement was noted, however, after six months from the onset. Five patients were upgraded in the disability

grades of Harris et al. (1964). Only three of the five, however, moved up one in the over-all disability grade. No striking difference was noted between those receiving PNF and those doing simple exercise. The cases are so variable, however, that one can hardly make a valid comparison without a large series.

The problem of the long-term efficacy of PNF treatment has therefore been approached in another way. In making the observations on the upper limbs in the cases already described the object has been to show improvement as manifested by increased power or greater dexterity. If PNF treatment is superior to other methods, then it ought to produce improvement in patients who have not had this treatment though they have reached a steady state as judged by tests of power and dexterity. Four patients have been tested in this way. They had not had PNF treatment up to the start of the investigation.

### METHOD OF INVESTIGATION

The particular tests of dexterity used depended on the patients' functional status, but all four patients had their grip measured. The patients were put through these tests, and they then attended the Occupational Therapy Department three or four times a week for practice in using the hand, including the performance of the tests themselves. Every two or three weeks they were retested and the process continued until they failed to show further improvement in their performance. At this point they were given PNF treatment to the arm and hand on five days a week for one month. In addition to the PNF session with the physiotherapist they did exercises in the gymnasium as advised by Kabat. After one month's PNF they were tested again. It seemed possible that, if impossible that, if improvement did not occur after PNF treatment, the fact that they had had this treatment might make the patients capable of responding favourably to further practice in these test. They were therefore given a further two weeks' practice in the Occupational Therapy Department and then tested again.

### RESULTS

Case 12.—A man aged 60 years with right hemiplegia but no sensory loss, of seven months' duration at the start of testing.

The curves in Fig. 1 show improvement in the cream carton, bobbin egg tray, and bobbin peg tests. The corresponding scores for the good hand are shown in the margins. The month of PNF treatment between the 11th and 15th weeks did not obviously affect the curve, nor did a further two weeks' practice. When tested again after three months without treatment the patient had deteriorated slightly in all the tests. Fig 2 shows that there has been no improvement in grip as a result of PNF treatment. There is a slight improvement in his score the pump, but only after a further two weeks' practice. The figure in the left-hand margin for the normal hand is for 30 seconds' pumping in contrast to 60 seconds for the hemiplegic hand. This restriction in time was necessary because it seemed likely that the patient would empty the bottle with the normal hand before one minute had elapsed.

