TREATMENT BY MOVEMENT

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The essence of the treatment of moving parts is movement. The manner in which therapeutic movement is most effectively applied varies from tissue to tissue. Choice of method is also influenced by the nature, position, and extent of the lesion, the integrity or not of such structures as nerve and bone, and the presence or absence of bacterial infection. In affections of moving parts, therefore, a necessary preliminary to treatment by movement may be the elimination of sepsis, the reduction of a fracture, splintage, or operations. The object of all these measures is to put the patient into the best position to benefit from treatment by movement. Speed is essential; for the shorter the period of immobilization the smaller the amount of stiffness and weakness.

The relative gravity of soft-tissue and bony injury must be assessed, and treatment directed to the more important component. Thus, in fracture of the surgical neck of the humerus the injury to bone can be ignored and the associated damage to soft parts treated at once. In other cases—e.g., a Colles's fracture—the paramount consideration is at first the maintenance of accurate reduction. The usual result of fracture of the shaft of the femur is not failure of the bone to unite but a stiff knee. Hence Young's (1942) method of so putting up this fracture that knee-flexion exercises can be begun at once provides another instance. Again, the renewed advocacy of plating for fractures of the leg bones (Burns and Young, 1942) clearly results from a wish to facilitate treatment by immediate movement. External splintage entails a stiff tarsus and a prolonged period of rehabilitation during immobilization and after the plaster cast has been removed. Internal splintage means that such stiffness is never allowed to develop. Orthopaedic surgery is undergoing changes as a result of orientation towards measures whose cardinal aim is to keep moving parts moving from the start.

Therapeutic movement may be divided into two categories—specific and non-specific. Those movements that bear directly on the patient's disability are termed specific; those that maintain general physical fitness and affect the injured part only incidentally are called non-specific. Non-specific movement takes the shape of gymnastics, games, and occupations like carpentry or gardening; they are performed under the supervision of the gymnast or craftsman and are not considered further in this paper, which deals with the more individual application of treatment by movement.

Specific Movements for Muscles

The chief function of muscle is to contract; as it does so it becomes wider. Thus the primary requirement for muscle is a capacity to broaden fully; the secondary, to lengthen fully.

Active Exercises.—These restore mobility and power to muscle and maintain cortical awareness of capacity for movement. They should be graduated and purposive so as to bring both muscle and mind into action. Active exercises represent the essence of the treatment of minor muscular traumata, in which the paramount consideration is healing in the presence of enough movement to ensure a strong and supple scar. Unwanted adhesions are best prevented from forming by full broadening out of the injured muscle; hence an adequate contraction in the position of full shortening must be secured. It is also wise to ensure full elongation of the damaged muscle by voluntary contraction of its antagonist, advantage thus being taken of reflex inhibition of tone. Passive movements can stretch but cannot broaden muscles out; they have therefore no value in the treatment of minor muscular injuries. The brachialis muscle stands alone in its unsuitability for active treatment. A contraction of muscle induced by faradism has neither more nor less local value than an equal voluntary contraction. But the patient's mind is not brought to bear. Thus faradism may occasionally be employed as a useful

prelude to active movement but never as a substitute. Otherwise the patient falls into the error of supposing that his muscles should receive periodic treatment, whereas it is essential to inculcate the idea of restoration of function by his own supervised but unaided efforts. Breathing exercises, post-operative, post-natal, and postural exercises, and precision exercises for neurological disease are all carried out actively.

Resisted Exercises.—These strengthen muscle and enhance its tone. They are called for when an increase in muscular power is required; hence they provide the keystone of treatment in the muscular wasting that follows disuse, immobilization, operations, or arthritis. In the case of minor muscular tears, resisted exercises should be begun only when union is well advanced; for if started too soon they put excessive strain on developing fibroblasts. These rupture again and a series of relapses leading to chronic traumatic fibrositis results. Sending a patient back to heavy work shortly after minor damage to a muscle is mistaken policy; for he is apt either to hold the part stiffly (thus avoiding therapeutic movement) or to allow a series of excessive pulls on the healing breach, each leading to renewed disablement. Herein lie the seeds of one type of traumatic neurasthenia. Unsupervised use of a muscle and the proper employment of therapeutic movement may thus be seen to have little in common. It is by free active contraction that muscular mobility is maintained in most situations; resisted exercises leading to heavy work may be instituted only when a firm and supple scar has formed.

