GROUP TRAINING IN PARKINSONISM: QUANTITATIVE MEASUREMENTS OF TREATMENT

S. W. Pedersen, B. Öberg, A. Insulander and M. Vietman

Department of Clinical Neurophysiology and Neurology, University Hospital, Linköping, Sweden

ABSTRACT. Ten patients with mild to moderate parkinsonism were tested before and after a 12-week training program. Strength was tested with simultaneous EMG registration in the ankle flexors at different angular velocities using a modified Cybex II equipment. Peak Torque (pT), Torque area (Ta) and EMG area (iEMG) for the eccentric and concentric contractions were calculated. Quotients TpT (Ta/iEMG) for evaluation of work per iEMG in concentric and eccentric contractions were calculated. Gait analysis and a questionnaire for evaluation of the functional level were also included. Mean peak torque values did not change with training. Concentric quotients pT/Ta between test one and control was significantly lower in 30°/s and 120°/s eccentric quotient pT/Ta was significantly lower in the same velocities but between test 2 and control. No improvement in gait was found. Patient questionnaire ratings did not improve significantly though patients had an overall impression of a beneficial effect of physical therapy. No long term effect was found. The results showed with the measuring methods presented no consistent measurable effect from group training in Parkinson’s disease.

Key words: exercise, gait, isokinetic measurement, physical therapy, parkinsonism, rehabilitation.

In Parkinson’s disease (PD) physical therapy is used extensively in conjunction with medical therapy, even though conclusive evidence regarding effectiveness has never been presented. Even this paper does not present conclusive evidence of a positive effect of group training. Subjective assessments of group therapy have been made and the general impression has been positive (7, 9, 13, 14). A decrease in bradykinesia has been reported. It has also been postulated that after training patients are better able to perform activities of daily living (5, 6, 7, 15). Several functional tests for evaluating the effects of physical therapy have been developed (8, 12), but objective methods for quantifying the effects are seldom used. In an attempt to verify whether group therapy can be beneficial to Parkinson patients we developed a training program designed for these patients. Using modified Cybex II equipment (Lumex, Bayshore, New York), the patients were tested both before and after training for isokinetic concentric and eccentric muscle strength in the ankle dorsiflexors. At the same time gait analysis and clinical evaluation were also carried out.

PATIENTS

The test group consisted of ten patients (5 men and 5 women, mean age 66.5 years, SD = 7.25) with mild to moderate parkinsonism (Hoehn and Yahr 1-3) (10), and a duration of disease of 3-5.3 years, SD = 2.1 years. With one exception all patients were taking ordinary antiparkinson drugs and all were in a clinically stable condition. No change in medication was made during the trial. None of the patients had any other major disease. One of the patients did daily gymnastic exercises, but no one in the group participated in organized training. All were out-patients and all volunteered after giving their informed consent. One patient did not want to complete the training and was therefore excluded. The study was approved by the local Ethics Committee.

METHODS

The training program emphasized dynamic movements with variation in speed and adjustment to space. The types of exercises which were used are presented in Table I. The exercises were accompanied by music. The patients participated in group training, in one-hour sessions two times a week for twelve weeks, and were also given special instructions for exercising at home. The patients were tested with a standardized method (13) both before and after the 12-week training period. Four months after the training was completed the patients were retested (control). Patients were tested at the same time of day, preferably before lunch. Each patient was used as his own control. Testing of patients’ general physical condition was not performed.

For objective evaluation of treatment two methods (gait analysis and muscle strength measurement) were used. Both have previously been used in the description of the symptoms of Parkinson’s disease and have in other medical disciplines proved useful in evaluation of given treatment. Both describe motor function but under different circumstances (velo and...
Table I. List of items in the questionnaire

Name and age
Occupation
Degree of daily exercise
Subjective impression of rigidity
Difficulties in gait and postural control
Tendon
Spasm and muscular pain
Muscle weakness
Difficulties in activities of daily living
Daily symptom fluctuations
Evaluation of effects of training

without postural involvement. Isokinetic muscle strength measurements during eccentric and concentric contractions were obtained using modified Cybex II equipment. Tests of strength were done at different angular velocities (0-30°; 60-120°; 180°/s). Torque curves for eccentric and concentric mus-cle contractions were recorded. The patients were informed of the purpose of the study and they were given verbal en-couragement during the tests.

