Spasticity: the role of physiotherapy

Cherry Kilbride, Anne McDonnell

This article discusses the role and aims of physiotherapy in the treatment and management of spasticity. For effective rehabilitation, physiotherapists need to be able to analyse any deviations from normal movement and use a variety of interventions in order to maximise their potential for improvement.

The physiotherapist's role in the treatment of clients with neurological physical deficits is extensive, working both on an individual basis and as part of a team. The main aspects of the intervention may include the following objectives:

- To optimise/maintain function
- To modulate tonal changes
- To re-educate and facilitate movement
- To prevent/minimise secondary complications, e.g. soft tissue adaptation and pain.

NEUROMUSCULAR ALTERATIONS

An obvious clinical feature of cerebral spasticity is an increased resistance to movement. This was originally thought to be attributable to a velocity-dependant increase in tonic stretch reflexes with exaggerated tendon jerks resulting from hyper-excitability of the stretch reflex as one component of the upper motor neurone syndrome (Katz and Rymer, 1989). However, in recent years there has been an increasing awareness of additional contributory changes within the neuromuscular system that may lead to changes in muscle length and visco-elastic properties in the surrounding structures, such as ligaments, fascia, muscles and joint capsules. This compounds the difficulties in recruitment of movement for function (Ada and Cannon, 1990).

Muscle is a highly adaptable medium and possible intrinsic changes include:

- Increase/decrease in number of sarcomeres in series which leads to a respective lengthening/shortening of the muscle length
- Alteration in proportion to the connective tissue that provides support to the muscle
- Atrophy in hypertrophy of muscle fibres
- Change in muscle type
- Changes in muscle spindle sensitivity.

These variations can contribute to an alteration in the muscle's ability to generate and maintain appropriate force due to an abnormal response to sensory and motor input (Goldspink, 1990; O'Dwyer et al, 1996).

This can be seen clinically when the spastic hypersensitive muscle can be easily triggered by proprioceptive information, e.g. touch, movement or voice, into an abnormal pattern of movement such as flexor withdrawal or mass extension. Subsequently this may develop into abnormal postures with muscle imbalance, poverty of movement and contractures. Patients with spasticity, therefore, have the potential to demonstrate poor alignment (which is often complicated by pain and sensitivity) and altered movement patterns which are effortful and generally dominated by flexion components. Hence they lack the ability to be able to recruit selective movement as the basis for function (Herbert, 1988). However, we must remember that there are those patients for whom the presence of some spasticity actually allows them to achieve a degree of function (Ward, 1999).

MOVEMENT ANALYSIS

In order to fully assess the effects of the above on function and movement, the neuro-physiotherapist must be able to make an in-depth analysis of postural deviation from the norm. Thus the physiotherapist must recognise not only the non-cooperative alignment of the limbs with respect to one another and to the trunk and head, but also specifically the poor alignment of muscles and the effects this may have on function (Byrne and Ridgeway, 1998). The therapist needs to be able to use this information to identify primary problems and secondary compensatory strategies.

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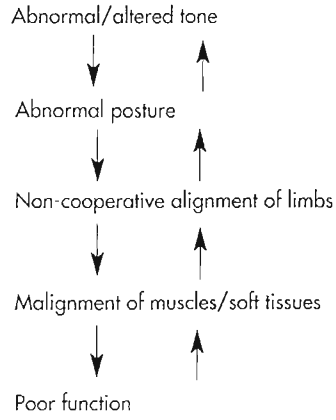


Figure 1. The form/function theory.

For example, the patient who is only able to sit on an asymmetrical pelvis due to shortened hamstrings, hip flexors and abdominals and therefore bearing weight through their sacrum (instead of having evenly-distributed weight via their ischium, thighs and feet) will exhibit compensatory overactivity in their upper limbs and head, therefore compromising balance in sitting and function in their arms. In this instance, treatment needs to be focused towards improved pelvic alignment and activity in order to free the head and arms for movement.

This may become a self-perpetuating circle which feeds into the form/function theory (*Figure 1*) (Kidd et al, 1992).

Appropriate postural alignment† promotes normal movement that is varied, effortless, and efficient for the achievement of motor goals. It is adaptable and allows choice of movement patterns (Shumway et al, 1995; Association of Chartered Physiotherapists Interested in Neurology (ACPIN) National Conference, 1996).

Treatment aims to facilitate appropriate movement and alteration in the alignment of particular key points‡ of the body in order to influence muscle tone in other areas indirectly. For example, mobilisation of the trunk and shoulder girdle can lead to a decrease in tone throughout the arm and the release of a flexed wrist and hand (Bobath, 1991). To avoid futile treatment to apparent distal tightness instead of addressing the true proximal problem, clinical decision-making needs to be based upon accurate alignment of the whole limb from proximal to distal or vice versa (Byrne and Ridgeway, 1998). This scenario can also be seen with excessive tone in the limbs due to an underlying low-tone trunk which is not able to offer a reference point of stability for movement.

For movement to be selective it is necessary to have an adequate background of postural control to allow activity against gravity and also to stabilise the orientation and position of the segments that serve as a reference point to movement (Massion, 1994). However, there is limited documented information on the effects of handling on tone and spasticity from which to build an evidence base for practice (Lynch et al, 1998; Stephenson et al, 1998). Spasticity is thought to be partly due to abberant plastic adaptation through axonal sprouting, denervation supersensitivity and unmasking of latent pathways, therefore treatment needs to be directed at preventing or guiding these changes to lead to the facilitation of 'normal' synaptic pathways to heighten their proprioceptive awareness and control (Kidd et al, 1992). It is thought that therapy uses afferent input as a basis to guide this potential adaptation of the central nervous system in an attempt to make it more normal and therefore to improve the capacity for function in the long term (Perry, 1980; Thornton and Kilbride, 1998).

