VIBRATION

Although ***mechanical vibration*** has long been considered one of the acceptable tools of treatment in ***physical medicine***, it has not been widely considered of much practical value in the clinical setting, except as a way of enhancing the effects of ***postural drainage***. This may be because the greatest part of published research on the subject has focused on vibration's ability to evoke or ***facilitate*** mild ***muscular contraction***. This, of course, puts it in the category of being non-essential for the clinical practitioner who prefers any number of instruments that can produce much stronger involuntary muscular contractions and are more efficient to use. *

The earliest investigators of the effects of vibration on muscle tissue were able to demonstrate that vibration (repeated quick stretch) of a ***tendon*** or ***muscle*** could produce an ***involuntary contraction*** from the muscle (the response being greater from application to the tendon than to the muscle). They showed that the provoked contraction emanated from within the muscle itself as a ***stretch reflex***, and ***not*** as a higher center response to ***tactile sensory nerve stimulation***. They additionally demonstrated that the strength of contraction was directly proportional to the amplitude of the force of vibration.

Later investigators established that the ***muscle spindle*** was the organ within the muscle responsible for the involuntary contraction produced by vibration. They showed that the slowly developed muscle contraction depended on the muscle spindle's ***afferent proprioceptive*** (sensory) influence over certain supraspinal centers. Vibration initially caused the muscle spindle to respond with the ***phasic stretch reflex***, which is immediately inhibited by the supraspinal centers (after the ***extrafusal muscle twitch*** occurs). If stimulation continues, the ***supraspinal centers*** respond to the continuing proprioceptive input from the muscle spindle by provoking the muscle spindle's contractile elements to begin to slowly contract and, through the ***tonic stretch reflex***, cause the ***extrafusal muscle*** to also begin contracting (***increasing muscle tone***). This slow developing contraction is conventionally called the ***tonic vibratory response*** (TVR). The TVR is present in skeletal muscles when the spinal cord is intact, though it is not found in the facial muscles or tongue. Notably, it was found that vibration of a muscle's tendon at frequencies of from 50 to 100 cycles per second (Hz) gradually increased its activity (***tone***) and conversely decreased the neuromuscular tone of its ***antagonist***. They also found that the facilitation effects of vibration on the muscle generally disappeared thirty seconds after cessation of vibration, and that the subject ***could*** stop the involuntary response (muscle contraction).

Later clinical electromyometric (EMM) studies and case study observations (performed by the author and associates) of the ***inhibitory*** effects of vibration on the ***antagonists*** of muscles vibrated (at the low frequencies of 30 and 60 Hz), showed that the ***inhibitory effects*** of vibration continued to develop for up to 14 minutes after cessation of vibration, and that the resultant resetting of the muscle spindles and their influence over the involved supraspinal centers often lasted considerably longer. These findings would seem to imply that vibration is indeed a valuable treatment tool, not only as a muscle contraction facilitator, but also as a ***contraction inhibitor***. **

The most common vibrator available on the market is the ***rotary vibrator*** that oscillates back and forth to produce its vibration. Because of the sliding motion that it imparts to the skin beneath the vibrator, the vibration is spread out and less exact than the practitioner might desire.

The vibrator most recommended here for clinical use is a ***linear vibrator*** that provides its vibratory action as a series of repetitive taps or up and down motions, much like a jackhammer. Consequently, it may be applied with more exactitude than the rotary vibrator, since its vibratory action is concentrated solely under the head of the vibrator.

Application:

- Place the patient in a position which will be comfortable for the duration of the treatment session.
- If its construction allows it, preset the vibrator to deliver the required force at an appropriate frequency (usually 30 or 60 Hz).
- Turn the vibrator on.

- Place the head of the vibrator over the treatment site and hold there will a steady firm hand pressure. Hold the vibrator lightly for tactile sensory stimulation, but with more pressure to induce muscular contraction and reciprocal inhibition.

