Most of the members of the therapeutic team in stroke rehabilitation take the effectiveness of physical treatments after stroke for granted. Yet, published data show that the evidence is not so straightforward or easy to evaluate. The majority of the hard evidence, however, does imply that stroke patients benefit from rehabilitation with physiotherapy. This benefit may be statistically small, but for a given individual, it could mean the difference between living at home or in an institution. Few studies address the question of the optimal physiotherapy in stroke rehabilitation. The evidence available today suggests that it does not matter which form of treatment is chosen and that any of the available approaches will improve the patient’s functional status. In other words, if an optimal treatment exists, we have, so far, failed to identify it. Until further evidence emerges, we should therefore select therapies that are most cost-effective and that can be given to the largest number of patients. Well-planned clinical trials aimed at finding the best approach and discriminating potential responders from nonresponders are urgently needed.

The remarkable decline in stroke mortality in some countries during the last decades is predominantly due to a decrease in incidence and only to a lesser extent to an increase in survival rates. Thus, the decline may be seen as a triumph of prevention. At the same time, acute stroke therapy has failed to keep pace, and the role of rehabilitation in reducing stroke fatality is not clear at all. There are many uncertainties surrounding stroke rehabilitation. In particular two key questions need to be asked: Is stroke rehabilitation effective? and Which is the optimal approach?

Evidence Concerning the Effectiveness of Rehabilitation

A number of uncontrolled studies have suggested that rehabilitation programs lead to an improvement in functional status that cannot be attributed merely to spontaneous recovery. The introduction of stroke units brought about a significantly higher hospital discharge rate than historical controls. Similarly, the number of secondary complications after stroke is reported to be lowered by admission to a specialized stroke unit. Several groups have conducted controlled trials comparing the outcome of patients from stroke units with those from medical wards. The first such study reported no benefit for mildly and severely affected patients but a significantly better outcome for patients with moderate disabilities. Feigenson and colleagues showed in a similar trial that patients admitted to a stroke unit were more likely to be discharged home and were able to walk better.

Garraway et al performed a randomized trial comparing 152 hemiplegic, conscious stroke patients from a medical ward to 155 similar patients from a stroke unit, who also received significantly more physical therapy. Sixty days after hospital admission, 50% of the stroke unit patients but only 32% of the medical ward patients were functionally independent. In the next year, however, this difference was lost. Since the stay in the stroke unit averaged 55 days and that in the medical ward averaged 75 days, the authors conclude that longer rehabilitation is mandatory for sustained benefit. In a more detailed analysis of the same trial, the authors also conclude that an early start of rehabilitation is more important than the absolute amount of physiotherapy administered. They have no doubt that the coordinated team approach used in a stroke unit is superior to that in a medical ward. Unfortunately, this study (like the majority of other trials) was not a blind one.

Strikingly similar results were reported from Sweden. In a nonrandomized trial, 60 stroke patients were submitted to individually adapted programs of early activation by a specially trained nursing staff; 52 stroke patients from other wards served as controls. According to an activity index of functional capacity,
there was significant improvement only in the experimental group within 4 weeks after the acute event. After this period, both groups were treated conventionally. The effect of early activation was then lost during the following year.15

Smith and coworkers16 randomized 133 stroke patients who were fit enough to go through an intensive rehabilitation into three equally sized groups, an intensive rehabilitation group (4 entire days per week), a conventional rehabilitation group (3 half days per week), and a group that underwent no rehabilitation (patients were told only to carry on exercising as previously taught). In the first two groups, treatment was performed for up to 6 months. The functional outcome (index of daily life activities) was best in the first group. Conventional rehabilitation was less beneficial, and patients with no supervised rehabilitation deteriorated. Maximum benefit was obtained at 3 months, and continuation of the program merely maintained this success without extending it. This trial seems particularly relevant since it refutes Lind's view17 that spontaneous recovery, rather than rehabilitation, accounts for most of the improvement in functional ability.

Sivenius et al18 compared 40 patients treated conventionally with 45 others who were rehabilitated intensively with physiotherapy twice per day until no more functional improvement was observed. The intensively treated patients showed significantly better functional recovery, but death and institutionalization rates were not different. As in the previous trial, recovery occurred predominantly during the first 3 months. Furthermore, there were several disadvantages: the sample size was small, the study was not blind, and rehabilitation started perhaps too late. They found that practically all stroke survivors were helped by such a program, but it is also possible that they were merely unable to identify which subgroup responded less.

Other evidence has brought into question the effectiveness of rehabilitation programs. Three randomized controlled trials evaluating the usefulness of stroke rehabilitation were inconclusive,21-23 mainly due to the small sample sizes. Another group24 reported that physiotherapy did not lead to functional recovery nor prevent complications after stroke. A randomized controlled trial25 showed that traditional care, consisting of physical therapy only on request of the physician, resulted in survival rates for motor functions, males performed better when on team care, whereas females benefited more from traditional care. In terms of functional abilities, males receiving team care fared better, whereas women experienced no differences between the two treatments. Finally, one report26 implied that a community-based program to coordinate inpatient and outpatient rehabilitation was not effective in terms of functional outcome (Barthel index). Unfortunately, controls were not matched, allowing for considerable bias in this particular study.