Occupational therapy stimulates patients' interest and provides them with resisted exercises of a purposive type. The mind is brought to bear; morale is raised and precision is rewarded.

Deep Massage.—When the movement of a muscle is considerably restricted by the rigidity of the part which it spans, active exercises, even begun soon after an injury, may prove ineffective in maintaining mobility. Still less can they be expected to free scar tissue already formed. This state of affairs exists chiefly near the insertion of muscles into bone and in the muscles of the trunk. Thus the fibres at the iliac origins of the sacrospinalis and gluteus medius, at the scapular insertion of the vertebro-scapular, at the thoracic course of the erector spinae, at the occipital attachment of the semispinalis capitis, at the costal attachment of the abdominal oblique muscles, and at any part of the intercostal muscles can seldom be kept adequately moving by exercises of any sort. The only really effective way to restore mobility, and the best way to retain it, in these special positions is by deep massage applied transversely to the affected area. By this means the masseuse separates out the muscle fibres, thus preventing interfibrillary adhesion and rupturing such adherent scars as have already formed. This passive broadening out of muscle is only a therapeutic exaggeration of its normal behaviour. At all accessible situations deep massage is more effective than active contraction in securing full mobility of muscle in cases of recent injury; in chronic cases or in the special situations enumerated above it represents the only effective method. Active exercises follow the friction; they maintain the added mobility afforded by the massage. Thus rehabilitation by graded exercises and occupational therapy is very seldom called for in muscular rheumatism. Rheumatic—like traumatic—inflammation leads to resolution with fibrosis, not to weakness or wasting. The chief symptom is pain when the muscle moves; the aim of treatment is the restoration of full painless mobility. Accurate deep massage forms the central pivot of treatment, followed by a few minutes' instruction in the maintenance of mobility by active exercises.

Assisted Exercises.—These are used to elongate muscle and in cases of muscular weakness from severe arthritis or nervous disease. When a muscle needs to be lengthened the patient contracts the antagonists as powerfully as he can; meanwhile the movement is assisted by his own body-weight, by the pressure exerted through the muscles of his other limb, springs, weights acting over a pulley, or by the masseuse. When muscle power is much reduced gravity may have to be offset by the masseuse's help, immersion in brine, or slings.

Continuous Stretching.—Contracture in muscle due to ischaemia, healed sepsis, or prolonged immobilization can often be partly or wholly overcome by continuous traction with weights or by pressure splintage. Once the increased range of

movement has been secured it is maintained by passive and active movements carried out several times daily. A splint should be worn to prevent recurrence, and is particularly valuable in cases complicated by peripheral nerve lesions. The fingers must not be included in splints worn merely for a nerve palsy; they stiffen quickly, and months of rehabilitation may be required to correct rigidity that need never have arisen.

Movement under Local Analgesia.—In the immediate treatment of any muscular injury the unrestricted active movement secured by local analgesia possesses great therapeutic value. Pain ceases; whereupon local inhibition of movement is abolished, a full range of active movement resulting at once. In chronic cases local infiltration is curative only when a muscle is affected some distance from its attachment to the bone. Hydraulic pressure seems ineffective in freeing adhesions within a muscle unless the lesion lies at its most distensible part—the belly. The bellies of the trapezius, latissimus dorsi, pectoralis major, extensores carpi radialis, gluteus medius, and gastrocnemius muscles may be singled out as usually responding well to local infiltration. My view is that the action of such injections is unrelated to the local analgesic that the solution contains: the benefit is due to the physical effect—akin to that provided by natural movement or deep transverse massage—i.e., the water broadening the muscle out. Acute lumbago provides the most spectacular success for local analgesia. The patient, immobilized in bed and aware from past experience that he will remain so for perhaps a fortnight, gets up after his muscles have been anaesthetized and moves freely. Next day, apart from some soreness, he is able to go about his business. This result cannot be attained by mobilization under general anaesthesia; for this succeeds only in stretching the muscle without broadening it out. Doubtless faradism under general anaesthesia would succeed, but it is far simpler to make the patient move the muscle himself during the period of local analgesia. In severe cases the whole lumbar extent of both sacrospinalis muscles must be infiltrated to achieve this satisfactory result.

