An expert opinion: upper limb rehabilitation after stroke

Key take home messages

1. Clinically meaningful improvements are possible in chronic stroke patients.
2. The dose of rehabilitation treatment needs to be larger than currently delivered.
3. Rehabilitation is a complex intervention that cannot be reduced to a single element.

Somewhere between 50-80% of stroke survivors have upper limb symptoms after acute stroke and persistent difficulty in using the upper limb is a major contributor to ongoing physical disability. A commonly held view is that most recovery from stroke occurs over the first three to six months after which little improvement is possible, especially at the level of impairment. We argue that this may be a self-fulfilling prophecy due to the lack of provision of potentially helpful rehabilitation.

What is the best way to promote upper limb recovery after stroke? Most studies of behavioural interventions have investigated forms of constraint induced movement therapy (CIMT), repetitive task training (RTT) or robotics, each of which focuses on increasing the activity of the affected limb. Kwakkel et al. suggested that motor function, arm-hand activities and self-reported arm-hand functioning in daily life, improved immediately after CIMT and at long-term follow-up, but the comparison was often with usual care. It is worth noting that CIMT approaches were said to be more likely to be successful in promoting long-term benefits if the protocol included shaping, massed practice and a more complex transfer package, whereas simple forced use therapy was ineffective. RTT also has some evidence to support benefits over what is described as usual care, but the evidence for benefits over ‘matched therapy’ is less strong. The use of robotics can increase the number of movement repetitions, but has failed to produce clinically meaningful effects. Indeed, the recent RATULS study showed that compared with usual care, approximately 25 hours of robot-assisted training and matched dose upper limb therapy did not improve upper limb function. Overall, it would appear that asking patients to make simple repetitions of movement, however meaningful the task, is relatively ineffective without some way of actively translating any improvements into activities of daily living. Simply increasing the number of repetitions does not appear to be effective, and this in itself should give us pause for thought.

A few studies have tested more complex therapies incorporating a number of different elements. The iCARE study of upper limb treatment after stroke went beyond simple repetitions, using a structured, task-oriented motor training programme that was impairment focused, task specific, intense, engaging, collaborative, self-directed, and patient centred, starting about six weeks post-stroke. Outcomes were not improved by this approach, but on reflection it is likely that, as with many of the studies, the dose of 50 hours over ten weeks was too low (the usual care group received 11.2 hours over ten weeks). Despite scepticism that stroke patients would be able to tolerate much higher doses, one study managed to deliver 300 hours of upper limb therapy to chronic stroke patients over twelve weeks and reported changes in measures of both impairment and activity that were far greater than those in lower dose studies, and in fact the findings of this study have recently been replicated by the same group. We recently reported the findings of the Queen Square Upper Limb (QSUl) Neurorehabilitation programme, a single-centre clinical service that provides 90 hours of treatment focusing on the post-stroke upper limb. Most patients entering the programme were in the chronic stage (> 6 months post-stroke), but were able to complete the 90 hours of the programme, even though they exhibited a wide range of impairments and fatigue levels. Despite the time since stroke (median = 18 months) we observed (i) large clinically meaningful improvements in upper limb impairment and activity (of a magnitude similar to those reported by McCabe et al.), and importantly (ii) that these changes were maintained, or even improved upon, six months after treatment.

The first lesson to take from these studies is that post-stroke rehabilitation programmes and clinical trials are almost certainly under dosing patients. In future, clinical trials must investigate the effects of much higher doses.
than are currently being used. The second
question to be raised is what are the key
‘active ingredients’ of an upper limb rehabili-
tation treatment? Whilst it is not clear what
the optimal behavioural approach for promoting
upper limb recovery should be, it is clear that
simple protocol driven approaches have not led
to large or sustained effects, both
of which are necessary to produce a step
change in stroke recovery. Successful post-
stroke neurorehabilitation is likely to require
a combination of complimentary approaches. If
we accept this premise, then we are unlikely
to determine the optimal combination of active
ingredients simply by studying each approach
in isolation, because the interactions between
these elements will also have to be considered.

So how do we work out what the ‘active ingredients’
of upper limb rehabilitation are? A
more sensible way forward is to look at interventions
that have already demonstrated a high level of efficacy
and then begin to work
out their key components. Here, it is important
to say that we need to start with treatments that
have a high chance of achieving maximum
clinically important differences (MCID) rather
than small changes that might be statistically
significant. Both McCabe et al.9 and Daly
et al.10 as well as the QSL programme.11
produced large improvements in both impairment
and activity limitation and both involved
more complex treatment approaches, not
restricted to one element. It is worth consid-
ering these in more detail.