It is difficult to come to firm conclusions based on these data27 because study protocols differ widely among trials and stroke units vary from specialized acute care units19,20 to nonacute rehabilitation centers.20 Moreover, selection criteria for patient admission are not uniform, and duration, type, and onset of rehabilitation differ. Finally, measurements of outcome are not constant.28 Yet, after critical evaluation, particularly of the randomized trials (Table 1), stroke rehabilitation does seem to have its value. Spontaneous recovery can be impressive, but rehabilitation-induced recovery seems to be greater on average. The benefit may be statistically small, but it is medically relevant since, for a given patient, it could mean the difference between living at home or being institutionalized.

Rehabilitation should probably begin as soon as possible after the acute event. Whether highly intensive treatment is better than moderately intensive therapy is debatable. Even though the most marked improvement is achieved during the first 3 months,29 rehabilitation should be continued for a longer period to prevent subsequent deterioration. Clearly, the evidence is not as convincing as one would wish, and further meticulously planned studies are badly needed.

Evidence for Optimal Physiotherapy

Medical doctors are often stunned by the range of choices of physiotherapeutical approaches; acquainted with the techniques of researchers such as Bobath, Brunnstrom, Clayton, Coulter, Fay, Kabat, Knott, Rood, and Voss; and unfamiliar with the theories behind these techniques.30 At closer inspection, the conclusions drawn by these sometimes competing schools of thought lack sound scientific proof, and published data that indicate optimal physiotherapy is limited. For the purpose of this communication, physiotherapy is defined as any physical treatment including therapeutic exercise and ergotherapy.

Stern et al31 treated two groups of 31 stroke patients (partly randomized) with either proprioceptive neuromuscular facilitation or conventional physiotherapy. Patients were admitted into the trial up to 13 days after the acute event. There was no better recovery of mobility, strength, or function in the facilitation group than in the other populations. However, the sample size was small, the study was not blind, and rehabilitation started perhaps too late. Two earlier studies32,33 had addressed similar questions but are not detailed here because of certain deficiencies. One study32 used now-obsolete thera-
Table 1. Randomized Trials on the Efficacy of Stroke Rehabilitation

<table>
<thead>
<tr>
<th>Reference</th>
<th>Therapy group</th>
<th>Mean age (yr)</th>
<th>Blind evaluation</th>
<th>Start of rehabilitation</th>
<th>Duration of rehabilitation</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Garraway et al11,12 (1980)</td>
<td>Stroke unit*</td>
<td>72.5</td>
<td>No</td>
<td>No later than 3 days after stroke</td>
<td>55 days</td>
<td>60 days after stroke, 50% of stroke unit patients and 32% of medical ward patients were independent. Difference was lost at 1-year follow-up.</td>
</tr>
<tr>
<td></td>
<td>Medical ward</td>
<td>72</td>
<td>No</td>
<td>On discharge from acute care</td>
<td>75 days</td>
<td>ADL improvement was greatest in intensive care group and intermediate in conventional group. Deterioration was observed in self-care group.</td>
</tr>
<tr>
<td></td>
<td>Conventional care</td>
<td>66</td>
<td>No</td>
<td>No later than 1 week after stroke</td>
<td>6 months</td>
<td>15% of stroke unit patients and 39% of medical ward patients remained hospitalized 3 months after stroke.</td>
</tr>
<tr>
<td></td>
<td>Self care</td>
<td>65</td>
<td>No</td>
<td>No later than 1 week after stroke</td>
<td>6 months</td>
<td>Survival was similar in both groups. In motor performance, males were better with team care, and females were better with traditional care; in functional abilities, males were better with team care, and females fared the same in both groups.</td>
</tr>
<tr>
<td>Smith et al16 (1981)</td>
<td>Intensive care†</td>
<td>63</td>
<td>No</td>
<td>No later than 1 week after stroke</td>
<td>21 days</td>
<td>ADL improvement was greatest in intensive care group and intermediate in conventional group. Deterioration was observed in self-care group.</td>
</tr>
<tr>
<td></td>
<td>Medical ward</td>
<td>73</td>
<td>No</td>
<td>No later than 1 week after stroke</td>
<td>31 days</td>
<td>ADL improvement was greatest in intensive care group and intermediate in conventional group. Deterioration was observed in self-care group.</td>
</tr>
<tr>
<td></td>
<td>Conventional care</td>
<td>110</td>
<td>No</td>
<td>No later than 1 week after stroke</td>
<td>5 weeks</td>
<td>ADL improvement was greatest in intensive care group and intermediate in conventional group. Deterioration was observed in self-care group.</td>
</tr>
<tr>
<td></td>
<td>Self care</td>
<td>74.9</td>
<td>No</td>
<td>No later than 1 week after stroke</td>
<td>5 weeks</td>
<td>ADL improvement was greatest in intensive care group and intermediate in conventional group. Deterioration was observed in self-care group.</td>
</tr>
<tr>
<td>Loggigian et al34</td>
<td>Stroke unit§</td>
<td>72</td>
<td>No</td>
<td>No later than 1 week after stroke</td>
<td>21 days</td>
<td>ADL improvement was greatest in intensive care group and intermediate in conventional group. Deterioration was observed in self-care group.</td>
</tr>
<tr>
<td></td>
<td>Medical ward</td>
<td>73</td>
<td>No</td>
<td>No later than 1 week after stroke</td>
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</tr>
</tbody>
</table>

