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MUSLCE VIBRATION THERAPY IN CHILDREN WITH CEREBRAL PALSY[1]

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ABSTRACT. This preliminary report gives a brief account of various observations that were made during screening tests referring to the use of muscle vibration as a therapeutical aid in children with cerebral palsy. In all, about two hundred patients have been examined and as a rule they were severely handicapped. A small electrical motor that vibrates with an amplitude of 1.5 mm at a frequency of 100–200 Hz was used as a continuously acting reflex hammer. It was found that vibration evokes two basicly different effects that can be used therapeutically. Firstly, the vibration-induced afferent activity enhances the voluntary power of the vibrated muscle and simultaneously reduces the spasticity of its antagonist. This confirms earlier findings and can be explained as spinal reflex effects. Secondly, the increased afferent activity induced by vibration can be used to improve deficient "body image" functions thereby contributing to a better voluntary control. Both these effects are seen during and some minutes after vibration. It was concluded that muscle vibration is a useful complement to conventional physical therapy of the motor disturbances of cerebral palsy.

The observations preliminary reported in this communication were made during screening tests undertaken to evaluate what effects muscle vibration can induce in children with motor handicaps, especially in those with the different manifestations of cerebral palsy. The reflex effects of vibration in normal subjects and in adult patients with various motor disorders have been extensively reviewed by Hagbarth & Eklund (4) in this issue of the present journal. The reader is referred to that article for details and references on muscle vibration.

METHODS

The vibrators and the vibration technique were the same as described by Eklund & Hagbarth (2). Some two hundred children of various ages and with various motor disturbances have been studied. They generally stayed at the institution and as a rule they were severely handicapped. Broadly speaking, the physical therapist used the vibrator as a kind of a continuously acting reflex hammer and applied it to different muscles in all conceivable situations during the ordinary treatment sessions. When a certain muscle group was to be trained, the vibrator was fastened by a broad rubberband around the limb over or close to the tendon. During about half a minute continuous vibration support was given to the active resisted movements that should be trained. The pauses between each vibration were always longer than the periods of vibration. At the very maximum the motors were run up to one or two minutes at a time to avoid discomforting friction heat. The observed results have been noted and sometimes filmed.

RESULTS

The following short enumeration of the observations made during the screening tests is partly arranged after the major types of the motor disturbances. However, it was repeatedly found that vibration improved the patient's awareness of the body and his urge to move. This was a very common finding regardless of the type of the motor disturbance at hand. Vibration and the body image, is therefore dealt with in a separate section as is also some diagnostic aspects.

Hypertonus

Generally speaking it is possible to obtain only positive effects in this condition if vibration is appropriately applied. Thus, it was found that vibration of a paretic muscle *increased the voluntary power* and simultaneously *reduced the hypertonus of its antagonist*. These effects varied from case to case being the best when "true spasticity" was the main component of the hypertonus. The findings agree well with those encountered in adults as described by Hagbarth & Eklund (3, 4).

[1] Preliminary communication.

It should also be mentioned that in cases with spastic co-contractions in antagonists alternating vibration of the muscle groups involved may cause a post-vibratory reduction of hypertonus in both muscles.

Hypotonus

In this group there is no obvious advantage in the use of vibration as a complement to other forms of physical therapy. In selected cases, however, especially in older children the inability to overcome some of the vibration-induced effects may cause a frustration that sometimes can be used therapeutically.

The hypotonus of the lower extremities in children with *spina bifida* is of course to a great extent due to the cauda equina lesions. Thus one would not expect to find vibration useful therapeutically in these patients. However, the component of central damage may add to the hypotonus and vibration can be effective in this context. Vibration has been applied on the weak muscles at nursing times and it was found that the spontaneous movements increased. Also weak muscles with apparently no spontaneous activity have been strengthened significantly. In this way deformities can probably be prevented to some extent. See also under body image.