Simultaneous electromyographic (EMG) recordings were made over the muscle bellies of the anterior tibial muscle and the triceps surae. Self adhesive silver-silver chloride elec-
trodes were used with an interelectrode distance of 2-3 cm. Impedances were kept below 5 kohms. The recording system consisted of skin electrodes, amplifiers, and an RMS detector. The results were recorded on an electronic recorder (ES 1000 Coulb). Specifications for preamplifier: gain 60 dB (voltage), frequency range upper (~3 dB point) 2 kHz, lower (~3 dB point) 6 Hz, CMRR 100 dB. Specifications for the amplifier and the RMS detector: gain 20 dB (voltage), band-
width DC-2 kHz. The RMS detector detects true RMS values and consists of an integrated circuit (AD 576 Analog device).

Peak torque (PT), torque area (TA), integrated EMG (IEMG) were calculated during both the eccentric and the concentric contractions. The quotient between TA/EMG (quotient-q) was calculated as if the relation between work performed and EMG was changed. Area calculations for torque and e.m.g were performed using a Digitizer (Houston Instruments, Houston, USA). Muscle strength during the eccentric and the concentric contractions was only tested in the left leg, irrespective of where the patients had the most marked symp-
toms and whether it was the patient's dominant or non-
dominant leg. The test session was completed with a gait analysis in which the patient walked a distance of ten metres using five different paces ranging from the fastest they could go to the slowest. Body mass of the patient and EMG were calculated after two to three trials at each pace. Regression coefficients between stride length and stride frequency was calculated for obtaining stride length at constant velocity.

For evaluation of motor function we tested gait as well as isokinetic muscle strength. Both are needed to differentiate between the influences of central and peripheral factors on muscle performance. With this in mind we considered the methods used sufficient to detect as effect of the given treat-
ment (13, 18). The present methods have been used for de-
scribing motor disturbances and training effects in other dis-
cases.

Table III. Peak torque

Data given as mean and, in parentheses, standard deviation

<table>
<thead>
<tr>
<th>Test</th>
<th>Isometric</th>
<th>30°/s</th>
<th>120°/s</th>
<th>180°/s</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concentric peak torque (PT) values before and after training (Nm)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Before*</td>
<td>32 (13)</td>
<td>32 (12.6)</td>
<td>11.2 (8.8)</td>
<td>8.8 (6.6)</td>
</tr>
<tr>
<td>After*</td>
<td>24.7 (8.9)</td>
<td>28.7 (9.3)</td>
<td>9.1 (6.3)</td>
<td>5.9 (2.9)</td>
</tr>
<tr>
<td>Control†</td>
<td>25.6 (12.4)</td>
<td>19.0 (9.6)</td>
<td>11.0 (6.5)</td>
<td>8.8 (6.4)</td>
</tr>
<tr>
<td>Eccentric peak torque (PT) values before and after training (Nm)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Before*</td>
<td>37.5 (14.8)</td>
<td>37.4 (14.6)</td>
<td>40.8 (16.3)</td>
<td>39.3 (14.4)</td>
</tr>
<tr>
<td>After*</td>
<td>33.3 (14.5)</td>
<td>38.1 (13.3)</td>
<td>39.3 (13.4)</td>
<td>38.2 (12.9)</td>
</tr>
<tr>
<td>Control†</td>
<td>38.2 (12.9)</td>
<td>37.2 (12.4)</td>
<td>40.7 (12.7)</td>
<td>38.2 (12.9)</td>
</tr>
</tbody>
</table>

Table IV. Quotient-q (torque area/EMG area)

Data given as mean and in parentheses, standard deviation

<table>
<thead>
<tr>
<th>Test</th>
<th>30°/s</th>
<th>120°/s</th>
<th>180°/s</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concentric contraction (torque area/EMG area)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Before*</td>
<td>4.14 (1.63)</td>
<td>1.51 (1.28)</td>
<td>1.72 (1.98)</td>
</tr>
<tr>
<td>After*</td>
<td>2.60 (2.00)</td>
<td>0.96 (0.80)</td>
<td>0.82 (0.53)</td>
</tr>
<tr>
<td>Control†</td>
<td>1.21 (0.50)</td>
<td>0.61 (0.41)</td>
<td>0.63 (0.38)</td>
</tr>
<tr>
<td>Eccentric contraction (torque area/EMG area)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Before*</td>
<td>5.69 (7.0)</td>
<td>4.87 (7.41)</td>
<td>4.14 (2.55)</td>
</tr>
<tr>
<td>After*</td>
<td>4.82 (2.92)</td>
<td>4.20 (2.73)</td>
<td>4.26 (2.74)</td>
</tr>
<tr>
<td>Control†</td>
<td>2.19 (1.33)</td>
<td>2.73 (1.58)</td>
<td>2.92 (1.57)</td>
</tr>
</tbody>
</table>

