REPORT ON THE USE OF BIOFEEDBACK

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'n Oorsig van die jongste literatuur oor bioterugrigting en veral terapeutiese aanwending, word gegee. Toestande wat geskik is vir behandeling, metodes van aanwending en seine word genoem. Verskeie studies word aangehaal maar geen gekontrolleerde studie bewys tot dusver statisties die waarde van bioterugrigting nie.

Biofeedback, or more accurately, electromyographic biofeedback, appears from the current literature to be a promising and relatively new electrotherapeutic modality. It is used mainly for the treatment of neuromuscular disorders. It is an adjunct to the more conventional methods of treatment and physiotherapists, with the co-operation of bioengineers, may use it increasingly in the rehabilitation of patients. However, as its use as such increases, new techniques as regards its application will need to be developed to suit the individual patient's needs.

Recent studies and reports of therapeutic successes have shown that electromyographic biofeedback, used with carefully directed instruction and motivation, enables a patient to obtain ". . . an extraordinary degree of voluntary control over physiological activities previously considered (to be) involuntary, reflexive or subconscious." (Nafpliotis, 1976), and this degree of control is obtained in a relatively short period of time.

Electromyographic biofeedback involves some auditory or visual representation of a patient's muscular activity, which the patient is taught to monitor in an attempt to alter muscular activity voluntarily to achieve a desired response. This procedure seems to work equally well in cases of flaccidity and spasticity (Inglis *et al.*, 1976). Apart from use in neuromuscular disorders, it has been extended to retraining correct muscular activity in chronic respiratory conditions (Johnston & Lee, 1976), gait retraining in orthopaedic problems (Zimnicki & Fernie, 1976), and in relaxation of muscle spasm in tension headaches (Budzynski *et al.*, 1970) and torticollis (Brudny, Grynbaum & Korein, 1974).

In applying the method of electromyographic biofeedback, a full functional assessment is made of the patient, who is then introduced to the apparatus. Surface electrodes, which are most often used, are applied to the skin after cleaning the area with alcohol and a conductive paste is used to ensure proper electrical contact. The types of visual and/or auditory stimuli to be expected, and which are desired to elicit a voluntary response, are explained to the patient before a few "trial runs" are conducted. Treatment sessions lasting 30 to 60 minutes are usually carried out two to three times a week, and continued until the patient shows some gain in voluntary control and/or functional improvement.

Review of Current Literature

The use of electromyographic biofeedback was first reported in 1960 as a method of neuromuscular re-education in cases of hemiplegia (Marinacci & Horande, 1960). Needle electrodes and auditory feedback were used, firstly on the unaffected limb in the initial training. The authors claimed a 20% improvement in the function of the affected limb within one hour of treatment. In 1964 Andrews reported a noticeable improvement in the motor unit activity in non-functioning muscles in cases of hemiplegia with paresis of from one to fourteen years duration. Needle electrodes and visual feedback were used. In similar cases of one year duration with tibialis anterior paresis, needle electrodes and both auditory and visual feedback were used and good results reported in 1973 by Johnson & Garton. Some of these patients were reported to improve to the extent of no longer needing short-leg braces for foot-drop control after one month's treatment.

Surface electrodes and visual feedback were used at the same time by Amato *et al.* (1973), to treat spasticity of the gastrocnemius muscle group of about nine years duration. They reported improvement after four months' training, which was manifested in some cases as a heel-strike to mid-stance pattern with the foot being held flat. Swaan *et al.* (1974) extended the use of surface electrodes and auditory feedback to reduce muscle spasticity in cases of hemiplegia and, in the words of

Inglis *et al.* (1976), (found the procedure to be generally) ". . . more effective than conventional rehabilitation methods."

Brudny *et al.* (1974) found that the improvement in the function of the hemiplegic hand even 12 months or longer after onset of the hemiplegia lasted from two to twelve weeks after treatment with surface electrodes and auditory and visual feedback. They used four arbitrary grades of improvement in their study and reported that prehension became possible in about one-third of their cases. Brudny *et al.* (1976) carried out a follow-up three months to three years after treatment of patients with a hemiparesis who had received electromyographic biofeedback training. They found that approximately half had made and retained a significant functional improvement.

It was not until 1975, however, that the first attempt at a scientifically controlled study was reported by Basmajian *et al.* Again surface electrodes and auditory and visual feedback were used on patients with foot-drop following CVA. In this study, the effects of electromyographic feedback used with conventional physiotherapy were compared with those of standard rehabilitation methods alone (control group), assessing changes in muscle strength, range of motion in involved joints, and gait patterns. They found that approximately twice as much improvement in muscle strength and range of motion was shown in the group receiving electromyographic biofeedback and physiotherapy treatment as in the control group.

In 1976, Takebe & Basmajian also compared the gait of similar patients divided into three groups — those receiving biofeedback training, those receiving treatment with a peroneal nerve stimulator, and those receiving only intensive physiotherapeutic exercise. Generally speaking, they found the least improvement in the last group.

One of the latest reports on the use of electromyographic biofeedback is by Baker *et al.* in April 1977. They have applied this technique to patients with incomplete spinal cord lesions, paralysis from poliomyelitis, spasmodic torticollis and hemiplegia of 10 years duration, all of whom show ". . . promising results in terms of muscle re-education and functional improvement . . ." (Baker *et al.*, 1977).

Apart from its use in the above types of cases, electromyographic biofeedback has been reported to be used with success in teaching diaphragmatic breathing exercises (Black *et al.*, 1969), and in retraining correct breathing patterns in emphysematous patients (Johnston & Lee, 1976). Again surface electrodes and auditory and visual feedback were used.

Biofeedback has also been used with success as an aid in head-position training in the cerebral palsied child (Wooldridge & Russel, 1976). Wooldridge *et al.*, 1976, also report the successful use of an extension of this procedure in gait-training in cerebral palsied children, where the objective was either improved knee flexion or extension. In this case, where biofeedback is used to retrain a more functional gait pattern, the technique has been simplified. Instead of using the electromyograph with needle or surface electrodes to enable feedback via auditory or visual stimuli, an electrogoniometer and auditory feedback unit are used. In other cases of gait retraining, as for example in prosthetic training in geriatric above-knee amputees (Zimnicki & Fernie, 1976), an even simpler mechanism enabling biofeedback has been designed. This consists of an electrical switch fitted to the knee joint of the prosthesis, which is activated by the joint position, thereby triggering a buzzer — the auditory feedback mechanism. However, the principle of the procedure remains the same.

This review of the current literature indicates that although many different studies involving various conditions have been conducted, there are none reported to date which show a controlled scientific approach with statistics to give validity to the claims of improvement or therapeutic success made. Therefore, more controlled studies are obviously necessary in this field, and good experimental design and analysis are essential for an objective assessment of biofeedback, as a technique of value in rehabilitation, to be possible.

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