Dystonic syndromes of dyskinesia

In this group of patients vibration may be used to facilitate normal patterns of movement. Cases of athetoid movements and dystonia may react with panic and severe torsion spasms if the vibrator is suddenly applied. These undesired effects have been diminished by careful verbal instruction and cautious application of the vibrators. Thus, only children over six years of age and with average intelligence may benefit from vibration therapy in this group. By shifting the vibrators between different muscle groups it has been possible to reinforce the imitation of normal patterns more effectively than with resistance and visual aids only. In addition, applied resistance during vibration has added a strong reinforcement to conventional patterning.

Diagnostic aspects and preoperative evaluation

In congenital minor motor dysfunction, the so-called "clumsy children", a differential diagnosis is necessary for the habilitation regime. We have found vibration useful to reveal ataxic components and slight hypertonus when tendon reflexes are normal and motor tests only point to a developmental delay. For example, a child with some slight hypertonus of the elbow flexors but with full range of movement may become quite unable to flex at the elbow joint during vibration of the extensor muscles.

When muscle transpositions are discussed it is important to estimate the degree of weakness of the muscle groups to be involved in the operation. This is important in deciding the extent of the operation. In this context the vibrators can be used to evaluate how much of the paresis is due to reciprocal inhibition imposed upon the weak muscles from their spastic antagonists. It was found useful for the preoperative evaluation to assess the strength of the weak muscles in this way.

Body image

In his review on the pathophysiology of cerebral palsy Bobath (1) underlines that it "should be considered a sensorimotor disorder". The motor disturbance is generally the most obvious sign of the brain damage, but the associated sensory disturbances that often are much less obvious, must be considered since both the motor development and the habilitation depend to a great extent on the patient's awareness of the body. For this awareness and recognition of various parts of the body we use the term body image in a wide sense.

The following observations support the notion that body image functions can be improved by vibration. For instance, if vibration has been used to reduce the spasticity of a limb the patient could report "my legs feel so easy" or "now, I can move". In babies and other patients that could not communicate verbally one often noted signs of "well-being" together with the increase of voluntary movements. An otherwise passive and quiet baby with spina bifida, would start babbling as the legs were vibrated and some spontaneous movements occurred. These observations have also been recorded by different tests referring to the body image. A patient that normally draws the typical head–foot figure may after vibration of the hands and forearms draw figures that have both hands and fingers. In eye–hand training the speed of the movements may double after vibra-

tion has been used on the fingers and on the supinator of the forearm. Besides this improved control, vibration increased the patient's ability to understand instructions on how to move a limb in a particular way. Both these effects may last up to half an hour, giving the therapist sufficient time to teach the patient skilled movements. It was also found that activities such as eating and pronunciation could be considerably improved as a result of preceding vibration. In these exercises, an ordinary massage apparatus was applied on the tip of the tongue, around the mouth, and also under the chin, i.e. over the supra hyoid muscles. Such a vibration–treatment led to more controlled feeding patterns and better articulation in many patients.

It was also found that *the memory for motor acts* improved in some patients when vibration had been used together with the ordinary physiotherapy. This fact is of therapeutic value since many CP-children have difficulties in remembering how to perform certain movements from one day's treatment session to next day's session.

CONCLUSIONS

The muscle vibration technique has proved to be a useful complement to other methods in the treatment of movement disorders in cerebral palsy. It offers many advantages as compared to the conventional techniques, but a combination of the methods generally gives the best results. The basic principle of muscle vibration is that of PNF (proprioceptive neuromuscular facilitation) and it is used to train voluntary motor control and to reduce hypertonus. Many of the effects seen can be explained as reflex events at the segmental or spinal level due to the *I a* afferent inflow set up by vibration. However, it was also found that motor control improved as a result of a better body image. Thus, both supraspinal and cortical levels may be reached by the vibration-induced afferent activity from various sorts of receptors with phasic sensitivity. In this way vibration offers a means to instruct the patient when words and visual aids are insufficient.

It should finally be pointed out that the physical therapist using the muscle vibration technique must be observant, have a great deal of knowledge and experience regarding cerebrally palsied children and be well acquainted with the physiology of motor control; this is alpha and omega.

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