Specific Movements for Joints

Contrary to general belief, mobility is maintained at a joint just as well by passive as by active movement. It is the muscles about a joint, not the joint itself, that are influenced by the type of the movement. Hence, provided that the joint is *moved*, the agency is immaterial. It is difficult to see how any controversy could exist over this obvious truism. A joint is merely a passive hinge, dependent for its maintenance as such on being periodically moved.

Active Movements.—These are employed to retain mobility at a joint and slowly to increase the range. Their cardinal use is to keep normal structures normal. Thus all the joints of an injured part not actually immobilized should be put through their full range of movement daily, preferably actively, and therapeutic occupations chosen that bring the limb into effective play. The treatment after orthopaedic operations and the reduction of most fractures entails the regular performance of a series of suitably graded exercises. In most of these cases passive movements do not hasten recovery. After interference with joints such as excision of a meniscus from the knee, the traumatic arthritis set up by the operation recovers at a fixed maximum rate that is attained only when the proper exercises—first without, later with, weight-bearing—are conscientiously carried out. Inadequate treatment slows recovery and may even prevent it altogether, but there is an intensity of treatment by movement beyond which it is pointless to go.

Gentle Passive Movements.—These are used to increase the range of movement at a joint the site of a recent sprain (except the elbow). They are also required to maintain range pending recovery from neurological lesions. Adhesions about a joint are prevented from forming by the fact that the joint is moved, no matter by what agency. A ligament, for example, moves over subjacent bone just as much during passive as during equal active movement. Moreover, the patient is most quickly induced actively to increase the range of movement at a joint by a previous demonstration of the painlessness of the passive range. Full recovery from articular sprains is thus retarded by the present-day insistence on active movements alone in rehabilitation. However much this limitation may

apply to some muscles, active movements have no virtue over passive movements in the treatment of many sprains affecting joints. Indeed, they may be less effective, in so far as they are often performed through a smaller range. Hence the use of passive movements followed by their active repetition achieves the quickest results.

Forced Movements.—These are of two types—a quick jerk and a slow stretch. A quick jerk is called for when limitation of movement at a joint is caused by post-traumatic adhesions. *Patients should not be asked to rupture their own adhesions.* These should be broken passively with or without anaesthesia (according to circumstances) by the surgeon or the masseuse. Thereupon the patient must maintain the added range by his constantly repeated active endeavours, supervised, and if necessary assisted, by the masseuse. Slow stretching out is indicated in capsular contracture due to immobilization, diffuse scarring, or osteo-arthritis. Continued pressure by the masseuse or by means of apparatus is required; thereupon the increase in movement is retained actively. Resisted exercises for the coincident muscular wasting are always called for. Movements, especially forced, are contraindicated in the treatment of those joints that rely for their stability on their capsule and ligaments alone. When no muscle controls movement at a joint, sprain may result in permanent laxity. Only harm could result from further overstretching. Moreover, this is not required; for the prerequisite to adhesion formation—namely, healing in the absence of enough movement—is necessarily absent. Thus treatment of sprains of the acromio-clavicular, sterno-clavicular, sacro-iliac, and cruciate ligaments is protection and modified rest.