Results

In addition a patient questionnaire regarding the patient's own impression of his disability at the present time was answered before each test session. The questionnaire included several aspects of Parkinson syndrome (Table II). Visual analog scales (VAS-scales) were used for self estimation of functional status (posture, rigidity, ADL level) at the time of testing. Patients should also evaluate the group training and describe in what way they experienced the effect of training. Standard statistical methods were used including the Stu-
dent t-test (paired sample test) and Wilcoxon's rank sum test. Sign test was used for analysis of the questionnaire. Data are presented as mean and standard deviation.

RESULTS

Peak torque

There was no significant change in peak torque before and after training and at the 4 months control (Table III).

Table V. Gait

Gait parameters, maximum velocity and stride length (SL). Data given as mean and, in parentheses, standard deviation

<table>
<thead>
<tr>
<th>Test</th>
<th>Max. vel. (m/s)</th>
<th>SL(m) at 0.5 m/s</th>
<th>SL (m) at 1.1 m/s</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before*</td>
<td>1.03 (0.34)</td>
<td>0.89 (0.11)</td>
<td>1.26 (0.11)</td>
</tr>
<tr>
<td>After*</td>
<td>1.27 (0.46)</td>
<td>0.74 (0.12)</td>
<td>1.14 (0.18)</td>
</tr>
<tr>
<td>Control†</td>
<td>1.48 (0.39)</td>
<td>0.76 (0.13)</td>
<td>1.12 (0.16)</td>
</tr>
</tbody>
</table>

DISCUSSION

Even though the use of group therapy in Parkinson's disease is widespread some controversy still remains.
Table 1. List of items in the training program

Initial warm-up with different gait exercises
Standing and sitting ball-throwing exercises to increase coordination and mobility
Foot and leg exercises with varied speed to increase strength, mobility and coordination in the sitting and erect positions
Exercises in the recumbent position for improving strength, mobility and coordination in the abdominal, back and hip muscles
Training exercises for balance and postural control for pairs of patients using foottballs
Circular training court equipped with physical obstacles which are to be climbed over as fast as possible
Post training relaxation period

Table II. List of items in the questionnaire

Name and age
Occupation
Degree of daily exercise
Subjective impression of rigidity
Difficulties in gait and postural control
Torsion
Spasm and muscular pain
Muscle weakness
Difficulties in activities of daily living
Daily symptom fluctuations
Evaluation of effects of training

without postural involvement. Isokinetic muscle strength measurements during eccentric and concentric contractions were obtained using modified Cybex II equipment. Tests of strength were done at different angular velocities (0–30°/s, 120–180°/s). Torque curves for eccentric and concentric muscle contractions were recorded. The patients were informed of the purpose of the study and they were given verbal encouragement during the tasks. Simultaneous electromyographic (EMG) recordings were made on the muscle bellies of the anterior tibial muscle and the triceps surae. Self adhesive silver-mercury-chloride electrodes were used with an interelectrode distance of 2–3 cm. Impedances were kept below 5 kOhm. The recording system consisted of skin electrodes, amplifiers and an RMS detector. The results were recorded on an electronic recorder (ES 1000 Conti). Specifications for the amplifier: gain 66 dB (voltage), frequency range upper (=–3 dB point) 2 kHz, lower (=–3 dB point) 68 Hz, CMRR 100 dB. Specifications for the amplifier and the RMS detector: gain 20 dB (voltage), bandwidth DC-2 kHz. The RMS detector detects true RMS values and consists of an integrated circuit (AD 536 Analog device).

Peak torque (PT), torque area (TA), integrated EMG (IEMG) were calculated during both the eccentric and the concentric contractions. The quotient between TA/IEMG (quotient-q) was calculated as if the relation between work performed and EMG was changed. Area calculations for torque and EMG were performed using a Digitiser (Houston Instruments, Houston, USA). Muscle strength during the eccentric and the concentric contractions was only tested in the left leg, irrespective of where the patient had the most muscular symptoms and whether it was the patient’s dominant or non-dominant leg. The test session was completed with a gait analysis in which the patient walked a distance of ten metres using five different paces ranging from the fastest they could go to the slowest. Rotor parameters of gait (stride frequency, stride length, velocity of gait) were calculated after two to three trials at each pace. Regression coefficients between stride length and stride frequency was calculated for obtaining stride length at constant velocity.