- To induce muscular contraction, apply the vibration over the target muscle's origin, insertion, or tendon. Continue vibration of the treatment site as long as required by the treatment technique (sixty-seconds over each treatment site for neuromuscular response; several minutes for spastic sphincter control or sensory effects).

- Following application, lift the vibrator from the patient's skin before turning off or applying to another treatment site.

- For neuromuscular responses, after vibration is over, have the patient remain relatively motionless for an appropriate period (at least six minutes) before leaving the treatment area.

Precautions:

Except when applied for sensory effects, vibration should ***not*** be applied over a ***muscle belly***. It is not only less efficient than application to the muscle's ***origin, insertion, or tendon***, but may also activate an indwelling ***trigger point formation (intrafusal muscle spasm***) and its resultant ***referred pain pattern***.

Vibration should ***not*** be applied over contused (***bruised***) soft tissue, ***thrombus*** (blood clot), or the site of ***phlebitis or varicose vein***, because of the danger of additional thrombus development or the precipitation of an ***embolus***.

Do not apply vibration around the ***lips of children***, even for desensitization of the lips. Likewise, vibration should ***not*** be applied to the ***S2, S3, or S4 sensory dermatomes of infants or children with immature gastrointestinal systems***.

The vibration of ***phalangeal (finger) joints*** will almost certainly cause them to ***spontaneously swell*** (become edematous), sometimes to a gross extreme. Edema may become so extreme that pitting edema may become evident in both the phalanges and in the ***metacarpal*** portions of the hand.

If vibration is used in combination with ***electrical stimulation*** for the treatment of ***extrafusal muscle spasm***, ***trigger point formation referred pain***, or to ***facilitate the lengthening of a muscle***, apply it after electrical stimulation.

**In her lectures at the University of Southern California, Margaret Rood expounded on the use of vibration to affect muscle tone in atrophied or underdeveloped muscle. She reported that when used in conjunction with attempted voluntary contraction of the vibrated muscle (applied over the muscle belly), vibration could be used to increase the bulk of musculature that had never fully developed as a result of cerebral palsy paralysis (in the preadolescent patient).*

***Since little research has been published demonstrating the inhibitory effects of vibration, a pilot study has been included in the* APPENDIX *to help provide a basis for understanding.*

CIRCULATION ENHANCEMENT

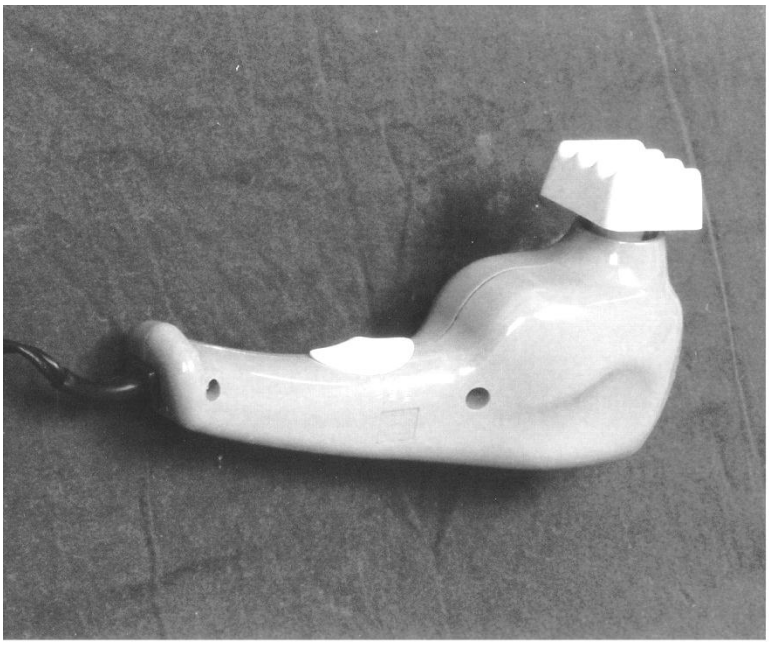
Clinical experience has demonstrated that vibration lightly applied may stimulate capillary bed activity and increase dermal circulation.