- Analysis of movement and performance in
activities of daily living. The initial assess-
ment is crucial. The question, ‘why does
this persons hand and arm not work?’
should never be answered with ‘because
they have had a stroke’. There needs to be
an appreciation of the range of poten-
tial contributory impairments (patterns of
weakness, spasticity, loss of joint range,
shoulder restriction and pain, sensory loss,
apraxia, cognitive deficits, depression, apathy,
fatigue etc.) because each of these
becomes a therapeutic target. Our view is
that without informed clinical reasoning
based on the presence or absence of
specific impairments, the correct treatment
approach is unlikely to be selected.
- Identify and treat barriers. Avoid compli-
cations that will prevent participation
in an active rehabilitation programme. We
commonly see loss of passive joint range
preventing people accessing fingers or
thumb movement, due to either spasticity
or non-neural shortening. This can happen
at most joints, but particularly in the hand.
As well as increased finger flexion, be
alert to loss of flexion at MCP joints which
makes it difficult to shape the hand prop-
erly. Treatment involves splinting and
optimal spasticity management. We also
see pain and restriction of range in the
shoulder. Reduction of external rotation
in particular should raise the possibility
of adhesive capsulitis. Despite the lack of a
clear evidence base for treating poststroke
adhesive capsulitis, anecdotally we have
had success with capsular hydrodistillation
followed by physiotherapy.
- Preparation. Manual techniques are used
to optimise and improve baseline at an
impairment level, for example mobilising
joints to improve range, lengthening and
strengthening muscles to ensure they are
at a biomechanical advantage to generate
force, training sensory discrimination and
improving postural control and balance.
- Reduction of impairment and re-education
of quality and control of movement within
activities of daily living. Individualised
meaningful tasks are practiced repeatedly
in order to facilitate task mastery with a
focus on quality of movement. This is
achieved through (i) adaptation of the
task, e.g. decomposing tasks into indi-
vidual components to be practiced; (ii)
adaptation of the environment, e.g. fabri-
cation of functional splints and adaptation
of tools such as cutters or screwdrivers, to
enable integration of the affected hand in
meaningful activities; (iii) assistance, e.g.
de-weighting the arm to allow strengthen-
ing and training of movement quality
and control through increased range.
- Coaching (involving instruction, supervi-
sion, reinforcement) was considered a
key component of the QSL programme,
used throughout to embed new skills and
knowledge into individual daily routines.
Consequently, individuals increase participa-
tion and confidence in their desired
goals, enhancing self-efficacy and motiva-
tion to sustain behaviour change beyond
the end of the active treatment period.
- Sustaining change. Our view is that the
approach described, delivered at a high
dose is most likely to achieve clinically
meaningful improvement together with
improved self-efficacy and behaviour
change that results in retention of gains
or further improvement (something not
routinely seen with many upper limb inter-
ventions that have been investigated).

Rehabilitation is often criticised for not
following standardised approaches that lend
themselves to investigation through clinical
trials. However, when single elements are then
studied in isolation the results are often not
clinically meaningful and are not sustained.12,27
Looking at the difference between these
approaches and those taken by McCabe et
al.9, Daly et al.10 and QSL1 should be informa-
tive, with a view to formally describing the
key elements of a successful treatment. Whilst
approaches at the activity and participation
level will vary as they are tailored to an indi-
vidual's specific meaningful goals, the overall
therapeutic approach taken towards specific
imperfections should be the same across all patients. Ideally, it should be possible to describe the principles of an optimal intervention using a format such as the TIDIER guidelines.43,44

There is a way to go before we can really say we understand both the treatment itself and the effects of the treatment on individuals. This will require careful assessment of both the 'input' (the nature of the behavioural intervention) and the 'output' (the resulting behaviour change) at a level of fine-gained detail that is not currently achieved on a regular basis, for example using kinematic45 or neurophysiological46 assessment. In addition, this input-output relationship will be modulated by a number of patient characteristics, which could relate to behavioural characteristics (e.g. severity, presence of multiple impairments) or to biological characteristics (e.g. the nature and extent of brain damage, time since stroke, age, medication).

Overall, our experience suggests that much higher doses and intensity of upper limb neurorehabilitation can be delivered with beneficial effects. We have highlighted the need to consider the dose and the nature of the intervention as well as appropriate patient stratification in informing future clinical trial design.

REFERENCES


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