Deep Massage.—There exist various ligaments whose mobility is maintained or restored more effectively by massage than in any other way. The outstanding examples are the supraspinous ligaments and those at the knee. Exercises aggravate lesions of the supraspinous ligaments; mobilization under anaesthesia has little effect; whereas adequate digital friction is regularly successful in restoring mobility within a few weeks even in the most chronic cases that have resisted every other treatment. The coronary ligaments at the knee do not span the joint. Hence, adequate mobility after a sprain cannot be retained by moving the knee, whether actively or passively. Rotation sprains therefore get well very slowly. Nothing is easier than to keep the ligament moving by drawing the finger to and fro across it; and it is only by the masseuse's friction that adequate treatment by movement can be secured. Active exercises and instruction in gait follow. Any surgeon who cares to order this treatment will find that full recovery is obtained in as many weeks as it formerly took months. The same considerations apply with almost equal force to lesions of the medial collateral ligament—the commonest sprain at the knee. This ligament has a range of movement over the bones, lying anteriorly when the knee is fully extended and being drawn posteriorly as the knee is increasingly flexed. Since synovitis prevents a full range from being attained at the knee immediately, the ligament cannot be put through its full extent of movement by merely moving the knee. Hence unwanted adhesions form. Friction to the ligament moves it passively to and fro in imitation of its normal behaviour and prevents adhesion formation. Active exercises and instruction in gait follow at once. The same happens in cases of chronic sprain here: friction applied to the site of scarring wears down fibrous tissue to such an extent that passive forcing without anaesthesia becomes easy. In this case the massage prepares the way for the mobilization. The speed of recovery from sprains of the tarsal and carpal joints is also enhanced by deep massage, but the results are less spectacular.

Resisted Exercises.—These are employed when a diminished range of movement at a joint is desirable. A joint may be so disorganized that all movement is painful, and the patient too elderly for an operation like arthrodesis. This is often the position in advanced osteo-arthritis of the hip. An attempt to stabilize the joint by increasing the strength and tone of the muscles about it may be made by the use of faradism, static contractions, or exercises so resisted that no movement takes place. Exercises are given for the same reason to the short flexor muscles of the foot in the treatment of strain of the mid-tarsal joint or plantar fascia. The increased strength

of these muscles diminishes movement, thus avoiding excessive stress on the joint capsule or fascia. Compensation for over-stretching of the cruciate ligaments, by increasing the strength and tone of the quadriceps muscle, provides another case in point.

Specific Movements for Tendons

Tendons are treated only passively. Since tenosynovitis and tendinitis are often the result of over-use, exercises merely repeat the causative strains and aggravate the condition.

Deep Massage.—In tenosynovitis the cause of the pain appears to be friction between the surface of the tendon and the inner aspect of its sheath. The phenomenon of crepitus shows that roughening of these surfaces occurs, and the fact that cure follows operations slitting the sheath up shows that the roughening ceases to matter as soon as the sheath no longer fits accurately. Orthodox treatment by immobilization is cumbersome, slow, and uncertain in its results; moreover, in some situations (e.g., at the knee or shoulder) it is barely feasible. Deep massage to the affected stretch of tendon is always the treatment of choice, and is quickly successful. At the wrist, shoulder, and knee failure is almost unknown. In the case of tenosynovitis, it is my belief that the masseuse's transverse friction smooths the roughened surfaces off again. Though the results in tendinitis are equally consistent, the mode of action is obscure.

Manipulation.—A minor tear at a teno-periosteal junction can sometimes be stretched out enough to allow healing with slight lengthening. Mills's manipulation for a tennis-elbow acts in this way.

Anaesthesia and Analgesia

These are required when an attempt at the projected movement sets up such pain that the patient cannot allow its performance. Four methods exist, each with its own indication.

General Anaesthesia.—Consciousness has often to be abolished when the spinal, shoulder, knee, and tarsal joints require mobilization. Full muscular relaxation is an essential preliminary to forcing movement.

Local Analgesia.—Stretching muscles out under general anaesthesia has little or no therapeutic value, since broadening of the muscles cannot be secured thus. On the other hand, active use during the period of local analgesia, by allowing full broadening during a contraction that pain would otherwise have prevented, is a most useful measure, particularly in acute lumbago and minor muscular tears. Local analgesia is also the treatment of choice in ligamentous sprains during the first 24 hours after the accident. Not only is movement facilitated but the reflex that causes oedema, effusion into the joint, and muscular spasm has its point of departure removed for the duration of analgesia. Division of muscular or fascial adhesions with a tenotomy knife under local analgesia, followed by immediate active movements designed to ensure healing with lengthening, is called for in stubborn lesions of the trunk muscles.