Application:

- If its construction allows it, preset the vibrator to deliver 0.5 pounds per square inch (psi) at a frequency of 60 Hz. Cover the treatment site with a towel or other protective cover to avoid shearing as the vibrator is moved over the skin's surface.

- Place the head of the vibrator over the treatment site and move it evenly over the area for two minutes.

- Apply vibration twice daily, until the soft tissue circulation has sufficiently improved. If the patient suffers from diabetes or other pathology affecting the feet or legs, apply for two minutes, twice a day (possibly for the rest of the patient's life). Vibration of this type should not be applied just before going to bed. Vibration sets up an oscillating circuit in the nervous system that takes two hours to outlive; e.g., If vibration is applied just before going to bed the patient may not be able to sleep for two hours.



A commercially available hand-held vibrator

A commercially available foot vibrator

DESENSITIZATION OF SOFT TISSUE

Clinical experience and clinical study have verified that vibration may temporarily desensitize hypersensitive soft tissues. It does this by increasing the tactile sensory threshold of stimulated sensory nerves. While the overt effects of such stimulation last for only up to 10 minutes after the vibration has ended, clinical experience has suggested that in some cases repeated applications may have a cumulative long term effect that may eventually lead to permanently desensitized soft tissues.

Application:

- If its construction allows it, preset the vibrator to deliver 1 to 3.5 psi at a frequency of 60 Hz. Place the head of the vibrator over the treatment site and firmly hold in place with moderate pressure. Vibrate for at least 10 minutes.

- Treat on a daily basis until the soft tissues have been sufficiently desensitized. If ***no*** sign of general desensitization occurs after six sessions, treatment should be discontinued.

Desensitization of soft tissues with vibration may most effectively be employed along with towel rubbing or brushing.

NEUROMUSCULAR MANAGEMENT

Neuromuscular management using vibration refers to the facility of low frequency (30 Hz) vibration to facilitate involuntary contraction of vibrated muscle while conversely inhibiting neuromuscular activity (tonus) of antagonistic musculature. Vibration may be defined as a series of quick stretches imposed on the musculature. A quick stretch causes the stretched muscle to *pull back* or shorten as a function of the neuromuscular servo-system that is constantly at play in innervated muscle. As a consequence, the vibrated muscle is caused to contract, while contraction of its antagonist is inhibited (tending to lengthen) through the neuromuscular reciprocal relationship between antagonists. This relationship is called *reciprocal inhibition*.

Clinical tests and measurement of the effects of vibration on neuromuscular activity have shown that while vibration has a short-term facilitatory effect on the musculature vibrated, it has a long-term inhibitory effect on its antagonists. Earlier studies demonstrated that while vibration of a voluntarily contracting muscle initially increased the force of contraction, the force of subsequent contractions (without vibration) was diminished below normal. This would seem to imply that the vibration had a long-term inhibitory effect on the vibrated muscle as well, but the researchers failed to make much of this implication. More current testing has demonstrated that neuromuscular inhibition affects both antagonists, regardless of which one is vibrated, and it is increasingly effective as time goes by if the muscle is *not* subsequently and voluntarily contracted. Testing demonstrated that for at least 14 minutes after the cessation of vibration a hyperactive muscle might enjoy as much as a 71% decrease in its myoelectric activity. These results seem all the more impressive since a change in neuromuscular activity of both antagonists may be effected by the vibration of one of them for only a single minute.

Clinical experience has shown that the inhibitory effects of vibration may be effectively used to (1) relieve referred pain of trigger point formation origin, (2) to lengthen abnormally short muscles or relieve spasm, and (3) to increase the effect of vertebral (cervical or lumbar) traction.