For evaluation of motor function we tested gait as well as muscle strength. Both are needed to differentiate between the influences of central and peripheral factors on muscle performance.

In addition a patient questionnaire regarding the patient’s own impression of his disability at the present time was answered before each test session. The questionnaire included several aspects of Parkinson’s disease (Table II). Visual analog scales (VAS-scales) were used for self estimation of functional parameters (gait, rigidity, dexterity) on a level at the time of testing. Patients should also evaluate the group training and describe in what way they experienced the effect of training.

Table III. Peak torque

Data given as mean and, in parentheses, standard deviation

<table>
<thead>
<tr>
<th>Test</th>
<th>Isometric</th>
<th>30°/s</th>
<th>120°/s</th>
<th>180°/s</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concentric peak torque (PT) values before and after training (Nm)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Before (1)</td>
<td>52.7 (8.9)</td>
<td>24.7 (5.3)</td>
<td>9.1 (6.3)</td>
<td></td>
</tr>
<tr>
<td>After (2)</td>
<td>28.7 (12.6)</td>
<td>12.2 (8.8)</td>
<td>11.0 (6.5)</td>
<td></td>
</tr>
<tr>
<td>Control (3)</td>
<td>25.6 (12.4)</td>
<td>19.0 (6.8)</td>
<td>8.8 (6.4)</td>
<td></td>
</tr>
<tr>
<td>Eccentric peak torque (PT) values before and after training (Nm)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Before (1)</td>
<td>28.5 (14.5)</td>
<td>20.5 (14.6)</td>
<td>40.8 (16.3)</td>
<td></td>
</tr>
<tr>
<td>After (2)</td>
<td>35.3 (14.5)</td>
<td>38.1 (13.5)</td>
<td>39.3 (14.6)</td>
<td></td>
</tr>
<tr>
<td>Control (3)</td>
<td>38.2 (12.9)</td>
<td>37.2 (12.4)</td>
<td>40.7 (12.7)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Test</th>
<th>Max. vel. (m/s)</th>
<th>SL (m) at 0.5 m/s</th>
<th>SL (m) at 1.1 m/s</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before (1)</td>
<td>1.63 (0.34)</td>
<td>0.89 (0.13)</td>
<td>1.26 (0.11)</td>
</tr>
<tr>
<td>After (2)</td>
<td>1.27 (0.46)</td>
<td>0.74 (0.12)</td>
<td>1.14 (0.18)</td>
</tr>
<tr>
<td>Control (3)</td>
<td>1.48 (0.39)</td>
<td>0.76 (0.13)</td>
<td>1.12 (0.16)</td>
</tr>
</tbody>
</table>

Table IV. Quotient-q (torque area/EMG area)

Data given as mean and in parentheses, standard deviation

<table>
<thead>
<tr>
<th>Test</th>
<th>30°/s</th>
<th>120°/s</th>
<th>180°/s</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test values for concentric quotient-q (TA/IEMG)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Before (1)</td>
<td>4.14 (0.65)</td>
<td>1.51 (1.28)</td>
<td>1.72 (0.98)</td>
</tr>
<tr>
<td>After (2)</td>
<td>2.40 (0.26)</td>
<td>0.96 (0.80)</td>
<td>0.82 (0.53)</td>
</tr>
<tr>
<td>Control (3)</td>
<td>1.21 (0.50)</td>
<td>0.61 (0.41)</td>
<td>0.63 (0.38)</td>
</tr>
<tr>
<td>Test values for eccentric quotient-q (TA/IEMG)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Before (1)</td>
<td>5.69 (7.0)</td>
<td>4.87 (4.74)</td>
<td>4.14 (2.55)</td>
</tr>
<tr>
<td>After (2)</td>
<td>4.82 (2.92)</td>
<td>4.20 (2.73)</td>
<td>4.26 (2.74)</td>
</tr>
<tr>
<td>Control (3)</td>
<td>2.19 (1.33)</td>
<td>2.73 (1.58)</td>
<td>2.92 (1.57)</td>
</tr>
</tbody>
</table>

| * Before training.  | * After training.  | * Control four months after training, indicates significant changes between test one and test two (*), between test one and test three (**), between test two and test three (***) |

Table V. Gait

Gait parameters, maximum velocity and stride length (SL). Data given as mean and, in parentheses, standard deviation