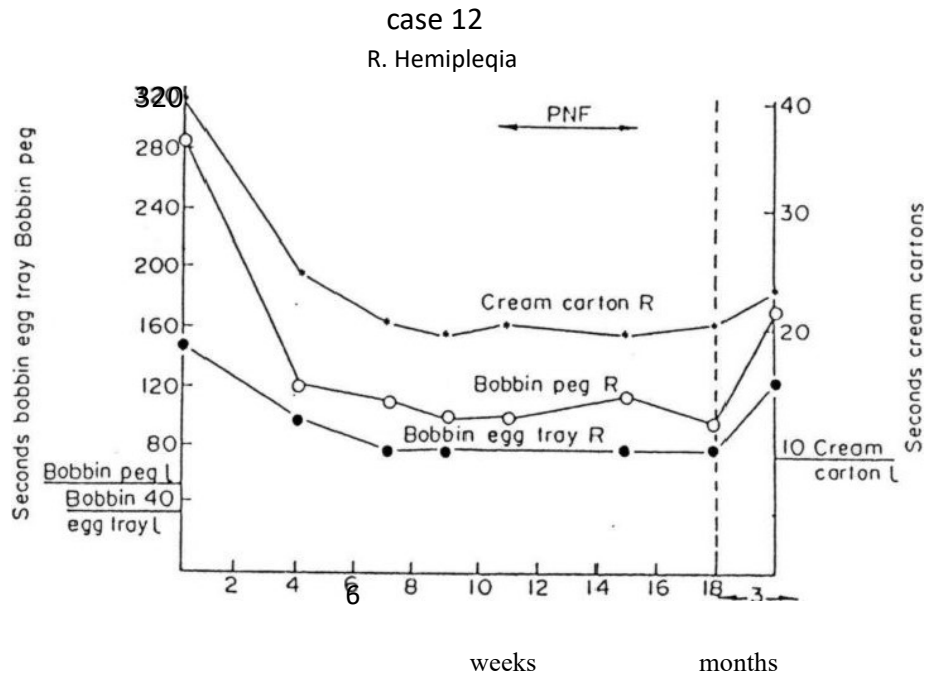


FIG-1

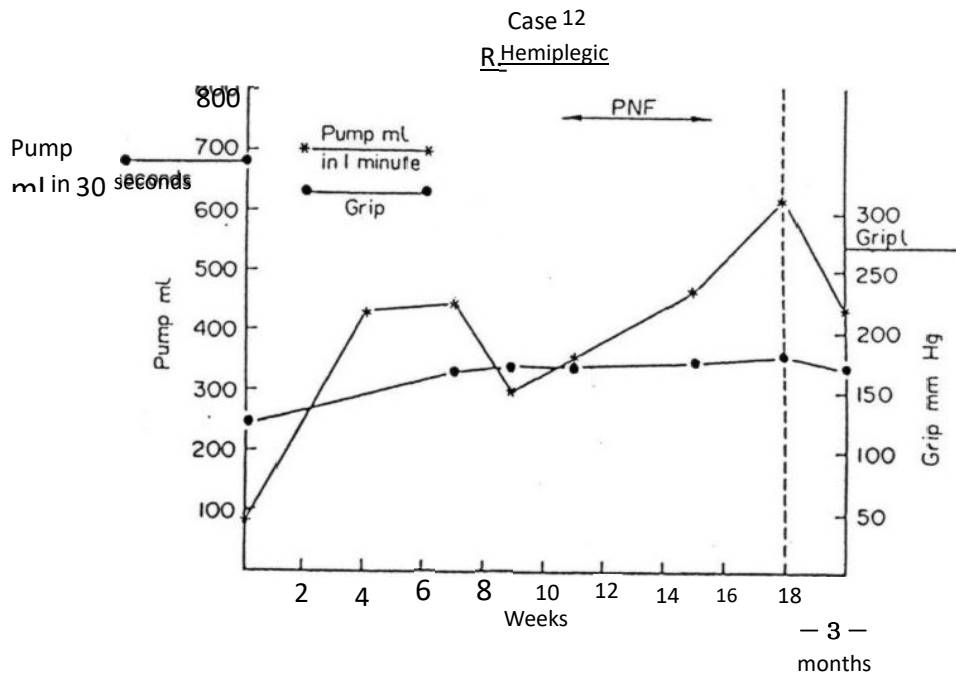


Fig. 2

Case 13.—A woman of 63 with right hemiplegia but no sensory loss and of three months' duration at the start of testing.

Tests of dexterity, the bobbin peg test, and the small peg test showed no improvement after PNF treatment. Fig. 3 shows the result of the grip and pump test in this patient. There is improvement in the grip after PNF treatment from 115 to 150 mm. Hg, no further improvement after two weeks' practice, but improvement again after three months without treatment. There is no improvement in the pump