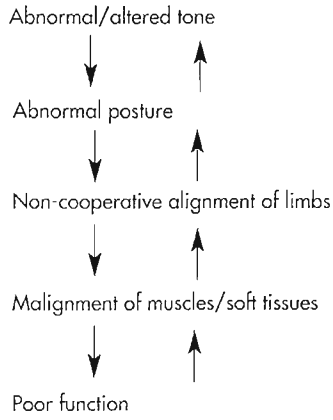
Afferent input from the periphery can be from a variety of sources including sensory, visual, auditory and vestibular (Musa, 1986; Lynch, 1991). The treatment goals are decided between the patient and therapist aiming towards a functional end point via specific treatment modalities.

TREATMENT PRINCIPLES

Throughout any aspect of treatment it is essential that the interaction between the base of support (BOS) and gravity is taken into account and utilised to the optimum, for maximum treatment effects and to enable interaction with the environment for function. Generally, the larger the BOS the lower the tonal influence, for example, lying requires less postural activity than unsupported sitting. Therefore, the therapist must be careful to choose the best posture for treatment. However, it must be remembered that posture requires a dynamic degree of reciprocal innervation (RI) which allows tonal changes for movement and positions per se are more static and less changeable (Massion, 1994). Muscle therefore has to be adaptable to allow for RI. Through the therapeutic handling of the patient the therapist aims to prepare the neuromuscular system to promote an effect of change towards a functional goal. The therapist as part of his/her assessment

†= Alignment in this article is defined as the efficient position and the interaction of body segments in relation to gravity and the base of support. This includes the cooperative alignment at the joints within the skeletal frame and the muscles surrounding it.

‡= Points within the body from which you can alter more easily the tone and movement elsewhere.



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can assess the movement available and the potential of muscle activity, and plastic change within the tonal state, along with the compliance of the soft tissue structures (Edwards, 1996).

This may be done via:

- Soft tissue mobilisation for the realignment of muscle fibres so that they become more receptive to requests made of them (Shumway et al, 1995) and to increase the circulation. A poorly perfused muscle is ineffective.

Metabolism is also increased as an effect of muscle stretch (Frank et al, 1984):

- To increase axoplasmic flow for the rebuilding of muscle by protein synthesis (Kidd et al, 1992)
- To make the muscle more receptive and able to gate information from sensory receptors (Kandel and Schwartz, 1991)
- To maintain the optimum length of sarcomeres within muscle units (Carr and Shepherd, 1998).

Modulation of tone

Weight bearing promotes the influence of gravity within the optimum alignment for the recruitment of appropriate levels of tone. Standing is a vital tool for therapists in the treatment of spasticity. However, it must be dynamic and not static so as to have access to and influence from the vestibular system. It is thought that the vestibular system primarily encourages the recruitment of extensor activity (Markham, 1987; Brown, 1994).

Facilitation of movement

The neurological physiotherapist has to develop skills in specific handling techniques in addition to having extensive knowledge of movement science in order to maximise patient participation. It is important to encourage the patient to become more active during the intervention but only at the appropriate time and with the appropriate alignment and when they have the background of postural stability upon which to support more selective activity of the limbs.

This is thought to enhance neuroplastic changes (Stephenson, 1993). This is possibly due to the experience of more normality (Kidd et al, 1992; Shumway Cook et al, 1995).

The management of spasticity requires a 24 hour approach from the whole team. Therefore, the physiotherapist must have a good understanding of the respective roles of the other team members. In addition to physical intervention it may be necessary to use pharmacological agents. In some patients, however, it may be necessary to use pharmacological agents in addition to physical intervention. Antispasmodic drugs may be required to allow the therapist to break the cycle of altered input (Brar et al, 1991). Traditionally, drugs such as baclofen, dantrolene and diazepam have been used. More recently, tizanidine has become available on prescription in this country and is reported to have fewer side-effects (Wagstaff and Bryson, 1997). However, for localised spastic muscle, botulinum toxin has been demonstrated to have good results in selected patients. There is some evidence to suggest that it may help to minimise local mechanical changes, which may then lead to a functional deterioration (Losseff and Thompson, 1995). The therapist may also use other adjuncts to treatment such as splinting, plastering and specialised seating and positioning to allow for optimum carry over (Edwards, 1996; Pope, 1996; ACPIN Guidelines, 1998).

Last, it is necessary to recognise that the patient must be an active learner or participant in the rehabilitation process. Motivation is key to successful rehabilitation and achievement of goals. Patients need to have a degree of locus of control/ownership over the progression of their condition for maximum long-term potentiation of change (Keshner, 1990).

Physiotherapy aims to achieve the potential for learning more normal movement in order to promote carry over from treatment into function. This is achieved through the treatment and management of spasticity and by managing the changes in progressive conditions.

CONCLUSIONS

The successful physical treatment of spasticity is based on an appropriate application of the knowledge of movement science in order to maximise/maintain function, decrease compensatory strategies and mnimise muscle length changes. The client must be interactive in the control of their spasticity in order to promote long-term success. BJTR

Key points

- Spasticity is clinically seen/felt as an increased resistance to movement.
- Spasticity has central and peripheral components that require addressing.
- The physiotherapist needs to be aware of and able to treat the effects and complications that arise from the combination of these factors.
- The physiotherapist needs an in-depth knowledge of normal movement upon which to base clinical reasoning.

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