<table>
<thead>
<tr>
<th>Test</th>
<th>Max. vel. (m/s)</th>
<th>SL (m) at 0.5 m/s</th>
<th>SL (m) at 1.1 m/s</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before (1)</td>
<td>1.63 (0.34)</td>
<td>0.89 (0.13)</td>
<td>1.26 (0.11)</td>
</tr>
<tr>
<td>After (2)</td>
<td>1.27 (0.46)</td>
<td>0.74 (0.12)</td>
<td>1.14 (0.18)</td>
</tr>
<tr>
<td>Control (3)</td>
<td>1.48 (0.39)</td>
<td>0.76 (0.13)</td>
<td>1.12 (0.16)</td>
</tr>
</tbody>
</table>

| * Before training.  | * After training.  | * Control four months after training, indicates significant changes between test one and test two (*), between test one and test three (**), between test two and test three (***) |

Quotient-q

Concentric contraction (torque area/EMG area)

There was a significant decrease in quotient-q in the concentric contraction at 30°/s (p < 0.05) and 120°/s (p < 0.05) between the first test and at the 4 month control, but otherwise no significant change was found (Table IV).

Eccentric contraction (Torque area/EMG area)

No significant change was found in the quotient-q after training; only between the second test and the control a significant decrease in quotient-q was found during 30°/s (p < 0.02) and 120°/s (p < 0.04) (Table IV).

Electromyography

Muscles triceps surae showed no notation during contraction of muscles tibialis anterior in muscle strength measurement.

Gait

The gait analysis showed a significant decrease in maximum velocity after training (p < 0.03). Significant decrease in stride length was found and results are presented as stride length at constant velocity at 0.5 m/s (p < 0.04) and 1.1 m/s (p < 0.05) after training (Table V).

Questionnaire

The results of the questionnaire were non-conclusive. According to the evaluations with the VAS-scales there was no significant improvement in the items asked about. In spite of this, all the patients found it beneficial to attend physical training sessions even though they may have indicated in the questionnaire that their functional ability had not improved.

RESULTS

Peak torque

There was no significant change in peak torque before and after training and at the 4 months control (Table III).

DISCUSSION

Even though the use of group therapy in Parkinson’s disease is widespread some controversy still remains
in regard to the effects (4, 5, 7). The purpose of this study was to test the effect of a group-training program for patients with PD using motor function test. Results from previous studies are inconsistent and inconclusive (for a review see Palmer et al. 1986 (14)), but the general impression is that there is a positive psychological effect from group training (5, 9).

Measurement of time is often used in the evaluation of training effects. We did not approach this line of strategy but wanted to see if patients were capable of improvement in motor capability by improving muscle strength and gait.

In this study we found no improvement of muscle strength. Significant changes in mean peak torque were not found and the decrease in quotient-q was not consistent.

It is well known that gait is affected in Parkinson’s disease (11, 17), but we found no explanation for the decrease in maximum gait velocity and stride length at constant velocity after training. The results were difficult to interpret. Maybe they could be explained by the daily fluctuations in symptoms experienced by many patients. The patients’ VAS evaluation of their functional ability indicated no improvement after training, but they all had positive attitudes towards the given group training. This is also the impression obtained from other studies (1, 2, 13, 16). The discrepancies between objective and subjective results could be explained by the short period of training or by decreased psychological comfort.

Assuming that the trainability of Parkinson patients and normal individuals is equal, effect from training would be expected. To explain the lack of effect in this study it could be assumed that the patients’ responsivity to training was decreased because of their relative immobilization and the secondary atrophy of fast muscle fibers (3). It is also possible that diseases of the central nervous system reduce the ability to benefit from group therapy when weakness is not due merely to the effect of disease or when there is no weakness but a lack of activation. Recruitment patterns have been shown to be disrupted in PD. The high mean age of these patients should influence the test results negatively, since it has been proved that it is still possible to increase strength in old age (with individual training), (8, 17).

With the present methods, and testing a group of limited size no effects of group training were found on the motor symptoms of Parkinson’s disease. However, the patients’ subjective impression of beneficial effects from training stand firm, and therefore group training in order to alleviate psycho-social discomfort should be considered. We believe that physical training should be regarded as an important part of management and rehabilitation in Parkinson’s disease. This conclusion is in line with that of other authors (4, 5, 6, 7, 14, 15).

ACKNOWLEDGMENT

The financial assistance of The Vanv. L. Smith Foundation, Houston, Texas, is gratefully acknowledged.