n is the number of patients in each therapy group. If a single value (or statement) is given for a particular study, this represents the therapy groups of that study combined. ADL, activities of daily living.

*Operated according to Isaacs.
†Outpatient treatments (essential details are missing).
‡This study was only quasi-randomized (allocation by available space in stroke unit).
§Team work of specialists, early start, family education.
|| Evaluation not strictly blind but by a noninvolved third party.

pies, and the other study33 used a facilitation group of only four patients, unmatched controls, and no randomization.

Loggigian et al34 performed a study in which 42 stroke patients (stroke history was ≤ 7 weeks) were randomly allocated to “traditional” or Bobath’s physiotherapy. Neither the Barthel index nor the Kendall muscle test showed group differences, but both groups improved in the same way. Again, the same drawbacks were present: the sample size was small, the start of rehabilitation was late, and the study was not a blind one.

Lord and Hall35 matched two groups of stroke patients (n=19 and 20) from two different centers. One center focused on “traditional” techniques (average stroke history was 9 days); the other focused on facilitation techniques (average stroke history at entry was 26 days). There was a considerable overlap concerning the treatments administered. Hospitalization was 29 days in one center and 68 days in the other. A validated telephone questionnaire on daily life activities 8 months after the acute event showed a slight, but clinically meaningless, advantage in self-feeding ability in the facilitation group. Other functions were not significantly different. This study suffers from the disadvantages of the above trials plus considerable intergroup inequality, as outlined above.

Smedley et al36 compared two groups of 25 patients each from two hospitals in a nonrandomized trial. Both groups were treated traditionally for 1 month, but the experimental group had to play with a modified “slot machine” to enhance motor function, strength, and coordination of the upper limb. All these variables improved significantly better in the experimental group. Yet this study is poorly controlled, and decisive details on treatment modalities and patient characteristics are missing.

Dickstein and coworkers37 performed a large quasi-randomized (n=131) study on three different physiotherapies: conventional, facilitation, and Bobath. The patients admitted to rehabilitation 16 days after the acute event were treated for 6 weeks. In the early phase, conventionally treated patients fared better in terms of ambulation. At the end of the trial, there were no significant differences among the groups with regard to functional recovery. In this study, rehabilitation was started late and was of short duration.
Basmajian et al\textsuperscript{38} tested two physical therapies on hemiparetic stroke patients. Twenty-nine patients were randomly assigned to either Bobath treatment or a “behavioral cognitive physical therapy” consisting mainly of a specially designed electromyographic biofeedback program for the upper limb. The assessment of arm function was by blind evaluation. After 9 months, both therapies showed significant improvements, but there were no differences between the two groups. According to other reports\textsuperscript{39} (most of them not randomized), biofeedback seems a promising approach in stroke rehabilitation. It is particularly favorable when initiated early in only mildly affected patients.\textsuperscript{38,40–42} This therapy is not costly or work intensive and can be performed on outpatients; it deserves further study to define its role in stroke rehabilitation.

With the exception of one study,\textsuperscript{36} which is even more problematic in design and execution than other investigations, all trials seem to convey the same message: the type of treatment does not matter as long as the stroke patient gets some sort of physiotherapy (Table 2). This must be sobering to the followers of one particular school, but it represents the state of the art today. In no way, however, is this conclusion nihilistic toward physical therapy and rehabilitation. On the contrary, it bears an optimistic prospect that stroke rehabilitation is preferable to spontaneous recovery,\textsuperscript{43} regardless of which physiotherapy is chosen. One-sided approaches neglect the complexity of the problem and must be avoided.\textsuperscript{44,45}

These data on effectiveness of stroke rehabilitation imply that early start is preferable. The trials comparing one approach to another are invariably burdened by the relatively late start of the particular intervention to be tested. Future studies aimed at clarifying the issue of optimal rehabilitation should begin therapy in the very early phase after the acute event. Existing data also suggest that if an optimal physical therapy exists, it has not yet been identified. Further investigation is also necessary to determine which patient benefits from a rehabilitation program and which does not.

For the time being, the obvious conclusion is that stroke rehabilitation should be applied in forms that are most cost-effective and that can be administered to the largest number of patients. From our present knowledge, or rather from the lack of it, only one thing is undebatably and painfully clear: “Controlled clinical trials are essential if the role of rehabilitation, its indications, and its contraindications are to be more adequately understood.”\textsuperscript{46}

## References


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