Application:

- Preset the vibrator to deliver a force of 1 and 3.5 psi, at a frequency of 30 Hz, if its construction allows it.

- Put the muscle to be lengthened on stretch. Place the head of the vibrator over the origin, insertion, or tendon of a target muscle. Apply the vibration for 60 seconds over each treatment site. First vibrate the muscle put on stretch and then one or more of its antagonists.

- After vibration, have the patient remain relatively motionless for six to 15 minutes before leaving the treatment area. If applied as a pre-traction procedure, begin traction immediately following cessation of vibration.

Cervical Traction Enhancement

To enhance the effect of cervical traction, collectively vibrate the muscles most closely associated with posterior cervical tension, the posterior cervical group (the suboccipital, splenius capitis, semispinalis cervicis, semispinalis capitis, multifidus, levator scapulae, sternocleidomastoideus, splenius cervicis and upper trapezius muscles). This may be accomplished by applying the vibration to the suboccipital area occupied by the suboccipital muscle group. The contralateral side may be vibrated if the involved side is too sensitive for the patient to tolerate.

Next, vibrate the origin, insertions or tendons of the musculature antagonistic to the posterior cervical group, as individual muscles or as groups. These muscles include the infraspinatus, subscapularis, teres major, latissimus dorsi, lower and middle trapezius, rhomboids and pectoralis minor muscles. The primary target sites include the inferior posterior aspect of the juncture between the humerus and the scapula (where the tendons of the infraspinatus, subscapularis, latissimus dorsi and teres major make passage to their insertions), the site shared by the rhomboid major and the lower trapezius between the medial border of the scapula

and the spine, and the space just distal to the clavicle occupied by the pectoralis minor.

Following vibration, apply cervical traction immediately. Continue the traction for from 10 to 20 minutes (refer to **Vertebral Traction**, Horizontal Cervical Traction, Vibration Enhancement, Electrical Stimulation and Vibration Enhancement in Combination**)**.

Lumbar Traction Enhancement

Vibrate the paraspinous muscles in the lower thoracic (T8 to T12), and lumbar (L1 to S1) areas, bilaterally, and then their antagonists (the rectus abdominis muscles) to enhance lumbar traction. After all sites have been vibrated, institute lumbar traction without delay. If a swing chair lumbar traction unit is used, traction for three three-minute, or two five-minute, periods. Interpose a one-minute rest between each period, (refer to **Vertebral Traction**, Swing Chair Lumbar Traction, Vibration Enhancement, Electrical Stimulation and Vibration Enhancement in Combination**)**.

Muscle Lengthening

To lengthen a muscle that has been tonically shortened or in spasm, put it on stretch. Vibrate its origin, insertion, or tendon for one minute. Vibrate the origin, insertion or tendon of each of its antagonists for one minute, as well. Instruct the patient to rest in the treatment position for from six to 15 minutes after vibration has ceased. The muscle lengthening effect will be immediately apparent if the appropriate muscles were selected as targets, and there is no neurological or orthopedic complication. This effect will only last, however, as long as functional habit or an underlying cause (inflammation or neurogenic reflex) is prevented from tonically re-shortening it.

Trigger Point Formation Treatment

To relieve a trigger point formation, put the muscle housing the trigger point formation on stretch, and then vibrate its origin, insertion, or tendon for one minute. Follow this with vibration of the origin, insertion, or tendon of each of its antagonists, for one minute. Instruct the patient to rest in the treatment position for 6 to 15 minutes after vibration. Relief of the referred pain originating from the trigger point formation is usually immediate. The relief provided may be long lasting, if the trigger point formation is acute (resulting from abnormal strain or trauma), or fairly brief (often lasting only hours) if the condition is chronic and generated by soft tissue inflammation, weakness or psychoneurogenic mechanisms. In the latter case, treatment may be repetitively required until underlying causes are ameliorated through other means.

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