Upper Limb Activity: Biofeedback

Overview

Biofeedback is a term describing the use of electronic equipment to provide augmented sensory feedback (auditory, visual) in order to optimise motor learning (King, 2002). Electromyographic biofeedback uses the signals generated via muscle activity (surface electrodes) to feedback via an auditory signal (or visual output). In general it is used to feedback muscle activity that is otherwise undiscernible to the person and that once aware they can try to “increase” the signal. It can be used in conjunction with electrical stimulation such that once a certain EMG threshold (of muscle activity) is reached the ES unit provides an additive stimulus. EMG biofeedback can also be used to train inhibition of unwanted activity for example in spastic muscles (Swaan et al. 1974).

Feedback on joint position can be provided through the use of a biofeedback unit which, for example, incorporates touch-plates and kinematic data from the 3 Space Isotrak System, a real-time electromagnetic tracking system (Maulucci and Eckhouse, 2001).

Biofeedback is more quantitative than feedback provided by a therapist (Inglis et al, 1984). The biofeedback technique also allows for continuous and immediate feedback whereas during conventional rehabilitation the patient only receives information about their muscles after a period of time has elapsed (Swaan et al, 1974).

Mechanisms behind the use of augmented sensory feedback:

• Because the CNS has plasticity i.e. the capacity to change or adapt.
• Plasticity can be driven by sensory input and therefore motor activities can be altered
• Plasticity or recovery can be aided by non-specific sensory information, however substantial improvement requires specific feedback such as knowledge of performance/results
• This type of knowledge is provided and/or augmented by the external sensory feedback signals (Maulucci and Eckhouse, 2001).

Research

The biofeedback literature is difficult to interpret. A systematic review by van Dijk et al. (2005) found 16 studies using biofeedback, only four of which reported benefits for upper limb function (mostly EMG biofeedback). A more recent systematic review by Langhorne et al. (2009) found EMG biofeedback (in addition to routine therapy) produced moderate improvements in arm function.

Application

A biofeedback unit may be used to provide auditory feedback/information to the patient, about what they

Funded by the former Rural Stroke Outreach Service, Royal Brisbane and Women’s Hospital, Queensland Health. The input of the Centre for Allied Health Evidence, University of South Australia, is gratefully acknowledged.
are aiming to achieve while they are carrying out tasks (Maulucci and Eckhouse, 2001). Applications may include augmenting biofeedback from activity in the wrist extensors, finger extensors, biceps or triceps.

It is important to link the biofeedback with actual task performance to enable transference of learning.

It is thought the stroke survivors benefit from being aware of their performance/errors as they have made them, and being given the opportunity to correct these during task performance (Maulucci and Eckhouse, 2001).

Considerations

Small EMG biofeedback units are available for relatively easy clinical application. Training goals need to be established and the role of using EMG feedback to augment intrinsic feedback should be clear to all before commencement. It should be used in conjunction with conventional upper limb rehabilitation.

The equipment required for any of the above joint position biofeedback units is unlikely to be readily available in most Australian clinics at this time.

Readings