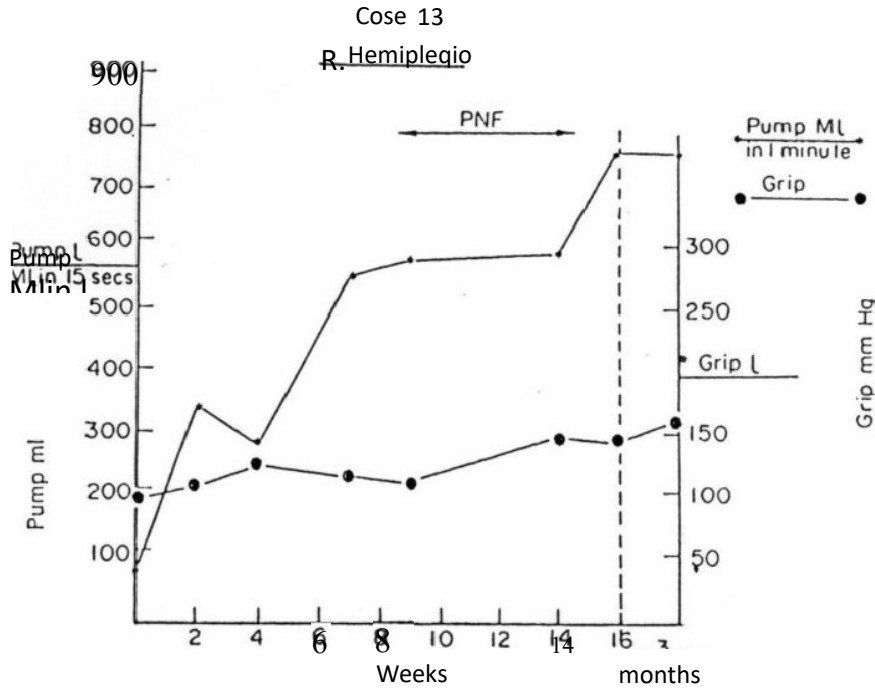


FIG. 3

score after PNF treatment, but there is after a further two weeks' practice, and this is maintained at three months without treatment. Although the grip is only 35 mm. Hg short of the figure for the normal hand, the performance on the pump is much inferior to the normal, for the figure on the left is the score for 15 seconds. In this case, therefore, there is evidence of increase in power following PNF treatment but no improvement in dexterity.

Case 14.—A man aged 54 years with left hemiplegia of five months' duration at the start of testing.

He was able to perform the bobbin peg test and small peg test. Improvement in these tests occurred with practice, but there was no further improvement in these tests occurred with practice, but there after PNF treatment. Following PNF there was improvement from 142 mm. Hg to 170 mm. Hg in grip (figure for normal hand 280mm. Hg), but there was no improvement in the pump test.

Although there was no improvement in dexterity in these cases there was some evidence of improvement in strength. The preliminary period in these three cases was occupied in practice on the tests themselves, and apart from the use of the pump did not include any treatment likely to improved strength. In the next patient, therefore, exercises against resistance were introduced in the preliminary period. He did exercises in the gymnasium, including the use of a spring dumb-bell for the hand and exercises against springs for the rest of the upper limb, special attention being paid to the shoulder abduction, which was particularly weak.

Case 15.—A man aged 65 years with considerable left-sided weakness and spasticity but without sensory loss.

He was able to perform the cream carton and bobbin egg tray tests. There was no alteration in his performance in these tests following PNF treatment. The results of the grip and shoulder abduction measurements showed that there was no improvement following PNF treatment.

## DISCUSSION

The results in these last four cases show that PNF treatment had no effect on the patient's ability to use the hand in tests of dexterity. There is, however, some evidence of improvement in strength in the first three cases. In the fourth patient, who received exercises against resistance in the preliminary period, there was no improvement in strength following PNF treatment.

It may be said that exercises against resistance were employed in the last case and that this is one of the methods advocated by Kabat. Exercises against resistance, however, were used as a routine before Kabat introduced his method. The special techniques advised by Kabat and other advocates of PNF are: (1) the precise application of resistance by the physiotherapist herself; (2) the use of mass movement patterns; (3) the use of proprioceptive and other reflexes; and (4) the reversal of antagonists. In connection with application of resistance by the physiotherapist Kabat (1952) has said: "Manual resistance allows the greatest range of technical procedures for facilitation and is essential in the effective treatment of paralysis". It would therefore seem that ordinary exercises against resistance such as have been employed for the last of these four cases is no substitute for manual resistance by the physiotherapist using PNF techniques.

Kabat (1952), referring to the use of mass movement patterns, says that by a variety of facilitation techniques applied to non-paralysed as well as to paralysed muscles "co-ordinated patterns which can carry over directly in practical activities are developed more effectively". It is fair to assume, therefore, that any beneficial effect resulting from treatment with PNF techniques should be demonstrated by improvement in the ability to use the hand and that this should show in the results of the tests of dexterity described in this paper. There is no such improvement in the four cases which have been carefully studied by means of these tests. In three of the patients, however, there has been some improvement in strength following PNF treatment. It is questionable whether improvement in dexterity should be expected to follow the opening up of new pathways below cortical level, for it is the correlation of sensory with motor impulses in the cerebral cortex which is the essential mechanism on which the performance of skilled acts depends. If new pathway If new pathways were opened up below the level of the internal capsule, some improvement in strength might therefore occur without improvement in dexterity. Increase in strength following PNF treatment might be explained in this way or, alternatively, it might result from strengthening of muscle fibres already functioning under voluntary control. The results of the last of the four cases, in which exercises against resistance were given in the preliminary period, gives a hint that such exercises may be as effective as the more elaborate procedures of PNF treatment.

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These findings are in harmony with the results of the controlled trial of Stern et al. (1970). These authors were unable to demonstrate any significant improvement in strength or mobility following facilitation exercises.

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