Heat Analgesia.—Heat increases blood supply and thus enhances the speed of destruction of the substance—Lewis's P-factor—responsible for the pain. Heat applied to a structure before it is stretched enables the patient to permit forcing through a greater range. To this end, the heat must reach the tissue at fault, usually the capsule of the shoulder, hip, or spinal joints. Hence short-wave diathermy is required; radiant heat has far too superficial an effect.

Massage Analgesia.—When a soft structure accessible to the masseuse's finger is to be treated by movement, deep massage is usually called for and has two effects. It induces traumatic hyperaemia; hence relief from pain is felt as soon as the friction ends. Like heat, therefore, massage given deeply results in an enhanced oxygenation of P-factor. Unlike heat, it also applies therapeutic movement to the part. Friction should thus be preferred for its double action when accessible structures need to be moved, heat being reserved for those outside the masseuse's reach.

Rehabilitation

The best rehabilitation is such effective treatment in the first place that little is required. When overriding considerations—e.g., sepsis, more serious injury elsewhere, or environmental lack of facilities—lead to the development of stiffness and

weakness, much time and endeavour must be devoted to the restoration of function. The present trend of orthopaedic surgery is towards the adoption of measures which ensure that treatment by movement can be begun so soon after the injury that stiffness and weakness have not had time to develop. In such cases active exercises maintain rather than restore power and mobility.

Graded exercises form an important part of the technique of rehabilitation. But it is a retrograde step to limit the scope of rehabilitation to active exercises alone. The particular method should be chosen that best brings treatment by movement to bear on the affected part.

Masseuses' main function is the application of treatment by movement. They are skilled in its three main divisions—active movement, passive movement, and deep massage. It is mistaken policy to limit treatment to the use of only one of these three measures. The indications for each kind of therapeutic movement are distinct but by no means mutually exclusive. Though it is undeniable that until lately there existed a tendency for masseuses to administer much misdirected radiant heat and gentle massage for conditions calling for exercises or deep massage, the pendulum is now swinging too far the other way. At present patients whom properly given friction would quickly relieve stand in real danger of being set to perform a series of exercises. Hence a sense of proportion must be maintained and the whole field of treatment by movement surveyed before the appropriate method is chosen and the masseuse instructed.

There is only one difficulty. A decision on the type of treatment best calculated to restore mobility rests on an accurate determination of the site of the lesion and of the nature of the damaged tissue. Deep massage affords effective treatment by movement only when applied to the right spot in the right way. Hence the masseuse must be provided with a diagnosis precise in detail before any question of friction can arise at all. The same applies to local analgesia, whether employed for diagnostic or for therapeutic purposes. Clearly, at a rehabilitation centre or in a physiotherapy department no less than in the other parts of a hospital, the best results are obtained when an exact diagnosis affords the pointer to equally exact treatment.

Summary of Principles

Most of the muscles of the limbs can be kept strong and mobile by active, later resisted, movements.

The muscles of the trunk span rigid parts and thus require deep massage to restore their mobility; active exercises then retain the added movement. This applies as much to traumatic as to rheumatic fibrosis.

Acute fibromyositis, whether traumatic or rheumatic, is best treated in the first instance by active movement under local analgesia.

Joints under muscular control (except the elbow) should be treated by movement after a sprain. Whether such movement is passive or active is immaterial; in practice, passive followed by active movements secure the best results.

Joints not under muscular control should be treated by rest after a sprain.

A few ligaments are more effectively moved by deep massage than in any other way. Active exercises retain the added range. During the first 24 hours after a ligamentous sprain local analgesia is the treatment of choice.

Tendons are treated by deep massage. No exercises follow.

Rehabilitation entails the selection of the type of therapeutic movement best suited to the lesion present, after precise diagnosis has been arrived at.

Full use should be made of masseuses, whose main function is the application of treatment by movement.

REFERENCES

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G. H. Faget and others (*Publ. Hlth. Repts. Wash.*, 1943, 58, 1729) have tried out a number of sulphonamide drugs in the treatment of leprosy. They find that the most effective of these is promin (known as promanide in Great Britain). They do not claim that it is a specific of leprosy, and observe that it has no bacteriostatic action on *M. leprae*, but conclude that it is capable of inhibiting the progress of the disease in a number of cases, the drug for the most part being given intravenously.