REFERENCES


Address for offprints: Stephan W sixteen Pedersen, M.D.
Department of Clinical Neurophysiology
University Hospital
S-681 83 Linköping
Sweden
in regard to the effects (4, 5, 7). The purpose of this study was to test the effect of a group-training pro-
gram for patients with PD using motor function tests. Results from previous studies are inconsistent and
inconclusive (for a review see Palmer et al. 1986 (14)),
but the general impression is that there is a positive
psychological effect from group training (5, 9).
Measurement of time is often used in the evalua-
tion of training effects. We did not approach this line
of strategy but wanted to see if patients were capable
of improvement in motor capability by improving
muscle strength and gait.
In this study we found no improvement of muscle
strength. Significant changes in mean peak torque
were not found and the decrease in quotient-q was not
consistent.
It is well known that gait is affected in Parkinson's
disease (11, 13), but we found no explanation for the
decline in maximum gait velocity and stride length
at constant velocity after training. The results were
difficult to interpret. Maybe they could be explained
by the daily fluctuations in symptoms experienced by
many patients. The patients' VAS Evaluation of their
functional ability indicated no improvement after
training, but they all had positive attitudes towards
the given group training. This is also the impression
obtained from other studies (1, 2, 3, 16). The dis-
crepancies between objective and subjective results
could be explained by the short period of training or
by decreased psychosocial discomfort.
Assuming that the trainability of Parkinson pa-
tients and normal individuals is equal, effect from
training would be expected. To explain the lack of
effect in this study it could be assumed that the pa-
tients' responsivity to training was decreased because
of their relative immobilization and the secondary
atrophy of fast muscle fibres (3). It is also possible
that diseases of the central nervous system reduce the
ability to benefit from group therapy when weakness
is not due merely to the effect of disease or when there
is no weakness but a lack of activation. Recruitment
patterns have been shown to be disrupted in PD.
The high mean age of these patients should not in-
fluence the test results negatively, since it has been proved
that it is still possible to increase strength in old age
(with individual training), (8, 17).
With the present methods, and testing a group of
limited size no effects of group training were found on
the motor symptoms of Parkinson's disease. How-
ever, the patients' subjective impression of beneficial
effects from training stand firm, and therefore group
training in order to alleviate psycho-social discomfort
should be considered. We believe that physical train-
ing should be regarded as an important part of man-
agement and rehabilitation in Parkinson's disease.
This conclusion is in line with that of other authors
(4, 5, 6, 7, 14, 15).

ACKNOWLEDGEMENT
The financial assistance of The Vivian L. Smith Foundation,
Houston, Texas, is gratefully acknowledged.

REFERENCES
1. Chatterje, M. E., Bernstein, N., Sharpe, W. & Schuw, R.
Short-term group therapy of patients with Parkinson's
2. Davis, M. T. Team management of Parkinson's disease.
3. Ekström, L. & Gislason, L.: Effects of exercise on the
4. Fleiss, B., Capriles, R. & Rose, F. C.: Physiotherapy and
assessment in Parkinson's disease using the polaris-
ted light goniometer. In Research Progress in Parkin-
406-413. Pitman Medical. Tunbridge Wells, Kent, En-
gland, 1981.
Physiotherapy in Parkinson's disease. In Research Prog-
ress in Parkinson's Disease (ed. F. C. Rose & R. Capri-
des), pp. 397-400. Pitman Medical. Tunbridge Wells,
6. Gauthier, L., Delziel, S. & Gauthier, S.: The benefits of
group occupational therapy for patients with Parkinson's
J. B.: A controlled trial of physiotherapy for Parkinson's
F. C. Rose & R. Capriles), pp. 401-403. Pitman Med-
cal, Tunbridge Wells, 1981.
8. Grinthy, G.: Physical activity and muscle training in the
sjogrynsmässiga effekter av gruppskårdning. Sjogryns-
ma 833, 19-21.
12. Monigh, E. C., Fari B: The Northwestern University
concept of rehabilitation through group physical therapy.
14. Palmer, R. S., Mortimer, J. A., Webster, D. D., Webster,
D. I., Bistems, R. & Dickinson, G. L.: Exercise therapy
for Parkinson's disease. Arch Phys Med Rehabil 67:
15. Sostèly, B. C., Kousinovic, N. N. & Sheppard, W.: Ad-
junctive treatment in Parkinson's disease: physical ther-
apy and supportive group therapy. Rehabilitation Lit-

Scand J Rehab Med 22